

**INTERNATIONAL ECOLOGICAL
CLASSIFICATION STANDARD:**

TERRESTRIAL ECOLOGICAL CLASSIFICATIONS

**Alliances and Groups
of the Central Basin and Range Ecoregion**

**Appendix Accompanying Report and Field Keys for the Central Basin and Range Ecoregion:
[NatureServe_2017_NVC Field Keys and Report_Nov_2017_CBR.pdf](#)**

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by

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This subset of the International Ecological Classification Standard covers vegetation alliances and groups of the Central Basin and Range Ecoregion. This classification has been developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. Comments and suggestions regarding the contents of this subset should be directed to Mary J. Russo, Central Ecology Data Manager, NC <mary_russo@natureserve.org> and Marion Reid, Senior Regional Ecologist, Boulder, CO <marion_reid@natureserve.org>.



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1. FOREST & WOODLAND

Tropical, temperate and boreal forests, woodlands and tree savannas characterized by broadly mesomorphic (including scleromorphic) tree growth forms (including *broad-leaved*, *needle-leaved*, *sclerophyllous*, *palm*, *bamboo trees*, and *tree ferns*), typically with at least 10% cover (but tropical tree savannas up to 40% cover, when trees <8 m tall), irregular horizontal spacing of vegetation structure, and spanning humid to seasonally dry tropical to boreal and subalpine climates and wet to dry substrate conditions. Includes native forests, as well as managed, and some plantation forests where human management is infrequent.

1.B. Temperate & Boreal Forest & Woodland

Temperate & Boreal Forest & Woodland is typically dominated by broad-leaved deciduous and needle-leaved trees, with some broad-leaved evergreens in warmer regions, and a climate that varies from warm-temperate with only rare frosts to very cold subarctic conditions. It is found across the globe in the mid-latitudes, typically between 25° and 60-70°N and S latitude, and includes boreal, cool-temperate, and warm-temperate/Mediterranean forests.

1.B.2. Cool Temperate Forest & Woodland

Cool Temperate Forest & Woodland includes temperate deciduous forest and woodland, temperate needle-leaved forest and woodland, and temperate rainforest, dominated by broad-leaved or needle-leaved tree growth forms.

1.B.2.Nb. Rocky Mountain Forest & Woodland

This division is composed of forests, woodlands and savannas of the lower montane to subalpine zones of the continental temperate climates of western North America characterized by the conifers *Abies concolor*, *Abies grandis*, *Abies lasiocarpa*, *Abies religiosa*, *Juniperus* spp. (*Juniperus osteosperma*, *Juniperus scopulorum*), *Larix lyallii*, *Larix occidentalis*, *Picea engelmannii*, *Picea engelmannii x glauca* hybrids, *Picea pungens*, *Pinus albicaulis*, *Pinus aristata*, *Pinus contorta* var. *latifolia*, *Pinus flexilis*, *Pinus hartwegii*, *Pinus longaeva*, *Pinus ponderosa* (var. *brachyptera*, var. *ponderosa*, var. *scopulorum*), *Pseudotsuga menziesii* var. *glauca*, *Thuja plicata*, and *Tsuga heterophylla*.

M022. Southern Rocky Mountain Lower Montane Forest

These are conifer and mixed deciduous- conifer lower montane forests, woodlands and savannas of the southern Rocky Mountains and west into the ranges of the Great Basin.

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

1.B.2.Nb.1.a. M022 Southern Rocky Mountain Lower Montane Forest

G229. Southern Rocky Mountain Ponderosa Pine Open Woodland

Type Concept Sentence: This group includes savanna-like woodlands with widely spaced (<25% tree canopy cover) *Pinus ponderosa* (primarily var. *scopulorum* and var. *brachyptera*) (>150 years old) as the predominant conifer. The understory vegetation is predominantly fire-resistant grasses and forbs that resprout following surface fires. These occur at the lower treeline/ecotone between grassland or shrubland and more mesic coniferous forests typically in warm, dry, exposed sites and are found predominantly in the Colorado Plateau region, west into scattered locations in the Great Basin, and north along the eastern front of the southern Rocky Mountains into southeastern Wyoming.

OVERVIEW

Scientific Name: *Pinus ponderosa* / *Festuca* spp. - *Muhlenbergia* spp. Southern Rocky Mountain Open Woodland Group

Common Name (Translated Scientific Name): Ponderosa Pine / Fescue species - Muhly species Southern Rocky Mountain Open Woodland Group

Colloquial Name: Southern Rocky Mountain Ponderosa Pine / Grass Open Woodland

Type Concept: This group is found predominantly in the Colorado Plateau region, west into scattered locations in the Great Basin, and north along the eastern front of the southern Rocky Mountains into southeastern Wyoming. These savannas occur at the lower treeline/ecotone between grassland or shrubland and more mesic coniferous forests typically in warm, dry, exposed sites. Elevations range from less than 1900 m in central and northern Wyoming to 2800 m in the New Mexico mountains to well over 2700 m on the

higher plateaus of the Southwest. It is found on rolling plains, plateaus, or dry slopes usually on more southerly aspects. This group is best described as a savanna that has widely spaced (<25% tree canopy cover) (>150 years old) *Pinus ponderosa* (primarily *var. scopulorum* and *var. brachyptera*) as the predominant conifer. It is maintained by a fire regime of frequent, low-intensity surface fires. A healthy occurrence often consists of open and parklike stands dominated by *Pinus ponderosa*. Understory vegetation in the true savanna occurrences is predominantly fire-resistant grasses and forbs that resprout following surface fires; shrubs, understory trees and downed logs are uncommon. Important species include *Festuca arizonica*, *Muhlenbergia straminea* (= *Muhlenbergia virescens*), *Pseudoroegneria spicata*, *Andropogon gerardii*, *Schizachyrium scoparium*, *Festuca idahoensis*, *Piptatheropsis micrantha* (= *Piptatherum micranthum*), and *Bouteloua gracilis*. A century of anthropogenic disturbance and fire suppression has resulted in a higher density of *Pinus ponderosa* trees, altering the fire regime and species composition.

Classification Comments: The Pine Escarpment regions of northwestern and central Nebraska are not included within this group; they have been lumped into Black Hills-Northwestern Great Plains Ponderosa Pine Forest & Woodland Group (G216). This group was created to account for the new concept of ponderosa pine savannas in the southern Rocky Mountains. Presently, many stands contain understories of more shade-tolerant species, such as *Pseudotsuga menziesii* and/or *Abies* spp., as well as younger cohorts of *Pinus ponderosa*. Central Rocky Mountain Ponderosa Pine Open Woodland Group (G213) in the eastern Cascades, Okanogan, and Northern Rockies regions receives winter and spring rains, and thus has a greater spring "green-up" than the drier woodlands in the Central Rockies.

Similar NVC Types:

- G228 Southern Rocky Mountain Ponderosa Pine Forest & Woodland
- G216 Black Hills-Northwestern Great Plains Ponderosa Pine Forest & Woodland
- G213 Central Rocky Mountain Ponderosa Pine Open Woodland

Diagnostic Characteristics: This group is dominated by well-spaced *Pinus ponderosa*. The understory is predominantly fire-resistant grasses such as *Festuca arizonica*, *Muhlenbergia straminea*, *Pseudoroegneria spicata*, *Andropogon gerardii*, *Schizachyrium scoparium*, *Festuca idahoensis*, *Piptatheropsis micrantha*, and *Bouteloua gracilis*. This group will have floristic affinities to adjacent grasslands, especially when it occurs in the ecotone between foothill woodlands and grasslands.

VEGETATION

Physiognomy and Structure: This group is characterized by widely spaced conifers forming open savannas (<25% cover) and a parklike understory strongly dominated by fire-resistant graminoids. Shrubs are few or absent from communities within this group. There may be a mid-level canopy of shrubs, copses of oaks, or even an occasional oak tree, but these are minor vegetation components.

Floristics: This group is dominated by well-spaced *Pinus ponderosa* with other conifers such as *Pseudotsuga menziesii* and *Abies* spp. sometimes present as canopy associates. Small trees and shrubs are poorly represented but can include scattered *Juniperus* spp., *Quercus gambelii*, *Artemisia tridentata*, and *Chrysothamnus depressus*. The understory is predominantly graminoid-dominated with species including *Festuca arizonica*, *Muhlenbergia straminea* (= *Muhlenbergia virescens*), *Pseudoroegneria spicata*, *Andropogon gerardii*, *Carex rossii*, *Elymus elymoides*, *Koeleria macrantha*, *Poa fendleriana*, *Schizachyrium scoparium*, *Festuca idahoensis*, *Piptatheropsis micrantha* (= *Piptatherum micranthum*), and *Bouteloua gracilis*.

ENVIRONMENT & DYNAMICS

Environmental Description: Elevations range from less than 1900 m in central Wyoming to 2800 m in the New Mexico mountains to well over 2700 m on the higher plateaus of the Southwest. It is found on a variety of landforms including rolling plains, plateaus, or cinder cones, bottomlands, mesas, and dry slopes usually on all aspects. *Climate:* Where precipitation is greater than about 480 mm, blue grama is absent or minor and ponderosa pine occurs with understory bunchgrass species, mainly *Festuca arizonica*, *Muhlenbergia montana*, and/or *Muhlenbergia straminea*. Fires, either lightning- or human-caused, are frequent in these dry forests.

Dynamics: Fire is a key factor in maintaining the open canopies characteristic of these savannas. Historically, surface fires and drought were influential in maintaining open-canopy conditions in these savannas. With settlement and subsequent fire suppression, stands have become more dense. Presently, many contain understories of more shade-tolerant species, such as *Pseudotsuga menziesii* and/or *Abies* spp., as well as younger cohorts of *Pinus ponderosa*. These altered stand structures have affected fuel loads and altered fire regimes. Presettlement fire regimes were primarily frequent (5- to 15-year return intervals), low-intensity surface fires triggered by lightning strikes or deliberately set by Native Americans. With fire suppression and increased fuel loads, fires are now less frequent and often become intense crown fires which can kill mature *Pinus ponderosa*. Establishment is erratic and believed to be linked to periods of adequate soil moisture and good seed crops, as well as fire frequencies which allow seedlings to reach sapling size. Longer fire intervals have resulted in many stands having dense subcanopies of overstocked and unhealthy young *Pinus ponderosa*. Savage and Swetnam (1990) suggest that continuity of understory fuels, especially the grass layer,

maintained high frequencies of low-intensity, surface fires along the entire gradient from ponderosa pine woodlands to spruce-fir forests. This hypothesis is supported by evidence that forests with grassy understories were once extensive and continuous over a large elevational range (Savage and Swetnam 1990, Moir et al. 1997). Descriptions of forests around the turn of the century noted open, large areas not confined to ponderosa pine forests. Most ecologists agree that hot, crown fires were not extensive in these open ponderosa pine savannas, although small thickets would have been destroyed by spot crown fires.

DISTRIBUTION

Geographic Range: This group is found predominantly in the Colorado Plateau region, west into scattered locations of the Great Basin, and north along the eastern front of the Rocky Mountains of Colorado and Wyoming.

Spatial Scale & Pattern [optional]: Large patch

Nations: US

States/Provinces: AZ, CO, NM, NV, UT, WY

TNC Ecoregions [optional]: 18:C, 19:C, 20:C, 21:C

USFS Ecoregions (2007): 315A:CC, 315B:CC, 315H:CP, 321A:PP, 331B:CC, 331G:C?, 331H:CC, 331I:CC, 331J:CP, 342F:CC, M313B:PP, M331B:CC, M331F:CC, M331G:CP, M331I:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- < Interior Ponderosa Pine: 237 (Eyre 1980)

LOWER LEVEL UNITS

Alliances:

- A3419 *Pinus ponderosa* / Grass Understory Southern Rocky Mountain Open Woodland Alliance

AUTHORSHIP

Primary Concept Source: M.G. Harrington and S.S. Sackett (1992)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 03/17/2010

Classif Resp Region: West

Internal Author: MEH 3-10, mod. GK 12-15

REFERENCES

References: Eyre 1980, Faber-Langendoen et al. 2017a, Harrington and Sackett 1992, Johansen and Latta 2003, Mehl 1992, Moir and Dieterich 1988, Moir et al. 1997, Savage and Swetnam 1990

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

G229. Southern Rocky Mountain Ponderosa Pine Open Woodland

A3419. *Pinus ponderosa* / Grass Understory Southern Rocky Mountain Open Woodland Alliance

Type Concept Sentence: These woodlands are characterized by widely spaced canopies dominated by *Pinus ponderosa* primarily occurring in the southern Rocky Mountains and extending into adjacent ecoregions.

OVERVIEW

Scientific Name: *Pinus ponderosa* / Grass Understory Southern Rocky Mountain Open Woodland Alliance

Common Name (Translated Scientific Name): Ponderosa Pine / Grass Understory Southern Rocky Mountain Open Woodland Alliance

Colloquial Name: Southern Rocky Mountain Ponderosa Pine / Grass Open Woodland

Type Concept: These woodlands are characterized by widely spaced canopies primarily dominated by *Pinus ponderosa* in association with other conifers, including *Juniperus* spp., *Pinus discolor*, *Pinus edulis*, and *Pseudotsuga menziesii*. The typically moderately dense herbaceous layer has greater cover than the shrub layer and is dominated by graminoids. The most common dominant graminoids include *Andropogon gerardii*, *Bouteloua gracilis*, *Festuca arizonica*, *Muhlenbergia montana*, *Muhlenbergia straminea* (= *Muhlenbergia virescens*), and *Schizachyrium scoparium*. These woodlands occur from the central and southern Rocky Mountains, extending south to the mountains of western Texas, escarpments of the Great Plains and west to the Mogollon Rim and Colorado

Plateau. Stands occur on bottomlands, elevated plains, cinder cones, piedmont slopes, mesas, foothills, and mountains at elevations ranging from 1700-2900 m.

Classification Comments:

Internal Comments: DFL 1-16: Canada removed.

Other Comments:

Similar NVC Types: This alliance is similar to that listed above, but is distinguished by having understories where shrubs are poorly represented typically with <5% total cover.

- A3398 *Pinus ponderosa* Southern Rocky Mountain Forest & Woodland Alliance

Diagnostic Characteristics: This alliance is dominated by well-spaced *Pinus ponderosa*. The diagnostic feature of this alliance is the depauperate shrub layer with cover typically <5% and dense herbaceous understory predominantly dominated by fire-resistant grasses.

VEGETATION

Physiognomy and Structure: These are widely spaced woodland stands of needle-leaved evergreen trees 10-30 m in height. Associated trees are primarily needle-leaved evergreen species. The understory may consist of a depauperate shrub layer with cover typically <5%. and a dense herbaceous understory predominantly dominated by graminoids.

Floristics: This alliance includes woodlands dominated by *Pinus ponderosa*. Structurally, these are savannas with large, open growth-form *Pinus ponderosa* trees (generally) as the only canopy dominant. Average tree canopy cover ranges from 10-50%. Other conifers, including *Juniperus* spp., *Pinus discolor*, *Pinus edulis*, and *Pseudotsuga menziesii*, may be present at low cover. The diagnostic feature of this alliance is the depauperate shrub layer with cover typically <5% and moderate to dense herbaceous understory predominantly dominated by fire-resistant grasses. Shrubs which may occur at low cover include *Artemisia tridentata*, *Brickellia californica*, *Ceanothus fendleri*, *Ceanothus fendleri*, *Cercocarpus montanus*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Fallugia paradoxa*, *Mahonia* spp., *Purshia tridentata*, *Quercus gambelii*, *Quercus grisea*, *Rhus trilobata*, *Tetradymia canescens*, and *Yucca baccata*. The herbaceous layer is dense and composed of fire-resistant graminoids. Dominant species may include *Andropogon gerardii*, *Bouteloua gracilis*, *Festuca arizonica*, *Muhlenbergia montana*, *Muhlenbergia straminea* (= *Muhlenbergia virescens*), and *Schizachyrium scoparium*. Other graminoid associates may include *Achnatherum lobatum* (= *Stipa lobata*), *Andropogon gerardii*, *Aristida* spp., *Bothriochloa barbinodis* (= var. *barbinodis*), *Bouteloua curtipendula*, *Bouteloua hirsuta*, *Carex geophila*, *Carex rossii*, *Elymus elymoides*, *Hesperostipa comata*, *Koeleria macrantha*, *Piptochaetium fimbriatum*, and *Piptochaetium pringlei*. An assortment of forbs may occur, but cover is low relative to graminoids. Common associates may include *Ageratina rothrockii* (= *Eupatorium rothrockii*), *Allium cernuum*, *Antennaria* spp., *Artemisia ludoviciana*, *Campanula rotundifolia*, *Chaetopappa ericoides*, *Chaetopappa ericoides*, *Erigeron* spp., *Lotus wrightii*, *Oxytropis lambertii*, *Packera neomexicana*, *Penstemon* spp., and *Silene laciniata*.

ENVIRONMENT & DYNAMICS

Environmental Description: These woodlands typically occur between grassland or shrubland and more mesic coniferous forests. The quantity and timing of precipitation vary greatly across the range of the alliance, ranging from 25-60 cm annually, with at least some seasonal drought. East of the Continental Divide and in the Southwest, summer precipitation predominates. Monsoonal summer rains can contribute a substantial proportion to the annual precipitation totals in the Southwest. Stands occur on bottomlands, elevated plains, cinder cones, piedmont slopes, mesas, foothills, and mountains at elevations ranging from 1700-2900 m. Fire is a key factor in maintaining the open canopies characteristic of these woodlands, but soil drought or infertility may be equally important in some areas. Soils are derived from igneous, metamorphic, and sedimentary materials and are characterized by good aeration and drainage, coarse textures, circumneutral to slightly acidic pH, an abundance of mineral material, and periods of drought during the growing season.

Dynamics: *Pinus ponderosa* is a drought-resistant, shade-intolerant conifer which usually occurs at lower treeline in the major ranges of the western United States. Historically, surface fires and drought were influential in maintaining open-canopy conditions in these woodlands. With settlement and subsequent fire suppression, stands have become more dense. Presently, many stands contain understories of more shade-tolerant species, such as *Pseudotsuga menziesii* and/or *Abies* spp., as well as younger cohorts of *Pinus ponderosa*. These altered stand structures have affected fuel loads and altered fire regimes. Presettlement fires were frequent (5- to 15-year return intervals) with low-intensity surface fires triggered by lightning strikes or deliberately set by Native Americans. With fire suppression and increased fuel loads, fires are now less frequent and often become intense crown fires which can kill mature *Pinus ponderosa*. Establishment is erratic and believed to be linked to periods of adequate soil moisture and good seed crops, as well as fire frequencies which allow seedlings to reach sapling size. Longer fire-return intervals have resulted in many stands having dense subcanopies of overstocked and unhealthy young *Pinus ponderosa*.

DISTRIBUTION

Geographic Range: This alliance is found predominantly in the central and southern Rocky Mountains, west into the Colorado Plateau and Mogollon Rim, east to Texas, the Great Plains and Black Hills.

Nations: MX, US

States/Provinces: AZ, CO, MT, NE, NM, OK, SD, TX, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- ? *Pinus ponderosa* woodland alliance (Hoagland 1998a)
- >< Interior Ponderosa Pine: 237 (Eyre 1980)

LOWER LEVEL UNITS**Associations:**

- CEGLO00856 *Pinus ponderosa* / *Festuca arizonica* Woodland
- CEGLO00863 *Pinus ponderosa* / *Muhlenbergia straminea* Woodland
- CEGLO00864 *Pinus ponderosa* / *Muhlenbergia straminea* - *Festuca arizonica* Woodland
- CEGLO00852 *Pinus ponderosa* / *Cercocarpus montanus* / *Andropogon gerardii* Open Woodland
- CEGLO00848 *Pinus ponderosa* / *Bouteloua gracilis* Woodland
- CEGLO00862 *Pinus ponderosa* / *Muhlenbergia montana* Woodland

AUTHORSHIP

Primary Concept Source: M.S. Reid and D. Sarr, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Diamond 1993, Eyre 1980, Faber-Langendoen et al. 2017b, Hoagland 1998a

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

1.B.2.Nb.1.b. M022 Southern Rocky Mountain Lower Montane Forest

G228. Southern Rocky Mountain Ponderosa Pine Forest & Woodland

Type Concept Sentence: This widespread woodland group is found throughout the cordillera of the Rocky Mountains at lower treeline typically in warm, dry, exposed sites where the dominant tree is *Pinus ponderosa* (primarily *var. scopulorum* and *var. brachyptera*) usually with a shrubby layer of species of *Artemisia*, *Arctostaphylos*, *Cercocarpus*, *Purshia*, *Symphoricarpos*, and *Quercus gambelii*, with *Pseudoroegneria spicata*, *Pascopyrum smithii*, and species of *Achnatherum*, *Bouteloua*, *Festuca*, *Hesperostipa*, and *Muhlenbergia* common grasses.

OVERVIEW

Scientific Name: *Pinus ponderosa* Southern Rocky Mountain Forest & Woodland Group

Common Name (Translated Scientific Name): Ponderosa Pine Southern Rocky Mountain Forest & Woodland Group

Colloquial Name: Southern Rocky Mountain Ponderosa Pine Forest & Woodland

Type Concept: This widespread group is most common throughout the cordillera of the Rocky Mountains, from the Greater Yellowstone region south. It is also found in the Colorado Plateau region, west into scattered locations of the Great Basin. Its easternmost extent in Wyoming is in the Bighorn Mountains. These woodlands occur at the lower treeline/ecotone between grassland or shrubland and more mesic coniferous forests typically in warm, dry, exposed sites. Elevations range from less than 1900 m in northern Wyoming to 2800 m in the New Mexico mountains. Occurrences are found on all slopes and aspects; however, moderately steep to very steep slopes or ridgetops are most common. This group generally occurs on soils derived from igneous, metamorphic, and sedimentary material, with characteristic features of good aeration and drainage, coarse textures, circumneutral to slightly acidic pH, an abundance of mineral material, rockiness, and periods of drought during the growing season. *Pinus ponderosa* (primarily *var. scopulorum* and *var. brachyptera*) is the predominant conifer; *Pseudotsuga menziesii*, *Pinus edulis*, *Pinus*

contorta, *Populus tremuloides*, and *Juniperus* spp. may also be present in the tree canopy. The understory is usually shrubby, with *Artemisia nova*, *Artemisia tridentata*, *Arctostaphylos patula*, *Arctostaphylos uva-ursi*, *Cercocarpus montanus*, *Purshia stansburiana*, *Purshia tridentata*, *Quercus gambelii*, *Symphoricarpos* spp., *Prunus virginiana*, *Amelanchier alnifolia*, and *Rosa* spp. common. *Pseudoroegneria spicata*, *Pascopyrum smithii*, and species of *Hesperostipa*, *Achnatherum*, *Festuca*, *Muhlenbergia*, and *Bouteloua* are some of the common grasses. Mixed fire regimes and surface fires of variable return intervals maintain these woodlands, depending on climate, degree of soil development, and understory density.

Classification Comments: Central Rocky Mountain Ponderosa Pine Open Woodland Group (G213) in the eastern Cascades, Okanogan and Northern Rockies regions receives winter and spring rains, and thus has a greater spring "green-up" than the drier woodlands in the Central Rockies. This group also intergrades with Southern Rocky Mountain Ponderosa Pine Open Woodland Group (G229). They are distinguished by the high-frequency surface-fire regime, less steep or rocky environmental setting, and more open grassy understory structure of the savanna group. Ponderosa pine woodlands, savannas, and "escarpments" of central and eastern Montana, eastern Wyoming, the Black Hills region, western Dakotas, and Nebraska are now included in Black Hills-Northwestern Great Plains Ponderosa Pine Forest & Woodland Group (G216).

Similar NVC Types:

- G229 Southern Rocky Mountain Ponderosa Pine Open Woodland
- G210 Central Rocky Mountain Douglas-fir - Pine Forest
- G216 Black Hills-Northwestern Great Plains Ponderosa Pine Forest & Woodland
- G213 Central Rocky Mountain Ponderosa Pine Open Woodland

Diagnostic Characteristics: *Pinus ponderosa* (primarily var. *scopulorum* and var. *brachyptera*) is the predominant conifer; *Pseudotsuga menziesii*, *Pinus edulis*, *Pinus contorta*, *Populus tremuloides*, and *Juniperus* spp. may also be present in the tree canopy. The understory is usually shrubby, with *Artemisia nova*, *Artemisia tridentata*, *Arctostaphylos patula*, *Arctostaphylos uva-ursi*, *Cercocarpus montanus*, *Purshia stansburiana*, *Purshia tridentata*, *Quercus gambelii*, *Symphoricarpos* spp., *Prunus virginiana*, *Amelanchier alnifolia*, and *Rosa* spp. common. *Pseudoroegneria spicata*, *Pascopyrum smithii*, and species of *Hesperostipa*, *Achnatherum*, *Festuca*, *Muhlenbergia*, and *Bouteloua* are some of the common grasses.

VEGETATION

Physiognomy and Structure: Conifer-dominated open forests or woodlands. Shrubs tend to predominate in the understory. Graminoids are common, but not as abundant as seen in the graminoid-dominated savanna group.

Floristics: This group is dominated by *Pinus ponderosa* with *Pseudotsuga menziesii*, *Pinus edulis*, *Pinus contorta*, *Populus tremuloides*, and *Juniperus* spp. as common canopy associates. In the southern Rocky Mountains and the mountains of southern Arizona and New Mexico, associated trees include *Pseudotsuga menziesii*, *Abies concolor*, *Picea pungens*, *Pinus strobiformis*, *Pinus edulis*, *Pinus discolor*, *Pinus cembroides*, *Pinus flexilis*, *Juniperus scopulorum*, and *Populus tremuloides*. In far southern stands, *Juniperus deppeana* may also be common. Average tree canopy cover ranges from 20-70%. The understory may include dense stands of shrubs or be dominated by grasses, sedges, or herbaceous species, although many of the associations are named for shrub species. Existing stands usually have younger cohorts of *Pinus ponderosa* present and may be less open than in the past. Understory shrub species include *Artemisia nova*, *Artemisia tridentata*, *Arctostaphylos patula*, *Arctostaphylos uva-ursi*, *Cercocarpus montanus*, *Purshia stansburiana*, *Purshia tridentata*, *Quercus gambelii*, *Symphoricarpos* spp., *Fallugia paradoxa*, *Ribes* spp., *Robinia neomexicana*, *Alnus incana*, *Forestiera pubescens*, *Prunus virginiana*, *Amelanchier alnifolia*, and *Rosa* spp. The herbaceous layer tends to vary inversely with shrub cover, but is composed primarily of graminoids. Important species include *Bouteloua gracilis*, *Carex geyeri*, *Carex rossii*, *Carex pensylvanica*, *Koeleria macrantha*, *Leucopoa kingii* (= *Festuca kingii*), *Muhlenbergia straminea* (= *Muhlenbergia virescens*), *Muhlenbergia montana*, *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Achnatherum occidentale* (= *Stipa occidentalis*), *Pseudoroegneria spicata*, *Poa secunda*, *Elymus elymoides*, *Festuca idahoensis*, *Festuca arizonica*, and *Hesperostipa comata* (= *Stipa comata*). Important or diagnostic forb species include *Aspidotis densa*, *Wyethia mollis*, *Balsamorhiza sagittata*, *Achillea millefolium*, *Sedum stenopetalum*, *Maianthemum racemosum* (= *Smilacina racemosa*), *Vicia americana*, and species of many other genera, such as *Erigeron*, *Lupinus*, *Fragaria*, *Lathyrus*, *Heterotheca*, *Arenaria*, and *Antennaria*.

ENVIRONMENT & DYNAMICS

Environmental Description: This group within the region occurs at the lower treeline/ecotone between grassland or shrubland and more mesic coniferous forests typically in warm, dry, exposed sites at elevations ranging from 1980-2800 m (6500-9200 feet). It can occur on all slopes and aspects; however, it commonly occurs on moderately steep to very steep slopes or ridgetops. At higher elevations, it will typically occur on south- or west-facing slopes. This group generally occurs on soils derived from igneous, metamorphic, and sedimentary material, including basalt, basaltic, andesitic flows, intrusive granitoids and porphyrites, and tuffs (Youngblood and Mauk 1985). Characteristic soil features include good aeration and drainage, coarse textures, circumneutral to slightly acidic pH, an abundance of mineral material, and periods of drought during the growing season. Some occurrences may

occur as edaphic climax communities on very skeletal, infertile, and/or excessively drained soils, such as pumice, cinder or lava fields, and scree slopes. Surface textures are highly variable in this group, ranging from sand to loam and silt loam. Exposed rock and bare soil consistently occur to some degree in all the associations. *Pinus ponderosa* / *Arctostaphylos patula* represents the extreme, with typically a high percentage of rock and bare soil present.

Precipitation generally contributes 25-60 cm annually to this group, mostly through winter storms and some monsoonal summer rains. Typically a seasonal drought period occurs throughout this group as well. Fire plays an important role in maintaining the characteristics of these open-canopy woodlands. However, soil infertility and drought may contribute significantly in some areas as well.

Climate: The quantity and timing of precipitation vary across the range of the group, ranging from 25-60 cm annually, with at least some seasonal drought. East of the Continental Divide and in the Southwest, summer precipitation predominates, whereas western stands receive most of their precipitation from westerly winter storms. Monsoonal summer rains can contribute a substantial proportion to the annual precipitation totals in the Southwest. Elevations decrease with increasing latitude, from less than 1000 m in eastern Washington to over 2750 m in southern Arizona and New Mexico. **Soil/substrate/hydrology:** Fire is a key factor in maintaining the open canopies characteristic of these woodlands, but soil drought or infertility may be equally important in some areas. This group generally occurs on soils derived from igneous, metamorphic, and sedimentary material, including basalt, basaltic, andesitic flows, intrusive granitoids and porphyrites, and tuffs (Youngblood and Mauk 1985). Characteristic soil features include good aeration and drainage, coarse textures, circumneutral to slightly acidic pH, an abundance of mineral material, and periods of drought during the growing season. Some occurrences may occur as edaphic climax communities on very skeletal, infertile, and/or excessively drained soils, such as pumice, cinder or lava fields, and scree slopes. Surface textures are highly variable in this group, ranging from sand to loam and silt loam. Exposed rock and bare soil consistently occur to some degree in all the associations.

Dynamics: *Pinus ponderosa* is a drought-resistant, shade-intolerant conifer which usually occurs at lower treeline in the major ranges of the western United States. Historically, surface fires and drought were influential in maintaining open-canopy conditions in these woodlands. With settlement and subsequent fire suppression, occurrences have become denser. Presently, many occurrences contain understories of more shade-tolerant species, such as *Pseudotsuga menziesii* and/or *Abies* spp., as well as younger cohorts of *Pinus ponderosa*. These altered structures have affected fuel loads and fire regimes. Presettlement fire regimes were primarily frequent (5- to 15-year return intervals), low-intensity surface fires triggered by lightning strikes or deliberately set fires by Native Americans. With fire suppression and increased fuel loads, fire regimes are now less frequent and often become intense crownfires, which can kill mature *Pinus ponderosa* (Reid et al. 1999).

Establishment is erratic and believed to be linked to periods of adequate soil moisture and good seed crops, as well as fire frequencies, which allow seedlings to reach sapling size. Longer fire-return intervals have resulted in many occurrences having dense subcanopies of overstocked and unhealthy young *Pinus ponderosa* (Reid et al. 1999). Mehl (1992) states the following: "Where fire has been present, occurrences will be climax and contain groups of large, old trees with little understory vegetation or down woody material and few occurring dead trees. The age difference of the groups of trees would be large. Where fire is less frequent, there will also be smaller size trees in the understory giving the occurrence some structure with various canopy layers. Dead, down material will be present in varying amounts along with some occurring dead trees. In both cases the large old trees will have irregular open, large branched crowns. The bark will be lighter in color, almost yellow, thick and some will like have basal fire scars."

Grace's warbler, pygmy nuthatch, and flammulated owl are indicators of a healthy ponderosa pine woodland. All of these birds prefer mature trees in an open woodland setting (Winn 1998, Jones 1998d, Levad 1998 as cited in Rondeau 2001).

DISTRIBUTION

Geographic Range: This group is found throughout much of the Rocky Mountains cordillera, from northwestern Wyoming, south through the Rocky Mountains of Colorado and into New Mexico, and a few scattered stands in west Texas. In Arizona, it occurs on the Mogollon Rim north into the Colorado Plateau region and west into scattered locations of the Great Basin.

Spatial Scale & Pattern [optional]: Matrix

Nations: MX, US

States/Provinces: AZ, CO, ID?, NM, NV, UT, WY

TNC Ecoregions [optional]: 9:C, 10:C, 11:C, 18:C, 19:C, 20:C, 21:C, 22:P, 24:P

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313C:CC, 313D:CC, 315A:CC, 315B:CC, 315H:CC, 321A:CC, 331B:CC, 331F:CP, 331G:CP, 331H:CC, 331I:CC, 331J:CC, 341A:CP, 341B:CC, 341F:CC, 342F:CC, 342G:CC, M313A:CC, M313B:CC, M331B:CC, M331D:CP, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M341A:CP, M341B:CC, M341C:CC, M341D:C?

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- < Interior Ponderosa Pine: 237 (Eyre 1980)
- > Pine Series, *Pinus ponderosa-Quercus gambelii* Association - 122.321 (Brown et al. 1979)
- > Pine Series, *Pinus ponderosa* Association - 122.321 (Brown et al. 1979)
- > Pine Series, *Pinus ponderosa*-Mixed Conifer Association - 122.321 (Brown et al. 1979)
- = Ponderosa Pine Series (Mauk and Henderson 1984)
- = Ponderosa Pine Series (Muldavin et al. 1996)
- = Ponderosa Pine Series (Youngblood and Mauk 1985)
- = Ponderosa Pine Series (Komarkova et al. 1988b)
- = Ponderosa Pine Series (Hoffman and Alexander 1976)
- = Ponderosa Pine Series (DeVelice et al. 1986)
- = Ponderosa Pine Series (Hess and Alexander 1986)
- = Xeric *Pinus ponderosa* Forest (Peet 1981)

LOWER LEVEL UNITS**Alliances:**

- A3398 *Pinus ponderosa* Southern Rocky Mountain Forest & Woodland Alliance

AUTHORSHIP

Primary Concept Source: F.H. Eyre (1980)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 03/17/2010

Classif Resp Region: West

Internal Author: MEH 2-10, mod. GK 12-15

REFERENCES

References: Brown 1982a, Brown et al. 1979, DeVelice et al. 1986, Eyre 1980, Faber-Langendoen et al. 2017a, Hess and Alexander 1986, Hoffman and Alexander 1976, Johansen and Latta 2003, Jones 1998d, Komarkova et al. 1988b, Mauk and Henderson 1984, Mehl 1992, Muldavin et al. 1987, Muldavin et al. 1996, Peet 1978a, Peet 1981, Peet 2000, Reid et al. 1999, Rondeau 2001, Winn 1998, Youngblood and Mauk 1985

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

G228. Southern Rocky Mountain Ponderosa Pine Forest & Woodland

A3398. *Pinus ponderosa* Southern Rocky Mountain Forest & Woodland Alliance

Type Concept Sentence: This broad and variable alliance represents forest and woodlands of the southern Rocky Mountains with scattered occurrences in adjacent ecoregions dominated by *Pinus ponderosa* in association with other conifer species.

OVERVIEW

Scientific Name: *Pinus ponderosa* Southern Rocky Mountain Forest & Woodland Alliance

Common Name (Translated Scientific Name): Ponderosa Pine Southern Rocky Mountain Forest & Woodland Alliance

Colloquial Name: Southern Rocky Mountain Ponderosa Pine Forest & Woodland

Type Concept: This forest and woodland alliance is widespread in the southwestern mountains occurring primarily in the southern Rocky Mountains, but extending into adjacent ecoregions. It is composed of open to closed forests and woodlands primarily dominated by *Pinus ponderosa*. Other canopy associates may include *Abies concolor*, *Juniperus scopulorum*, *Pinus contorta*, *Pinus edulis*, *Pinus flexilis*, *Pinus strobiformis*, *Populus tremuloides*, and *Pseudotsuga menziesii*. The understory ranges from dense shrub or graminoid layers to barren rock. Common dominant shrubs may include *Arctostaphylos patula*, *Arctostaphylos pungens*, *Arctostaphylos uva-ursi*, *Artemisia nova*, *Artemisia tridentata* ssp. *vaseyana*, *Cercocarpus intricatus*, *Cercocarpus montanus*, *Ericameria nauseosa*, *Fallugia paradoxa*, *Purshia stansburiana*, *Quercus gambelii*, *Quercus x pauciloba*, *Ribes cereum*, *Ribes inerme*, *Robinia neomexicana*, and *Symphoricarpos oreophilus*. The most common herbaceous dominants may include *Achnatherum hymenoides*, *Andropogon hallii*, *Bromus inermis*, *Carex inops* ssp. *heliophila*, *Carex rossii*, *Carex siccata*, *Festuca thurberi*, *Leucopoa kingii*, *Leymus salinus*, *Poa fendleriana*, and *Pteridium aquilinum*. Within the Rocky Mountains, these forests and woodlands grow at elevations between 1800-2600 m (6000-8500 feet). In the Black Hills and northeastern Wyoming, it can be found from 1080-2100 m (3600-7000 feet). Sites are dry/dry-mesic to xeric, and soils are generally well-drained and coarse-textured. Occurrences can be found on slopes of a variety of aspects and pitches, but is most often on gentle to moderate, northeast- to northwest-facing slopes.

Classification Comments:

Internal Comments: DFL 1-16: Canada removed. MSR 11-14: split into a Colorado Plateau & Great Basin vs RM alliance?

Other Comments:

Similar NVC Types:

- A3419 *Pinus ponderosa* / Grass Understory Southern Rocky Mountain Open Woodland Alliance

Diagnostic Characteristics: *Pinus ponderosa* (primarily *var. scopulorum* and *var. brachyptera*) is the predominant conifer; *Pseudotsuga menziesii*, *Pinus edulis*, *Pinus contorta*, *Populus tremuloides*, and *Juniperus* spp. may also be present in the tree canopy. Understories are characterized by dense shrubs, graminoids or sparse, barren ground.

VEGETATION

Physiognomy and Structure: These are forest stands of needle-leaved evergreen trees 10-30 m in height. Associated trees are typically needle-leaved evergreen species, but cold-deciduous and broad-leaved evergreen trees may form a subcanopy. The understory is typically dominated by cespitose graminoids, sclerophyllous or cold-deciduous shrubs.

Floristics: This alliance includes forests and woodlands dominated by *Pinus ponderosa*. Structurally, these are open to closed with tree canopy cover ranging from 20-100%. The understory may include dense stands of shrubs or be dominated by grasses, sedges, or other herbaceous species. Stands usually have younger cohorts of *Pinus ponderosa* present and may be less open than in the past. Associated trees vary widely across the range of this alliance and may include *Abies concolor*, *Juniperus scopulorum*, *Pinus contorta*, *Pinus edulis*, *Pinus flexilis*, *Pinus strobiformis*, *Populus tremuloides*, and *Pseudotsuga menziesii*. A shrub layer may be prominent or nearly absent, depending on location and disturbance history. Common dominant shrubs may include *Arctostaphylos patula*, *Arctostaphylos pungens*, *Arctostaphylos uva-ursi*, *Artemisia nova*, *Artemisia tridentata* ssp. *vaseyana*, *Cercocarpus intricatus*, *Cercocarpus montanus*, *Ericameria nauseosa*, *Fallugia paradoxa*, *Purshia stansburiana*, *Quercus gambelii*, *Quercus x pauciloba*, *Ribes cereum*, *Ribes inerme*, *Robinia neomexicana*, and *Symphoricarpos oreophilus*. The herbaceous layer tends to vary inversely with shrub cover, but is composed primarily of graminoids. The most common herbaceous dominants may include *Achnatherum hymenoides*, *Andropogon hallii*, *Bromus inermis*, *Carex inops* ssp. *heliophila*, *Carex rossii*, *Carex siccata*, *Festuca thurberi*, *Leucopoa kingii*, *Leymus salinus*, *Poa fendleriana*, and *Pteridium aquilinum*.

ENVIRONMENT & DYNAMICS

Environmental Description: These forests and woodlands typically occur at the lowest elevations of the coniferous forest and woodland zone within their range. These are among the driest forested habitats in the western United States, but quantity and timing of precipitation vary greatly across the range of this vegetation. Generally, these woodlands occur in areas which receive 25-60 cm of precipitation annually, with at least some seasonal drought. Fire is a key factor in maintaining the relatively open canopies characteristic of these stands, but soil drought or infertility may be equally important in some areas. Within the Rocky Mountains, *Pinus ponderosa* grows at elevations between 1800 and 2600 m (6000-8500 feet) (Mehl 1992). In the Black Hills and northeastern Wyoming, it can be found from 1080-2100 m (3600-7000 feet). Soils are highly variable across the range of this type, and are derived from igneous, metamorphic, and sedimentary materials. The most characteristic soil features are good aeration and drainage, circumneutral to slightly acidic pH, an abundance of mineral material, and periods of drought during the growing season. It can be found on slopes of a variety of aspects and pitches, but is most often on gentle to moderate, northeast- to northwest-facing slopes. Some stands may occur as edaphic climax communities on very skeletal, infertile, and/or excessively drained soils, such as cinder or lava fields.

Dynamics: *Pinus ponderosa* is a drought-resistant, shade-intolerant conifer which usually occurs at lower treeline in the major ranges of the western United States. Historically, surface fires and drought were influential in maintaining open canopy conditions. With settlement and subsequent fire suppression, stands have become denser than they once were. Presettlement fire regimes were primarily frequent (5- to 15-year return intervals) including low-intensity surface fires triggered by lightning strikes or deliberately set by Native Americans. With fire suppression and increased fuel loads, fires are now less frequent and often become intense crown fires which can kill mature *Pinus ponderosa*. Presently, many stands contain understories of more shade-tolerant species, such as *Pseudotsuga menziesii* and/or *Abies* spp., which may be affecting fuel loads and may alter future fire regimes. Establishment is erratic and believed to be linked to periods of adequate soil moisture, good seed crops, and the availability of bare, unshaded mineral substrate. At drier sites, competition from adjacent grassland or shrubland vegetation can strongly affect seedling survival (Burns and Honkala 1990a).

DISTRIBUTION

Geographic Range: This alliance is found from northwestern Wyoming, the Black Hills of South Dakota, south through the Rocky Mountains of Colorado and into New Mexico, and a few scattered stands in western Texas. In Arizona, it occurs on the Mogollon Rim north into the Colorado Plateau region and west into scattered locations of the Great Basin.

Nations: MX, US

States/Provinces: AZ, CA?, CO, ID?, MT, MXCH, MXSO, ND, NE, NM, NV, SD, TX, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- >< *Pinus ponderosa* (Ponderosa pine forest) Alliance (Sawyer et al. 2009) [87.010.00]
- ? *Pinus ponderosa* Alliance (Ponderosa pine forest) (Buck-Diaz et al. 2012)
- >< IA1b. Ponderosa Pine Forest (Allard 1990)
- >< Interior Ponderosa Pine - Black Hills (Mehl 1992)
- >< Interior Ponderosa Pine - Front Range (Mehl 1992)
- >< Interior Ponderosa Pine: 237 (Eyre 1980)
- >< Ponderosa Pine Series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS

Associations:

- CEG002794 *Pinus ponderosa* / *Artemisia tridentata* ssp. *vaseyana* Woodland
- CEG005645 *Pinus ponderosa* var. *scopulorum* / *Cercocarpus ledifolius* Southern Rocky Mountain Woodland
- CEG000846 *Pinus ponderosa* / *Artemisia nova* Woodland
- CEG002999 *Pinus ponderosa* / *Fallugia paradoxa* Woodland
- CEG000870 *Pinus ponderosa* / *Quercus gambelii* Woodland
- CEG000186 *Pinus ponderosa* / *Leucopoa kingii* Woodland
- CEG000849 *Pinus ponderosa* / *Carex inops* ssp. *heliophila* Woodland
- CEG000183 *Pinus ponderosa* / *Carex rossii* Forest
- CEG002998 *Pinus ponderosa* / Cinder Woodland
- CEG000199 *Pinus ponderosa* / *Ribes cereum* Forest
- CEG005808 *Pinus ponderosa* / *Andropogon hallii* Woodland
- CEG000874 *Pinus ponderosa* / *Quercus x pauciloba* Woodland
- CEG007091 *Pinus ponderosa* - *Pinus strobiformis* Forest
- CEG002944 *Pinus ponderosa* / *Pteridium aquilinum* Woodland
- CEG000876 *Pinus ponderosa* / *Ribes inerme* Scree Woodland
- CEG001490 *Pinus ponderosa* / (*Ericameria nauseosa*) / *Achnatherum hymenoides* Woodland
- CEG000877 *Pinus ponderosa* / Rockland Woodland
- CEG000842 *Pinus ponderosa* / *Arctostaphylos patula* Woodland
- CEG000843 *Pinus ponderosa* / *Arctostaphylos pungens* Woodland
- CEG000854 *Pinus ponderosa* / *Purshia stansburiana* Woodland
- CEG000844 *Pinus ponderosa* / *Arctostaphylos uva-ursi* Woodland
- CEG002943 *Pinus ponderosa* / *Bromus inermis* Ruderal Woodland
- CEG000861 *Pinus ponderosa* / *Juniperus scopulorum* Woodland
- CEG000851 *Pinus ponderosa* / *Cercocarpus montanus* Woodland
- CEG002384 *Pinus ponderosa* / Sparse Understory Woodland
- CEG005372 *Pinus ponderosa* / *Quercus gambelii* / *Carex inops* ssp. *heliophila* Woodland
- CEG005373 *Pinus ponderosa* / *Festuca thurberi* Woodland
- CEG005374 *Pinus ponderosa* / *Robinia neomexicana* Woodland
- CEG005362 *Pinus ponderosa* / *Leymus salinus* Woodland
- CEG005506 *Pinus ponderosa* / *Carex siccata* Woodland
- CEG005507 *Pinus ponderosa* / *Poa fendleriana* Woodland
- CEG005032 *Pinus ponderosa* / *Fallugia paradoxa* - *Ribes cereum* Woodland
- CEG005441 *Pinus ponderosa* - (*Pinus longaeva*) / *Cercocarpus intricatus* Woodland
- CEG005442 *Pinus ponderosa* - *Abies concolor* / *Symphoricarpos oreophilus* Woodland
- CEG005647 *Pinus ponderosa* var. *scopulorum* / *Purshia tridentata* Southern Rocky Mountain Woodland
- CEG000541 *Populus tremuloides* - *Pinus ponderosa* Rocky Mountain Forest

AUTHORSHIP

Primary Concept Source: M.S. Reid and D. Sarr, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Allard 1990, Buck-Diaz et al. 2012, Burns and Honkala 1990a, Diamond 1993, Eyre 1980, Faber-Langendoen et al. 2017b, Mehl 1992, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

1.B.2.Nb.1.c. M022 Southern Rocky Mountain Lower Montane Forest

G226. Southern Rocky Mountain White Fir - Douglas-fir Dry Forest

Type Concept Sentence: This group consists of dry mixed-conifer forests of mainly *Pseudotsuga menziesii* and *Abies concolor*, although as many as seven conifers can be found growing in the same occurrence, and there are a number of cold-deciduous shrub, forb and graminoid species common. It occurs throughout the southern Rocky Mountains and Great Basin and east into Texas, and has a mixed-severity fire regime.

OVERVIEW

Scientific Name: *Abies concolor* - *Pseudotsuga menziesii* Southern Rocky Mountain Dry Forest Group

Common Name (Translated Scientific Name): White Fir - Douglas-fir Southern Rocky Mountain Dry Forest Group

Colloquial Name: Dry White Fir Forest & Woodland

Type Concept: This is a group of the southern Rocky Mountains and Great Basin. It occurs from Nevada extending east into the Trans-Pecos plateaus of Texas, south to the Chihuahuan Desert, and throughout the Four Corners region. These are mixed-conifer forests occurring on all aspects at elevations ranging from 1200 to 3300 m. The composition and structure of the overstory are dependent upon the temperature and moisture relationships of the site and the successional status of the occurrence. *Pseudotsuga menziesii* and *Abies concolor* are most frequent, but *Pinus ponderosa* may be present to codominant. *Pinus flexilis* is common in Nevada. *Pseudotsuga menziesii* forests occupy drier sites, and *Pinus ponderosa* is a common codominant. *Abies concolor*-dominated forests occupy cooler sites, such as upper slopes at higher elevations, canyon sideslopes, ridgetops, and north- and east-facing slopes which burn somewhat infrequently. *Picea pungens* is uncommon in this group but does occur in cool, moist locations, often as smaller patches within a matrix of other associations. As many as seven conifers can be found growing in the same occurrence, and there are a number of cold-deciduous shrub, forb and graminoid species common, including *Juniperus communis*, *Cercocarpus ledifolius*, *Artemisia tridentata*, *Arctostaphylos uva-ursi*, *Mahonia repens*, *Paxistima myrsinites*, *Symphoricarpos oreophilus*, *Jamesia americana*, *Quercus gambelii*, *Galium triflorum*, *Muhlenbergia straminea* (= *Muhlenbergia virescens*), and *Festuca arizonica*. Forests in this group were undoubtedly characterized by a mixed-severity fire regime under "natural conditions," characterized by a high degree of variability in lethality and return interval.

Classification Comments: The transition between this group and Middle Rocky Mountain Montane Douglas-fir Forest & Woodland Group (G215) in Wyoming needs to be further clarified, both in terms of floristics and distribution details. For now, it is assumed that this group does not occur in the Bighorn Range or in the Yellowstone region, but its occurrence in isolated ranges of central and western Wyoming is possible.

Similar NVC Types:

- G202 Madrean Upper Montane Conifer - Oak Forest & Woodland
- G225 Rocky Mountain Douglas-fir - White Fir - Blue Spruce Mesic Forest
- G215 Middle Rocky Mountain Montane Douglas-fir Forest & Woodland

Diagnostic Characteristics: The tree canopy is often dominated by the widespread *Pseudotsuga menziesii*, whereas *Abies concolor* is an indicator species that may be present to dominant in stands in the southern half of Colorado and northern New Mexico west into Arizona, Utah and Nevada. Diagnostic understory species are dry-mesic site indicators such as *Arctostaphylos patula*, *Arctostaphylos uva-ursi*, *Arnica cordifolia*, *Carex rossii*, *Cercocarpus ledifolius*, *Cercocarpus montanus*, *Danthonia parryi*, *Festuca arizonica*, *Juniperus communis*, *Mahonia repens*, *Poa fendleriana*, *Physocarpus monogynus*, *Pseudoroegneria spicata*, *Quercus gambelii*, *Quercus x pauciloba*, and *Vaccinium myrtillus*.

VEGETATION

Physiognomy and Structure: Mixed conifer-dominated woodlands and forests with shrub, grass or sparse understories. Occasionally broad-leaved deciduous trees are intermixed with the conifers in mesic environments.

Floristics: This highly variable ecological group comprises mixed-conifer forests at montane elevations throughout the Intermountain West region. *Abies concolor* dominates at higher, colder locations; *Picea pungens* represents mesic conditions; and *Pseudotsuga menziesii* dominates intermediate zones. As many as seven conifers can be found growing in the same occurrence, with the successful reproduction of the diagnostic species determining the association type. Common conifers include *Pinus ponderosa*, *Pinus flexilis*, *Abies lasiocarpa* var. *lasiocarpa*, *Abies lasiocarpa* var. *arizonica*, *Juniperus scopulorum*, and *Picea engelmannii*. *Populus tremuloides* is often present as intermingled individuals in remnant aspen clones or in adjacent patches. The composition and structure of the overstory are dependent upon the temperature and moisture relationships of the site and the successional status of the occurrence (DeVelice et al. 1986, Muldavin et al. 1996).

A number of cold-deciduous shrub and graminoid species are found in many occurrences (e.g., *Arctostaphylos uva-ursi*, *Mahonia repens*, *Paxistima myrsinites*, *Symphoricarpos oreophilus*, *Jamesia americana*, *Quercus gambelii*, and *Festuca arizonica*). Other important species include *Amelanchier alnifolia*, *Arctostaphylos patula*, *Holodiscus dumosus*, *Jamesia americana*, *Juniperus communis*, *Physocarpus monogynus*, *Quercus x pauciloba*, *Robinia neomexicana*, *Rubus parviflorus*, and *Vaccinium myrtillus*. Where soil moisture is favorable, the herbaceous layer may be quite diverse, including graminoids *Bromus ciliatus* (= *Bromus canadensis*), *Calamagrostis rubescens*, *Carex geyeri*, *Carex rossii*, *Carex siccata* (= *Carex foenea*), *Festuca occidentalis*, *Koeleria macrantha*, *Muhlenbergia montana*, *Muhlenbergia straminea* (= *Muhlenbergia virescens*), *Poa fendleriana*, *Pseudoroegneria spicata*, and forbs *Achillea millefolium*, *Arnica cordifolia*, *Erigeron eximius*, *Fragaria virginiana*, *Linnaea borealis*, *Luzula parviflora*, *Osmorhiza berteroi*, *Packera cardamine* (= *Senecio cardamine*), *Thalictrum occidentale*, *Thalictrum fendleri*, *Thermopsis rhombifolia*, *Viola adunca*, and species of many other genera, including *Lathyrus*, *Penstemon*, *Lupinus*, *Vicia*, *Arenaria*, *Galium*, and others.

ENVIRONMENT & DYNAMICS

Environmental Description: This group is widespread throughout the southern Rocky Mountains, occurring mostly on northerly and cooler aspects and less commonly westerly and southerly aspects at elevations ranging from 1200-3300 m. Landforms are variable and can include canyons, plateaus, draws, benches, hills, mesas, ravines, shoulder, sideslopes and toeslopes. Slopes can be gentle to extremely steep. *Climate:* Rainfall averages less than 75 cm per year (40-60 cm), with summer "monsoons" during the growing season contributing substantial moisture. *Soil/substrate/hydrology:* Geologic substrates include volcanic andesite, rhyolite, rhyolitic tuffs, colluvium, shale gneiss, granite, sandstone and limestone. Soils are variable from cobbles, clay loam, silt loam, sandy loam, sand, and gravel.

Dynamics: Forests in this group represent the gamut of fire tolerance. Formerly, *Abies concolor* in the Utah High Plateaus were restricted to rather moist or less fire-prone areas by frequent surface fires. These areas experienced mixed fire severities, with patches of crowning in which all trees were killed, intermingled with patches of underburn in which larger *Abies concolor* survived (Mauk and Henderson 1984, Zouhar 2001). With fire suppression, *Abies concolor* has vigorously colonized many sites formerly occupied by open *Pinus ponderosa* woodlands. These invasions have dramatically changed the fuel load and potential behavior of fire in these forests. In particular, the potential for high-intensity crownfires on drier sites now codominated by *Pinus ponderosa* and *Abies concolor* has increased. Increased landscape connectivity, in terms of fuel loadings and crown closure, has also increased the potential size of crownfires.

Pseudotsuga menziesii forests are the only true "fire-tolerant" occurrences in this group. *Pseudotsuga menziesii* forests were probably subject to a moderate-severity fire regime in presettlement times, with fire-return intervals of 30-100 years. Many of the important tree species in these forests are fire-adapted (*Populus tremuloides*, *Pinus ponderosa*, *Pinus contorta*) (Pfister et al. 1977), and fire-induced reproduction of *Pinus ponderosa* can result in its continued codominance in *Pseudotsuga menziesii* forests (Steele et al. 1981). Seeds of the shrub *Ceanothus velutinus* can remain dormant in forest occurrences for 200 years (Steele et al. 1981) and germinate abundantly after fire, competitively suppressing conifer seedlings. Successional relationships in this group are complex. *Pseudotsuga menziesii* is less shade-tolerant than many northern or montane trees such as *Tsuga heterophylla*, *Abies concolor*, *Picea engelmannii*, and seedlings compete poorly in deep shade. At drier locales, seedlings may be favored by moderate shading, such as by a canopy of *Pinus ponderosa*, which helps to minimize drought stress. In some locations, much of these forests have been logged or burned during European settlement, and present-day occurrences are second-growth forests dating from fire, logging, or other occurrence-replacing disturbances (Mauk and Henderson 1984, Chappell et al. 1997).

Picea pungens is a slow-growing, long-lived tree which regenerates from seed (Burns and Honkala 1990a). Seedlings are shallow-rooted and require perennially moist soils for establishment and optimal growth. *Picea pungens* is intermediate in shade tolerance, being somewhat more tolerant than *Pinus ponderosa* or *Pseudotsuga menziesii*, and less tolerant than *Abies lasiocarpa* or *Picea engelmannii*. It forms late-seral occurrences in the subhumid regions of the Utah High Plateaus. It is common for these forests to be heavily disturbed by grazing or fire.

In general, fire suppression has led to the encroachment of more shade-tolerant, less fire-tolerant species (e.g., climax) into occurrences and an attendant increase in landscape homogeneity and connectivity (from a fuels perspective). This has increased the lethality and potential size of fires.

DISTRIBUTION

Geographic Range: This widespread group occurs throughout the southern Rocky Mountains, but extends west into the Great Basin in Nevada and east into the Trans-Pecos plateaus of Texas.

Spatial Scale & Pattern [optional]: Matrix

Nations: US

States/Provinces: AZ, CO, NM, NV, TX, UT, WY

TNC Ecoregions [optional]: 6:?, 9:C, 10:?, 11:C, 18:C, 19:C, 20:C, 21:C, 26:?

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313C:CC, 313D:CP, 315A:C?, 315H:CC, 321A:??, 322A:CC, 331B:CC, 331G:C?, 331H:CC, 331I:CC, 331J:CC, 341A:CC, 341B:CC, 341C:CP, 341D:C?, 341E:CC, 341F:CC, 341G:CP, 342A:C?, 342B:C?, 342C:C?, 342D:C?, 342E:CC, 342F:CC, 342G:CC, 342J:C?, M313A:CC, M313B:CC, M331B:C?, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:C?, M341A:CC, M341B:CC, M341C:CC, M341D:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate. USNVC Confidence from peer reviewer, not AE.

SYNONYMY

- >< *Abies concolor* Series (DeVelice et al. 1986)
- >< *Abies concolor* Series (Moir and Ludwig 1979)
- >< *Pseudotsuga menziesii* Series (DeVelice et al. 1986)
- >< *Pseudotsuga menziesii* Series (Moir and Ludwig 1979)
- > Blue Spruce: 216 (Eyre 1980)
- >< Interior Douglas-fir: 210 (Eyre 1980)
- >< White Fir: 211 (Eyre 1980)

LOWER LEVEL UNITS

Alliances:

- A3420 *Abies concolor* Dry Forest & Woodland Alliance
- A3453 *Picea pungens* Southern Rocky Mountain Forest & Woodland Alliance
- A3454 *Pseudotsuga menziesii* Southern Rocky Mountain Forest & Woodland Alliance

AUTHORSHIP

Primary Concept Source: W.H. Moir and J.A. Ludwig (1979)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 03/17/2010

Classif Resp Region: West

Internal Author: MEH 3-10, mod. GK 12-15

REFERENCES

References: Alexander et al. 1984b, Alexander et al. 1987, Boyce 1977, Bunin 1975c, Burns and Honkala 1990a, Chappell et al. 1997, DeVelice et al. 1986, Eyre 1980, Faber-Langendoen et al. 2017a, Fitzhugh et al. 1987, Giese 1975, Heinze et al. 1962, Hess 1981, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Komarkova et al. 1988b, Mauk and Henderson 1984, Moir and Ludwig 1979, Muldavin et al. 1996, Pfister et al. 1977, Steele et al. 1981, Steele et al. 1983, Youngblood and Mauk 1985, Zouhar 2001a

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

G226. Southern Rocky Mountain White Fir - Douglas-fir Dry Forest

A3420. *Abies concolor* Dry Forest & Woodland Alliance

Type Concept Sentence: Forests and woodlands of the southern Rocky Mountains characterized by canopies dominated by *Abies concolor* in association with other conifers.

OVERVIEW

Scientific Name: *Abies concolor* Dry Forest & Woodland Alliance

Common Name (Translated Scientific Name): White Fir Dry Forest & Woodland Alliance

Colloquial Name: Dry White Fir Forest & Woodland

Type Concept: Forests and woodlands of this alliance occur primarily in the southern Rocky Mountains and extend west into the intermountain ranges of the Great Basin. These mixed conifer forests and woodlands have an open to closed canopy with *Abies concolor* successfully reproducing and typically codominant in the tree canopy. The composition of other species in the tree canopy varies across the range of the alliance with *Pinus ponderosa* or *Pseudotsuga menziesii* being most consistent. *Populus tremuloides*

may codominate in early-seral stands. Other canopy associates that may be present include *Abies lasiocarpa*, *Picea engelmannii*, *Pinus flexilis*, and *Pinus strobiformis*. The density of the understory varies with the amount of tree canopy shading. Shrub and dwarf-shrub layers may be present and vary in structure and composition. Ericaceous or cold-deciduous shrubs are most common. Common shrub species include *Acer glabrum*, *Amelanchier alnifolia*, *Arctostaphylos patula*, *Arctostaphylos uva-ursi*, *Jamesia americana*, *Juniperus communis*, *Mahonia repens*, *Paxistima myrsinites*, *Purshia tridentata*, *Quercus gambelii*, *Ribes cereum*, *Rosa woodsii*, *Rubus parviflorus*, *Symphoricarpos oreophilus*, and *Vaccinium myrtillus*. The herbaceous layer may be dominated by shade-tolerant forbs, ferns or graminoids. The most common dominant herbaceous species include *Carex rossii*, *Carex siccata*, *Danthonia parryi*, *Festuca arizonica*, *Galium triflorum*, *Leymus triticoides*, and *Muhlenbergia straminea* (= *Muhlenbergia virescens*). These forests occur at middle to high elevations (1200-3150 m) and occupy a variety of topo-edaphic positions, such as lower and middle slopes of ravines, upper slopes at higher elevations, along stream terraces, ridgetops, and north- and east-facing slopes that burn somewhat infrequently. Parent materials and soils are highly variable and nondefinitive for these forests. Temperature and moisture regimes appear to be the key factors in their distribution.

Classification Comments: The name of the alliance needs to include better diagnostic species, as this alliance has a name very similar to *Abies concolor* Southern Rocky Mountain Mesic Forest & Woodland Alliance (A3369) (G225). For now, a hydrologic modifier is used to distinguish it.

Internal Comments: mjr 12-14: CA added for MOJN.

Other Comments:

Similar NVC Types:

- A3674 *Abies concolor* - *Pseudotsuga menziesii* Coastal, Cascadian & Sierran Forest Alliance

Diagnostic Characteristics: Forests and woodlands of the southern Rocky Mountains where *Abies concolor* is the dominant canopy species and is successfully reproducing. It is distinguished from other *Abies concolor* forests and woodlands in having an understory composed of species that have affinities to drier conditions.

VEGETATION

Physiognomy and Structure: These are open to closed, medium-statured to tall (20-50 m in height), multi-storied forests and woodlands of needle-leaved evergreen trees. Occasionally, a subcanopy (10-20 m tall) of broad-leaved evergreen or cold-deciduous trees may be present. Many densely stocked stands may have a somewhat depauperate understory, but more open stands often have a well-developed ericaceous or cold-deciduous shrub layer. The herbaceous layer is usually dominated by shade-tolerant forbs or caespitose graminoids.

Floristics: The successful reproduction of *Abies concolor* is always diagnostic in these stands and often it is one of the codominant species in the canopy. Common conifer associates include *Abies lasiocarpa* var. *arizonica*, *Abies lasiocarpa* var. *lasiocarpa*, *Juniperus scopulorum*, *Picea engelmannii*, *Picea pungens*, *Pinus flexilis*, *Pinus ponderosa*, *Pinus strobiformis*, and *Pseudotsuga menziesii*. *Populus tremuloides* is occasionally codominant in early-seral stands. The composition and proportions of these species are dependent upon the temperature and moisture relationships of the site and the successional status of the stand (DeVelice et al. 1986, Muldavin et al. 1996). A tall-shrub or low-tree layer composed of cold-deciduous species may also be present, including *Acer glabrum*, *Acer grandidentatum*, *Quercus gambelii*, or *Robinia neomexicana*. Locally abundant low to mid-statured shrubs include *Arctostaphylos patula*, *Arctostaphylos uva-ursi*, *Holodiscus dumosus*, *Jamesia americana*, *Juniperus communis*, *Mahonia repens*, *Paxistima myrsinites*, *Ribes cereum*, *Rubus parviflorus*, *Symphoricarpos oreophilus*, and *Vaccinium myrtillus*. The herbaceous layer can either be graminoid- or forb-dominated. Important forbs include *Erigeron eximius*, *Geranium richardsonii*, *Lathyrus lanszwertii*, *Maianthemum* spp. (= *Smilacina* spp.), *Pseudocymopterus montanus*, *Pteridium aquilinum*, *Thalictrum fendleri*, *Thermopsis rhombifolia*, and *Valeriana arizonica*. Important graminoids include *Bromus ciliatus* var. *ciliatus* (= *Bromus canadensis*), *Carex rossii*, *Carex siccata* (= *Carex foenea*), *Festuca arizonica*, *Koeleria macrantha*, and *Poa fendleriana*.

ENVIRONMENT & DYNAMICS

Environmental Description: These forests and woodlands occur at middle to high elevations (1200-3150 m) of major mountain ranges of the southern Rocky Mountains where annual precipitation is 75 cm or less. Summer "monsoonal" rainfall contributes substantial moisture. These forests and woodlands occupy a variety of topo-edaphic positions, such as lower and middle slopes of ravines, upper slopes at higher elevations, canyon sideslopes, along stream terraces, ridgetops, and north- and east-facing slopes that burn somewhat infrequently. All slopes and aspects are represented within this alliance. Parent materials and soils are highly variable and nondefinitive for these forests. Temperature and moisture regimes appear to be the key factors in their distribution.

Dynamics: With fire suppression, *Abies concolor* tends to replace many of the important conifers at lower elevation sites (Chappell et al. 1997). At higher elevations, the stands are naturally more closed and burn less frequently. Forb, shrub, and wildlife diversity varies greatly with the substrate (Chappell et al. 1997). In the Southern Rockies, frequent surface fires restricted these forests to

rather moist or less fire-prone areas. With fire suppression, *Abies concolor* has vigorously colonized many sites which were formerly occupied by open *Pinus ponderosa* woodlands. These invasions have dramatically changed the fuel load and potential behavior of fire in these forests. In particular, the potential for high-intensity crown fires has increased.

DISTRIBUTION

Geographic Range: This alliance is known from western Arizona east to the Colorado Plateau and southern Rocky Mountains of Utah, Colorado, New Mexico and Wyoming.

Nations: US

States/Provinces: AZ, CA, CO, NM, UT, WY

TNC Ecoregions [optional]: 4:C, 5:C, 11:C, 12:C, 14:C, 16:C, 17:C

USFS Ecoregions (2007): 322Aj:CCC, 341DI:CCC, M261A:CC, M261B:CC, M261D:CC, M261E:CC, M261Fe:CCC, M261G:CC, M262B:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Great Basin, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = *Abies concolor* (White fir forest) Alliance (Sawyer et al. 2009) [88.500.00]
- = *Abies concolor* Forest & Woodland Alliance (Evens et al. 2014)
- >< *Abies concolor* Series (Johnston 1987)
- = *Abies concolor* Forest Alliance (CNPS 2017) [88.500.00]
- >< Desert Mountain White Fir Forest (#85330) (Holland 1986b)
- >< Sierran White Fir Forest (#84240) (Holland 1986b)
- >< Southern California White Fir Forest (#85320) (Holland 1986b)
- >< Western Needleleaf Forests: 20: Spruce-Fir-Douglas fir Forest (*Picea-Abies-Pseudotsuga*) (Küchler 1964)
- >< Western Needleleaf Forests: 5: Mixed Conifer Forest (*Abies-Pinus-Pseudotsuga*) (Küchler 1964)
- >< White Fir: 211 (Eyre 1980) [Pacific coastal stands]

LOWER LEVEL UNITS

Associations:

- CEGl000887 *Abies concolor* / *Festuca arizonica* Woodland
- CEGl005357 *Abies concolor* / Mixed Grasses Forest
- CEGl002732 *Abies concolor* - *Pinus ponderosa* / *Cercocarpus ledifolius* Forest
- CEGl000888 *Abies concolor* / *Galium triflorum* Woodland
- CEGl000244 *Abies concolor* - *Pseudotsuga menziesii* / *Carex siccata* Forest
- CEGl000249 *Abies concolor* / *Juniperus communis* Forest
- CEGl000431 *Abies concolor* - *Pseudotsuga menziesii* / *Carex rossii* Forest
- CEGl000242 *Abies concolor* / *Arctostaphylos patula* Forest
- CEGl000251 *Abies concolor* / *Mahonia repens* Forest
- CEGl000886 *Abies concolor* / *Leymus triticoides* Woodland
- CEGl000261 *Abies concolor* / *Quercus gambelii* Forest
- CEGl000252 *Abies concolor* / *Muhlenbergia straminea* Forest
- CEGl000522 *Populus tremuloides* - *Abies concolor* / *Arctostaphylos patula* Forest
- CEGl000265 *Abies concolor* - *Pseudotsuga menziesii* / *Vaccinium myrtillus* Forest
- CEGl005350 *Abies concolor* - *Pseudotsuga menziesii* / *Festuca thurberi* - *Danthonia parryi* Woodland
- CEGl000885 *Abies concolor* / *Cercocarpus ledifolius* Woodland
- CEGl000243 *Abies concolor* / *Arctostaphylos uva-ursi* Forest
- CEGl005351 *Abies concolor* - (*Pseudotsuga menziesii*) / *Quercus gambelii* / *Carex rossii* Forest
- CEGl000891 *Abies concolor* - *Pseudotsuga menziesii* / *Robinia neomexicana* Woodland

AUTHORSHIP

Primary Concept Source: D. Sarr, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Barbour 1988, Barbour and Minnich 2000, CNPS 2017, Chappell et al. 1997, DeVelice et al. 1986, Evens and San 2006, Evens et al. 2014, Eyre 1980, Faber-Langendoen et al. 2017b, Fites-Kaufman et al. 2007, Franklin 1988, Gordon 1980, Hendrickson

and Prigge 1975, Holland 1986b, Imper 1988a, Jimerson 1993, Johnston 1987, Keeler-Wolf and Thomas 2000, Klein and Evens 2006, Küchler 1964, Laacke 1990a, Laacke and Fiske 1983, Minnich 1987, Minnich 2007b, Muldavin et al. 1996, Paysen et al. 1980, Rundel et al. 1977, Sawyer 2006, Sawyer 2007, Sawyer and Thornburgh 1977, Sawyer et al. 2009, Sugihara et al. 2006, Taylor and Randall 1977, Taylor and Teare 1979a, Taylor and Teare 1979b, Thomas et al. 2004, Thorne et al. 2007, Vasek 1985, Waddell 1982, Zouhar 2001a

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

G226. Southern Rocky Mountain White Fir - Douglas-fir Dry Forest

A3453. *Picea pungens* Southern Rocky Mountain Forest & Woodland Alliance

Type Concept Sentence: This forest and woodland alliance occurs in the central and southern Rocky Mountains west to the Great Basin and is defined by canopies dominated by *Picea pungens*.

OVERVIEW

Scientific Name: *Picea pungens* Southern Rocky Mountain Forest & Woodland Alliance

Common Name (Translated Scientific Name): Blue Spruce Southern Rocky Mountain Forest & Woodland Alliance

Colloquial Name: Southern Rocky Mountain Blue Spruce Forest & Woodland

Type Concept: This forest and woodland alliance occurs in the central and southern Rocky Mountains west to the Great Basin and is characterized by the dominance of *Picea pungens* in the forest canopy. Other conifers are usually present to codominant in these stands and may include *Abies concolor*, *Abies lasiocarpa*, *Picea engelmannii*, *Pinus contorta*, *Pinus ponderosa*, *Pinus strobiformis*, and *Pseudotsuga menziesii*. *Populus tremuloides* is the only widespread hardwood associate. The shrub layer usually has only moderate cover and is dominated by ericaceous or cold-deciduous species, with the latter group increasing with soil moisture or proximity to watercourses. Common dominant species include *Acer glabrum*, *Amelanchier alnifolia*, *Arctostaphylos patula*, *Arctostaphylos uva-ursi*, *Juniperus communis*, *Mahonia repens*, *Quercus gambelii*, and *Rubus parviflorus*. Due to favorable soil moisture, the herbaceous layer is usually a diverse mixture of forbs and graminoids, including *Achillea millefolium*, *Arnica cordifolia*, *Carex siccata* (= *Carex foenea*), *Festuca arizonica*, *Fragaria virginiana*, *Linnaea borealis*, *Packera cardamine* (= *Senecio cardamine*), and *Pseudoroegneria spicata*. Stands are usually found in moist, concave topographic positions. Soils are variable, but usually young and derived from glacial or alluvial materials. Stands often occupy sites that are protected from extreme sun and wind within *Pinus ponderosa* or *Pseudotsuga menziesii* montane forests. North aspects are most common.

Classification Comments: This alliance is the combination of the former *Picea pungens* Forest Alliance (A.165) and *Picea pungens* Woodland Alliance (A.557).

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Diagnostic of this alliance is the dominance of *Picea pungens* in the moderately closed to closed tree canopy on sites that are moist, but not flooded during the growing season.

VEGETATION

Physiognomy and Structure: These forests are of low to medium stature (10-25 m) and are dominated by needle-leaved evergreen trees. Cold-deciduous trees are often mixed in these stands, especially in recently disturbed areas. These communities often have sclerophyllous or cold-deciduous shrub layers of moderate cover (10-30%). The herbaceous layer is usually well-developed, and dominated by mesophytic forbs and graminoids less than 1 m in height.

Floristics: These forests are characterized by the dominance of *Picea pungens* in the forest canopy and usually represent a mesic phase of the mixed conifer forests of the southern Rocky Mountains and Colorado Plateau. Other conifers are usually present in these stands, depending upon geographic location, site moisture, and stand history. Common associates include *Abies concolor*, *Abies lasiocarpa*, *Picea engelmannii*, *Pinus contorta*, *Pinus ponderosa*, *Pinus strobiformis*, and *Pseudotsuga menziesii*. *Populus tremuloides* is the only widespread hardwood associate. The shrub layer usually has only moderate cover and is dominated by ericaceous or cold-deciduous species, with the latter group increasing with soil moisture or proximity to watercourses. Common species include *Acer glabrum*, *Amelanchier alnifolia*, *Arctostaphylos patula*, *Arctostaphylos uva-ursi*, *Artemisia tridentata* ssp. *vaseyana*, *Ceanothus velutinus*, *Chrysothamnus viscidiflorus*, *Juniperus communis*, *Mahonia repens*, *Paxistima myrsinites*, *Purshia tridentata*, *Quercus gambelii*, *Ribes cereum*, *Rosa woodsii*, *Rubus parviflorus*, *Shepherdia canadensis*, and *Symphoricarpos oreophilus*. Due to favorable soil moisture, the herbaceous layer is usually a diverse mixture of forbs and graminoids. Common and dominant graminoids may include *Achnatherum lettermanii*, *Carex siccata* (= *Carex foenea*), *Festuca arizonica*, *Hesperostipa comata*, *Poa*

fendleriana, and *Pseudoroegneria spicata*. Common forbs may include *Achillea millefolium*, *Arenaria congesta*, *Arenaria fendleri*, *Arnica cordifolia*, *Astragalus miser*, *Cirsium calcareum*, *Erigeron eximius*, *Fragaria virginiana* ssp. *glauca* (= *Fragaria ovalis*), *Galium boreale*, *Geranium* spp., *Linnaea borealis*, *Maianthemum stellatum*, *Mertensia ciliata*, *Packera cardamine* (= *Senecio cardamine*), and *Thalictrum fendleri*.

ENVIRONMENT & DYNAMICS

Environmental Description: These forests occur at middle elevations (1800-3300 m) of the central and southern Rocky Mountains and west to the Great Basin, usually in moist, concave topographic positions. Precipitation averages 46-60 cm annually, with the majority falling as growing-season rainfall. The temperature regime is continental and winters are moderately severe. Soils are variable, but usually young and derived from glacial or alluvial materials. The pH is neutral to slightly alkaline. Youngblood and Mauk (1985) suggest a preference by these forests for non-igneous parent materials. These communities often occupy sites that are protected from extreme sun and wind, within *Pinus ponderosa* or *Pseudotsuga menziesii* montane forests. These forests are typically most common on north-facing slopes, which can be gentle to steep.

Dynamics: *Picea pungens* is a slow-growing, long-lived tree which regenerates from seed (Burns and Honkala 1990a). Seedlings are shallow-rooted and require perennially moist soils for establishment and optimal growth. *Picea pungens* is intermediate in shade tolerance, being somewhat more tolerant than *Pinus ponderosa* or *Pseudotsuga menziesii*, and less tolerant than *Abies lasiocarpa* or *Picea engelmannii*. It forms late-seral stands in the subhumid regions of the southern Rocky Mountains. It is common for these forests to be heavily disturbed by grazing or fire.

DISTRIBUTION

Geographic Range: This forest alliance is from the central and southern Rocky Mountains, east to the Wyoming Basins and west to the Great Basin.

Nations: US

States/Provinces: AZ, CO, NM, OR?, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- >> *Picea pungens* Series (Muldavin et al. 1996)
- >> *Picea pungens* Series (Alexander et al. 1984b)
- >> *Picea pungens* Series (DeVelice et al. 1986)
- >> *Picea pungens* Series (Fitzhugh et al. 1987)
- >> Blue Spruce: 216 (Eyre 1980)

LOWER LEVEL UNITS

Associations:

- CEGLO00395 *Picea pungens* / *Mahonia repens* Forest
- CEGLO00385 *Picea pungens* / *Arctostaphylos uva-ursi* Forest
- CEGLO00392 *Picea pungens* / *Juniperus communis* Forest
- CEGLO05364 *Picea pungens* / *Arctostaphylos patula* Forest
- CEGLO00386 *Picea pungens* / *Arnica cordifolia* Forest
- CEGLO00397 *Picea pungens* / *Pseudoroegneria spicata* Forest
- CEGLO00895 *Picea pungens* / *Festuca arizonica* Woodland

AUTHORSHIP

Primary Concept Source: R.L. DeVelice et al. (1986)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Alexander et al. 1984b, Burns and Honkala 1990a, DeVelice et al. 1986, Eyre 1980, Faber-Langendoen et al. 2017b, Fitzhugh et al. 1987, Muldavin et al. 1996, Youngblood and Mauk 1985

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

G226. Southern Rocky Mountain White Fir - Douglas-fir Dry Forest

A3454. *Pseudotsuga menziesii* Southern Rocky Mountain Forest & Woodland Alliance

Type Concept Sentence: Forests and woodlands primarily of the southern Rocky Mountains with canopies dominated by *Pseudotsuga menziesii*.

OVERVIEW

Scientific Name: *Pseudotsuga menziesii* Southern Rocky Mountain Forest & Woodland Alliance

Common Name (Translated Scientific Name): Douglas-fir Southern Rocky Mountain Forest & Woodland Alliance

Colloquial Name: Southern Rocky Mountain Douglas-fir Forest & Woodland

Type Concept: These forests and woodlands are primarily distributed in the southern Rocky Mountains, and as far east as Texas. They include evergreen forests dominated by *Pseudotsuga menziesii*. Canopy associates vary widely depending on geographic location and may include *Abies lasiocarpa*, *Juniperus scopulorum*, *Pinus contorta*, *Pinus flexilis*, *Pinus ponderosa*, *Pinus strobiformis*, and *Populus tremuloides*. Understories are most often shrub-dominated, but in some associations a layer of graminoids takes prominence. Common dominant shrubs may include *Arctostaphylos patula*, *Arctostaphylos uva-ursi*, *Artemisia tridentata*, *Cercocarpus montanus*, *Holodiscus dumosus*, *Juniperus communis*, *Paxistima myrsinites*, *Physocarpus monogynus*, *Quercus gambelii*, and *Quercus x pauciloba*. Herbaceous dominants may include *Festuca arizonica*, *Jamesia americana*, *Muhlenbergia montana*, *Muhlenbergia straminea* (= *Muhlenbergia virescens*), and *Poa fendleriana*. Elevations range from less than 1000 m in the northern Rocky Mountains to nearly 2900 m in the Southern Rockies and plateaus of the southwestern U.S. Lower elevation stands typically occupy protected northern exposures or mesic ravines and canyons, often on steep slopes. At higher elevations, these forests occur primarily on southerly aspects or ridgetops.

Classification Comments:

Internal Comments: DFL 8-17: AB & Canada added per AB NHP. DFL 1-16: Canada removed.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Canopies are dominated or codominated by *Pseudotsuga menziesii* in association with other conifer species. These forests and woodlands are distinguished from other *Pseudotsuga menziesii* alliances in having a species composition that is more associated with the southern Rocky Mountains.

VEGETATION

Physiognomy and Structure: These forests are characterized by a multi-tiered needle-leaved evergreen tree canopy up to 50 m high, with 20-100% cover. Cold-deciduous, broad-leaved species occasionally codominate. Downed wood may also be abundant in older stands. Shrub cover is dominated by ericaceous or cold-deciduous species and can be dense. The herbaceous understory is primarily composed of graminoids.

Floristics: These forests and woodlands are dominated by *Pseudotsuga menziesii* in the canopy and almost always in the tree regeneration layer. *Pinus ponderosa* is an important seral species occurring in many associations, either as older seral remnants or codominating in the canopy. Other trees that can be present to abundant (typically seral) include *Populus tremuloides* (in the southern Rockies and south into New Mexico and Arizona), *Pinus strobiformis* (in New Mexico and Arizona), and *Pinus contorta* (throughout much of the alliance's range). Species of *Abies* and *Picea* do not commonly occur in this alliance, but are present in some stands. Understories in *Pseudotsuga menziesii* forests are varied; many associations have well-developed shrub layers, varying in height from <2 m (typically) to up to 5 m. Dominant or diagnostic species may include *Acer grandidentatum*, *Amelanchier alnifolia*, *Arctostaphylos patula*, *Jamesia americana*, *Physocarpus monogynus*, *Quercus arizonica*, *Quercus gambelii*, *Quercus rugosa*, *Quercus x pauciloba*, and *Quercus hypoleucoides*. *Arctostaphylos uva-ursi* and *Mahonia repens* are present to important throughout the range. The herbaceous layer can be sparse or, if the shrub layer is not abundant, can be relatively species-rich, usually graminoid-dominated. Important or dominant species include the graminoids *Bromus ciliatus*, *Calamagrostis rubescens*, *Carex geyeri*, *Carex rossii*, *Festuca arizonica*, *Festuca occidentalis*, *Luzula parviflora*, *Muhlenbergia montana*, and *Muhlenbergia straminea* (= *Muhlenbergia virescens*); and the forbs *Arnica cordifolia*, *Osmorhiza berteroi*, *Thalictrum occidentale*, *Viola adunca*, and species of many other genera, including *Arenaria*, *Erigeron*, *Fragaria*, *Galium*, *Lathyrus*, *Lupinus*, *Penstemon*, *Vicia*, and others.

ENVIRONMENT & DYNAMICS

Environmental Description: These *Pseudotsuga menziesii* forests and woodlands occur under a comparatively dry and continental climate regime. Elevations range from less than 1000 m in the northern Rocky Mountains to nearly 2900 m in the Southern Rockies

and plateaus of the southwestern U.S. Lower elevation stands typically occupy protected northern exposures or mesic ravines and canyons, often on steep slopes. At higher elevations, these forests occur primarily on southerly aspects or ridgetops. Annual precipitation ranges from 50-100 cm with moderate snowfall and a greater proportion falling during the growing season. Monsoonal summer rains contribute a significant proportion of the annual precipitation in Arizona, New Mexico, and Colorado. Soils are highly variable across the range of this alliance and are derived from diverse parent materials. *Pseudotsuga menziesii* forests are reported by most studies (Pfister et al. 1977, Steele et al. 1981, Mauk and Henderson 1984, Lillybridge et al. 1995) to show no particular affinities to geologic substrates. Rock types are typically sedimentary rocks in the Central and Southern Rockies and the Colorado Plateau. The soils are typically slightly acidic (pH 5.0-6.0), well-drained, and well-aerated. They can be derived from moderately deep colluvium or shallow-jointed bedrock, and are usually gravelly or rocky.

Dynamics: Successional relationships in this alliance are complex. *Pseudotsuga menziesii* seedlings compete poorly in deep shade. At drier locales, seedlings may be favored by moderate shading, such as by a canopy of *Pinus ponderosa*, which helps to minimize drought stress. In some locations, much of these forests has been logged or burned during European settlement, and present-day stands are second-growth forests dating from fire, logging, or other stand-replacing disturbances (Mauk and Henderson 1984, Chappell et al. 1997). *Pseudotsuga menziesii* forests were probably subject to a moderate-severity fire regime in presettlement times, with fire-return intervals of 30-100 years. Many of the important tree species in these forests are fire-adapted (*Populus tremuloides*, *Pinus ponderosa*, *Pinus contorta*) (Pfister et al. 1977), and fire-induced reproduction of *Pinus ponderosa* can result in its continued codominance in *Pseudotsuga menziesii* forests (Steele et al. 1981). Seeds of the shrub *Ceanothus velutinus* can remain dormant in forest stands for 200 years (Steele et al. 1981) and germinate abundantly after fire, competitively suppressing conifer seedlings. Some stands may have higher tree-stem density than historically, due largely to fire suppression. Fire suppression has also led to the succession of *Pinus ponderosa* woodlands or *Quercus* spp. woodlands to *Pseudotsuga menziesii* forests.

DISTRIBUTION

Geographic Range: This alliance primarily occurs in the southern Rocky Mountains, but extends west into the Great Basin, and east to Trans-Pecos Texas, and north into Alberta, Canada.

Nations: CA, US

States/Provinces: AB, AZ, CO, MT, NM, NV, TX, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- >< *Pinus ponderosa* - *Pseudotsuga menziesii* Woodlands (Chappell et al. 1997)
- >< Aspen: 217 (Eyre 1980)
- >< IA1a. Douglas Fir - Pine Forest (Allard 1990)
- >< Interior Douglas-fir: 210 (Eyre 1980)

LOWER LEVEL UNITS

Associations:

- CEG000911 *Pseudotsuga menziesii* Scree Woodland
- CEG002808 *Pseudotsuga menziesii* / *Artemisia tridentata* (ssp. *vaseyana*, ssp. *wyomingensis*) Woodland
- CEG000438 *Pseudotsuga menziesii* / *Jamesia americana* Forest
- CEG000902 *Pseudotsuga menziesii* / *Holodiscus dumosus* Scree Woodland
- CEG000446 *Pseudotsuga menziesii* / *Paxistima myrsinites* Forest
- CEG000424 *Pseudotsuga menziesii* / *Arctostaphylos uva-ursi* Forest
- CEG000452 *Pseudotsuga menziesii* / *Quercus gambelii* Forest
- CEG000449 *Pseudotsuga menziesii* / *Physocarpus monogynus* Forest
- CEG000433 *Pseudotsuga menziesii* / *Festuca arizonica* Forest
- CEG000444 *Pseudotsuga menziesii* / *Muhlenbergia straminea* Forest
- CEG000545 *Populus tremuloides* - *Pseudotsuga menziesii* / *Juniperus communis* Forest
- CEG000423 *Pseudotsuga menziesii* / *Arctostaphylos patula* Woodland
- CEG000443 *Pseudotsuga menziesii* / *Muhlenbergia montana* Forest
- CEG002809 *Pseudotsuga menziesii* / *Poa fendleriana* Woodland
- CEG000455 *Pseudotsuga menziesii* / *Quercus x pauciloba* Forest
- CEG000898 *Pseudotsuga menziesii* / *Cercocarpus montanus* Woodland

AUTHORSHIP

Primary Concept Source: M.S. Reid and D. Sarr, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2017/08/14

REFERENCES

References: Allard 1990, Chappell et al. 1997, Diamond 1993, Eyre 1980, Faber-Langendoen et al. 2017b, Lillybridge et al. 1995, Mauk and Henderson 1984, Pfister et al. 1977, Steele et al. 1981

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

1.B.2.Nb.1.d. M022 Southern Rocky Mountain Lower Montane Forest

G225. Rocky Mountain Douglas-fir - White Fir - Blue Spruce Mesic Forest

Type Concept Sentence: This group includes mesic or cold-site conifer, mixed conifer, or deciduous montane forests of the Rocky Mountains west into the ranges of the Great Basin. *Pseudotsuga menziesii* and *Abies concolor* are the most common canopy dominants, but *Picea engelmannii*, *Picea pungens*, or *Pinus ponderosa* may be present, as well as stands of conifer mixed with *Populus tremuloides* or *Acer grandidentatum*. The relatively mesic understory is diagnostic of the type, and naturally occurring fires are mostly light, erratic, and infrequent.

OVERVIEW

Scientific Name: *Abies concolor* - *Picea pungens* - *Pseudotsuga menziesii* Mesic Southern Rocky Mountain Forest Group

Common Name (Translated Scientific Name): White Fir - Blue Spruce - Douglas-fir Mesic Southern Rocky Mountain Forest Group

Colloquial Name: Southern Rocky Mountain Mesic Blue Spruce Forest

Type Concept: This group includes conifer, mixed conifer, and some deciduous montane forests of the Rocky Mountains west into the ranges of the Great Basin. Stands occur predominantly in cool ravines and on north-facing slopes with elevations from 1200 to 3300 m. Occurrences of this group are found on cooler and more mesic sites than Southern Rocky Mountain White Fir - Douglas-fir Dry Forest Group (G226). Such sites include lower and middle slopes of ravines, along stream terraces, moist, concave topographic positions, and north- and east-facing slopes. *Pseudotsuga menziesii* and *Abies concolor* are the most common canopy dominants, but *Picea engelmannii*, *Picea pungens*, or *Pinus ponderosa* may be present. This group includes mixed conifer/*Populus tremuloides* and mixed conifer/*Acer grandidentatum* stands as well as *Acer grandidentatum*-dominated forests. The relatively mesic understory is diagnostic of stands in this group. Although sites are not considered wetlands or true riparian areas, generally occurring outside the riparian floodplains, scattered riparian species may be present. Cold-deciduous shrub species include *Acer glabrum*, *Acer grandidentatum*, *Jamesia americana*, *Physocarpus malvaceus*, *Robinia neomexicana*, *Quercus gambelii*, *Vaccinium membranaceum*, and *Vaccinium myrtilloides*. Herbaceous species include *Bromus ciliatus*, *Carex geyeri*, *Carex rossii*, *Carex siccata*, *Muhlenbergia straminea* (= *Muhlenbergia virescens*), *Pseudoroegneria spicata*, *Erigeron eximius*, *Fragaria virginiana*, *Luzula parviflora*, *Osmorhiza berteroi*, *Packera cardamine*, *Thalictrum occidentale*, and *Thalictrum fendleri*. Naturally occurring fires are of variable return intervals and mostly light, erratic, and infrequent due to the cool, moist conditions.

Classification Comments: This group is similar to and often occurs adjacent to Southern Rocky Mountain White Fir - Douglas-fir Dry Forest Group (G226), which occurs on more upland and relatively xeric sites and exposures. The overstory species may be similar except for the absence or low cover of relatively mesic species such as *Abies concolor*, *Picea pungens*, *Populus tremuloides*, and *Acer grandidentatum*; however, it is the mesic understory species that are usually diagnostic of this group. This group is also similar to montane riparian woodlands but lacks an understory dominated by wetland species and is not closely associated with perennial streams.

Similar NVC Types:

- G226 Southern Rocky Mountain White Fir - Douglas-fir Dry Forest

Diagnostic Characteristics: The tree canopy is often dominated or codominated by conifers, especially *Pseudotsuga menziesii*, *Abies concolor*, and the less extensive *Picea pungens*. *Acer grandidentatum*-dominated stands are included in this group as are mixed conifer/deciduous stands codominated by *Populus tremuloides* and/or *Acer grandidentatum*. However, a mesic understory layer is usually diagnostic of this group with indicator species such as *Acer glabrum*, *Acer grandidentatum*, *Alnus incana*, *Betula occidentalis*, *Cornus sericea*, *Jamesia americana*, *Linnaea borealis*, *Lonicera involucrata*, *Packera cardamine*, *Physocarpus malvaceus*, *Robinia neomexicana*, *Symphoricarpos oreophilus*, *Vaccinium membranaceum*, and herbaceous species *Bromus ciliatus*, *Carex siccata*, *Muhlenbergia straminea*, *Pseudoroegneria spicata*, *Erigeron eximius*, *Fragaria virginiana*, *Luzula parviflora*, *Osmorhiza berteroi*, *Packera cardamine*, *Thalictrum occidentale*, and *Thalictrum fendleri*.

VEGETATION

Physiognomy and Structure: Conifer-dominated woodlands and forests with grassy or shrubby understories. Occasionally broad-leaved deciduous trees are intermixed with the conifers in mesic settings, or as seral components.

Floristics: This mesic forest group is characterized by a moderately dense to dense tree canopy typically dominated by *Pseudotsuga menziesii*, *Abies concolor*, and less frequently *Picea pungens*, but *Picea engelmannii* or *Pinus ponderosa* may be present. This group also includes mixed conifer/*Populus tremuloides* and mixed conifer/*Acer grandidentatum* stands as well as *Acer grandidentatum*-dominated forests. However, the more shade-tolerant conifers of this group form a subcanopy that will eventually overtake the *Populus tremuloides* in early-seral types, and *Acer grandidentatum*-dominated forests most likely represent the wettest portion of the environment supporting this group. A relatively mesic understory is diagnostic of stands in this group. Although sites are not considered wetlands or true riparian areas, occurring outside the riparian floodplains, scattered riparian and facultative wetland species may be present. Characteristic cold-deciduous shrub species include *Acer glabrum*, *Acer grandidentatum*, *Alnus incana*, *Betula occidentalis*, *Cornus sericea*, *Jamesia americana*, *Physocarpus malvaceus*, *Robinia neomexicana*, *Quercus gambelii*, *Vaccinium membranaceum*, and *Vaccinium myrtillus*. Common herbaceous species include *Bromus ciliatus*, *Carex geyeri*, *Carex rossii*, *Carex siccata*, *Muhlenbergia straminea* (= *Muhlenbergia virescens*), *Pseudoroegneria spicata*, *Erigeron eximius*, *Fragaria virginiana*, *Luzula parviflora*, *Osmorhiza berteroi*, *Packera cardamine*, *Thalictrum occidentale*, and *Thalictrum fendleri*.

ENVIRONMENT & DYNAMICS

Environmental Description: This group includes conifer, mixed conifer, and some deciduous montane forests of the southern Rocky Mountains west into the ranges of the Great Basin. Stands occur predominantly in cool ravines and on north-facing slopes with elevations from 1200 to 3300 m. Occurrences of this group are found on cooler and more mesic sites than Southern Rocky Mountain White Fir - Douglas-fir Dry Forest Group (G226). Such sites include lower and middle slopes of ravines, along stream terraces, moist, concave topographic positions, and north- and east-facing slopes. Naturally occurring fires are of variable return intervals and mostly light, erratic, and infrequent due to the cool, moist conditions.

Dynamics:

DISTRIBUTION

Geographic Range: This montane forest group is found in the southern Rocky Mountains of Arizona and New Mexico north and west into the ranges of the Great Basin, southern Wyoming and southeastern Idaho (but it is not common there), occurring predominantly in cool ravines and on north-facing slopes.

Spatial Scale & Pattern [optional]: Large patch

Nations: MX?, US

States/Provinces: AZ, CO, ID, NM, NV, UT, WY

TNC Ecoregions [optional]: 9:C, 10:?, 11:C, 18:C, 19:C, 20:C, 21:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313C:CC, 313D:CP, 315A:C?, 315H:CC, 321A:??, 322A:CC, 331B:CC, 331G:C?, 331H:CP, 331I:CC, 331J:CC, 341A:CC, 341B:CC, 341C:CP, 341D:CC, 341F:CC, 342A:C?, 342B:C?, 342D:CP, 342E:CC, 342F:CP, 342G:CP, 342J:CP, M313A:CC, M313B:CC, M331B:CP, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M341A:CC, M341B:CC, M341C:CC, M341D:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: High.

SYNONYMY

- >< *Abies concolor* Series (DeVelice et al. 1986)
- >< *Abies concolor* Series (Moir and Ludwig 1979)
- >< *Picea pungens* Series (Moir and Ludwig 1979)
- >< *Picea pungens* Series (DeVelice et al. 1986)
- >< *Pseudotsuga menziesii* Series (DeVelice et al. 1986)
- >< *Pseudotsuga menziesii* Series (Moir and Ludwig 1979)
- > Blue Spruce: 216 (Eyre 1980)
- >< Interior Douglas-fir: 210 (Eyre 1980)
- >< White Fir: 211 (Eyre 1980)

LOWER LEVEL UNITS

Alliances:

- A0165 *Picea pungens* Southern Rocky Mountain Mesic Forest Alliance
- A3370 *Pseudotsuga menziesii* Southern Rocky Mountain Mesic Forest Alliance
- A3369 *Abies concolor* Southern Rocky Mountain Mesic Forest & Woodland Alliance

AUTHORSHIP

Primary Concept Source: W.H. Moir and J.A. Ludwig (1979)

Author of Description: K.A. Schulz and M.E. Hall

Acknowledgments:

Version Date: 05/30/2013

Classif Resp Region: West

Internal Author: KAS 3-10, mod. MEH 5-13, mod. GK 12-15

REFERENCES

References: Alexander et al. 1984a, Alexander et al. 1984b, Alexander et al. 1987, Boyce 1977, Bunin 1975c, DeVelice et al. 1986, Eyre 1980, Faber-Langendoen et al. 2017a, Fitzhugh et al. 1987, Heinze et al. 1962, Hess 1981, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Komarkova et al. 1988b, Mauk and Henderson 1984, Moir and Ludwig 1979, Mueggler 1988, Parson and DeBenedetti 1979, Pfister 1972, Ream 1964, Youngblood and Mauk 1985

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

G225. Rocky Mountain Douglas-fir - White Fir - Blue Spruce Mesic Forest

M020. Rocky Mountain Subalpine-High Montane Conifer Forest

This is a diverse macrogroup of high montane and subalpine forests and woodland found throughout the mountainous regions of the western U.S. and southwestern Canada.

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

1.B.2.Nb.5.b. M020 Rocky Mountain Subalpine-High Montane Conifer Forest

G219. Rocky Mountain Subalpine Dry-Mesic Spruce - Fir Forest & Woodland

Type Concept Sentence: This group consists of matrix forests of the drier sites within the subalpine zone of the Cascades and Rocky Mountains with *Picea engelmannii* and *Abies lasiocarpa* dominating either mixed or alone. These forests often represent the highest elevation forests in an area, and the relatively xeric understory species are diagnostic.

OVERVIEW

Scientific Name: *Picea engelmannii* - *Abies lasiocarpa* - *Pinus contorta* Dry-Mesic Forest & Woodland Group

Common Name (Translated Scientific Name): Engelmann Spruce - Subalpine Fir - Lodgepole Pine Dry-Mesic Forest & Woodland Group

Colloquial Name: Scree & Talus Dry-Mesic Subalpine Fir - Engelmann Spruce Woodland

Type Concept: Engelmann spruce and subalpine fir forests comprise a substantial part of the subalpine forests of the Cascades and Rocky Mountains from southern British Columbia east into Alberta, and south into New Mexico and the Intermountain West region. They also occur on mountain "islands" of north-central Montana. They are the matrix forests of the subalpine zone, with elevations ranging from 1275 m in its northern distribution to 3355 m in the south (4100-11,000 feet). Despite their wide distribution, the tree canopy characteristics are remarkably similar, with *Picea engelmannii* and *Abies lasiocarpa* dominating either mixed or alone. *Pseudotsuga menziesii* may persist in occurrences of this group for long periods without regeneration. *Pinus contorta* is common in many occurrences, and patches of pure *Pinus contorta* are not uncommon, as well as mixed conifer/*Populus tremuloides* stands. In some areas, such as Wyoming, *Picea engelmannii*-dominated forests are on limestone or dolomite, while nearby codominated spruce-fir forests are on granitic or volcanic rocks. Upper elevation examples may have more woodland physiognomy, and *Pinus albicaulis* or *Pinus flexilis* can be a seral component. Relatively xeric understory species are diagnostic of this group and may include *Amelanchier alnifolia*, *Juniperus communis*, *Mahonia repens*, *Physocarpus malvaceus*, *Shepherdia canadensis*, *Vaccinium myrtillus*, or *Vaccinium scoparium*. In the Bighorn Mountains, *Artemisia tridentata* is a common shrub. These forests often represent the highest elevation forests in an area. Sites within this group are cold year-round, and precipitation is predominantly in the form of snow, which may persist until late summer. Snowpacks are deep and late-lying, and summers are cool. Frost is possible almost all summer and may be common in restricted topographic basins and benches. Disturbance includes occasional blowdown, insect outbreaks and stand-replacing fire. Mean return interval for stand-replacing fire is 222 years as estimated in southeastern British Columbia.

Classification Comments: What have been called "ribbon forests" or "tree islands" by some authors [citations?] are included in this group; they can be found at upper treeline in many areas of the Rockies, including the central and northern ranges in Colorado and the Medicine Bow and Bighorn ranges of Wyoming. These are more typically islands or ribbons of trees within open-meadow areas. These patterns are controlled by deposition of windblown snow where deep drifts prevent trees from establishing. The relationship of G218 and G219 may be complicated, given that they are wide-ranging groups, and it could be very hard to cleanly place associations into each group, floristically and geographically.

Similar NVC Types:

- G220 Rocky Mountain Lodgepole Pine Forest & Woodland
- G218 Rocky Mountain Subalpine Moist Spruce - Fir Forest & Woodland

Diagnostic Characteristics: These subalpine forests and woodlands are characterized by diagnostic subalpine trees *Picea engelmannii*, *Abies lasiocarpa*, and sometimes with *Pinus contorta* with dry to mesic understory shrub species such as *Juniperus communis*, *Mahonia repens*, or *Vaccinium scoparium*. [expand list of diagnostic shrubs and herbs?]

VEGETATION

Physiognomy and Structure: This group is composed of needle-leaved evergreen forests and woodlands dominated by tall (>30 m) trees. Canopy is generally closed to moderately open.

Floristics: This forest and woodland group has a tree canopy typically dominated by *Picea engelmannii* and *Abies lasiocarpa*, either mixed or alone, with a xeric understory species. *Pseudotsuga menziesii* may persist in occurrences of this group for long periods without regeneration. *Pinus contorta* is common in many occurrences, and patches of pure *Pinus contorta* are not uncommon, as well as mixed conifer/*Populus tremuloides* stands. In some areas, such as Wyoming, *Picea engelmannii*-dominated forests are on limestone or dolomite, while nearby codominated spruce-fir forests are on granitic or volcanic rocks. Upper elevation examples may have more woodland physiognomy, and *Pinus albicaulis* or *Pinus flexilis* can be a seral component. Xeric understory species may include shrubs and dwarf-shrubs such as *Jamesia americana*, *Juniperus communis*, *Mahonia repens*, *Physocarpus malvaceus*, *Ribes inerme*, *Rubus parviflorus*, *Shepherdia canadensis*, *Vaccinium cespitosum*, and *Vaccinium scoparium*. In the Bighorn Mountains, *Artemisia tridentata* is a common shrub. *Vaccinium myrtillus* occurs both on dry and mesic sites. More northern occurrences often have taller, more mesic shrub and herbaceous species such as *Empetrum nigrum*. Dry to mesic herbaceous species that are characteristic of this group include *Arnica cordifolia*, *Arnica latifolia*, *Calamagrostis rubescens*, *Carex geyeri*, *Carex rossii*, *Carex siccata*, *Leymus triticoides*, and near alpine elevation *Geum rossii* and *Trifolium dasyphyllum*. Mosses may also dominate the understory without significant cover of vascular plants.

ENVIRONMENT & DYNAMICS

Environmental Description: Engelmann spruce and subalpine fir forests comprise a substantial part of the subalpine forests of the Cascades and Rocky Mountains from southern British Columbia east into Alberta, and south into New Mexico and the Intermountain West region. They also occur on mountain "islands" of north-central Montana. They are the matrix forests of the subalpine zone, with elevations ranging from 1275 m in its northern distribution to 3355 m in the south (4100-11,000 feet). They often represent the highest elevation forests in an area. Sites within this group are cold year-round, and precipitation is predominantly in the form of snow, which may persist until late summer. Snowpacks are deep and late-lying, and summers are cool. Frost is possible almost all summer and may be common in restricted topographic basins and benches. In some areas, such as Wyoming, these forests are on limestone or dolomite, while nearby forests are on granitic or volcanic rocks. Stands found at upper treeline in many areas of the Rockies, including the central and northern ranges in Colorado and the Medicine Bow and Bighorn ranges of Wyoming, are more typically islands or ribbons of trees, sometimes with a krummholz form, with open-meadow areas in a mosaic. These patterns are controlled by snow deposition and wind-blown ice. *Climate:* Sites within this group are cold year-round, and precipitation is predominantly in the form of snow, which may persist until late summer. Snowpacks are deep and late-lying, and summers are cool. Frost is possible almost all summer and may be common in restricted topographic basins and benches.

Dynamics: *Picea engelmannii* can be very long-lived, reaching 500 years of age. *Abies lasiocarpa* decreases in importance relative to *Picea engelmannii* with increasing distance from the region of Montana and Idaho where maritime air masses influence the climate. Disturbance includes occasional blowdown, insect outbreaks and fire. Fire is an important disturbance factor, but fire regimes have a long return interval and so are often stand-replacing. Mean return interval for stand-replacing fire is 222 years as estimated in southeastern British Columbia. *Picea engelmannii* can rapidly recolonize and dominate burned sites, or can succeed other seral species such as *Pinus contorta* or *Populus tremuloides*. Due to great longevity, *Pseudotsuga menziesii* may persist in occurrences of this group for long periods without regeneration. Old-growth characteristics in *Picea engelmannii* forests will include treefall and windthrow gaps in the canopy, with large downed logs, rotting woody material, tree seedling establishment on logs or on mineral soils unearthed in root balls, and snags [citations?].

DISTRIBUTION

Geographic Range: This group is found in the eastern Cascades and throughout the Rocky Mountains from southern interior British Columbia east into Alberta, south into New Mexico and the Intermountain West region. This type tends to be very limited in the northern Oregon Cascades.

Spatial Scale & Pattern [optional]: Matrix

Nations: CA, US

States/Provinces: AB, AZ, BC, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]: 4:C, 7:C, 8:C, 9:C, 11:C, 20:C, 21:C, 26:C, 68:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 315A:PP, 321A:CC, 331J:CC, 341A:CC, 341B:CC, 341D:CC, 341E:CP, 341F:CC, 341G:CC, 342A:CC, 342B:CP, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CP, 342J:CC, M242B:CC, M242C:CC, M242D:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M341A:CC, M341B:CC, M341C:CC, M341D:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- < EF Engelmann Spruce - Sub-alpine Fir Dry Forested (Ecosystems Working Group 1998) [Dry Grouseberry/Crowberry sites, Azalea/Rhododendron sites in ESSFdv dv1 dv2 xc 3 xc4 xv1 xv2]
- < Engelmann Spruce - Subalpine Fir: 206 (Eyre 1980)

LOWER LEVEL UNITS

Alliances:

- A3645 *Abies lasiocarpa* - *Populus tremuloides* Rocky Mountain Dry-Mesic Forest Alliance
- A3643 *Abies lasiocarpa* - *Picea engelmannii* Rocky Mountain Dry-Mesic Forest Alliance
- A3644 *Abies lasiocarpa* - *Picea engelmannii* Dry-Mesic Scree & Talus Woodland Alliance
- A3641 *Abies lasiocarpa* - *Picea engelmannii* Southern Rocky Mountain Dry-Mesic Forest Alliance
- A3642 *Abies lasiocarpa* - *Picea engelmannii* Treeline Dry-Mesic Forest Alliance

AUTHORSHIP

Primary Concept Source: F.H. Eyre (1980)

Author of Description: K.A. Schulz

Acknowledgments: D. Tart

Version Date: 10/08/2013

Classif Resp Region: West

Internal Author: KAS 2-10, mod. DFL/MEH 10-13, mod. GK 12-15

REFERENCES

References: Alexander and Ronco 1987, Alexander et al. 1984a, Alexander et al. 1987, Clagg 1975, Cooper et al. 1987, Daubenmire and Daubenmire 1968, DeVelice et al. 1986, Ecosystems Working Group 1998, Eyre 1980, Faber-Langendoen et al. 2017a, Fitzhugh et al. 1987, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman and Alexander 1976, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Hopkins 1979a, Hopkins 1979b, Johnson and Clausnitzer 1992, Johnson and Simon 1987, Komarkova et al. 1988b, Lillybridge et al. 1995, Mauk and Henderson 1984, Mehl 1992, Meidinger and Pojar 1991, Muldavin et al. 1996, Peet 1978a, Peet 1981, Pfister 1972, Pfister et al. 1977, Romme 1982, Steele and Geier-Hayes 1995, Steele et al. 1981, Veblen 1986, Whipple and Dix 1979, Williams and Lillybridge 1983, Williams et al. 1995, Youngblood and Mauk 1985

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

G219. Rocky Mountain Subalpine Dry-Mesic Spruce - Fir Forest & Woodland

A3644. *Abies lasiocarpa* - *Picea engelmannii* Dry-Mesic Scree & Talus Woodland Alliance

Type Concept Sentence: This forest and woodland alliance of the northern, central and southern Rocky Mountains occurs on talus and scree slopes dominated by *Abies lasiocarpa* or *Picea engelmannii*.

OVERVIEW

Scientific Name: *Abies lasiocarpa* - *Picea engelmannii* Dry-Mesic Scree & Talus Woodland Alliance

Common Name (Translated Scientific Name): Subalpine Fir - Engelmann Spruce Dry-Mesic Scree & Talus Woodland Alliance

Colloquial Name: Scree & Talus Dry-Mesic Subalpine Fir - Engelmann Spruce Woodland

Type Concept: This forest and woodland alliance of the northern, central and southern Rocky Mountains occurs on talus and scree slopes. Currently there is no floristic or environmental data available for *Abies lasiocarpa* Scree Woodland (CEGL000925), and therefore the description of this alliance is based on the other two associations attributed here. Canopy cover is open to moderately closed and dominated by *Abies lasiocarpa* or *Picea engelmannii*. Canopy associates may include *Pseudotsuga menziesii* and occasionally *Pinus strobiformis*. Understories are distinctly shrubby. Dominant shrubs may include *Acer glabrum*, *Holodiscus dumosus*, *Jamesia americana*, *Juniperus communis*, and *Symphoricarpos oreophilus*. The herbaceous layer is poorly represented and may have sparse to moderate cover. The most common species is *Leymus triticoides*. This alliance is restricted to upper elevations above 3020 m and occurs on steep slopes with cobbly soils derived from talus and scree.

Classification Comments: This alliance is provisional as two of the member associations occur in the far southern Rocky Mountains and one occurs in the north-central Rocky Mountains leaving a substantial geographic information gap. This alliance is based upon a series concept in which *Abies lasiocarpa* or *Picea engelmannii* may not be the dominant tree canopy species but is always present in the regeneration layer, and it is assumed would dominate the site should "climax" conditions be reached. These forests and woodlands have been poorly sampled and may prove with further data to be sparsely vegetated types that should be moved into the sparse vegetation class of the USNVC.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Moderately closed to nearly sparse needle-leaved evergreen forests and woodlands of the northern, central and southern Rocky Mountains occurring on scree and talus slopes dominated by *Abies lasiocarpa* or *Picea engelmannii*.

VEGETATION

Physiognomy and Structure: These are forests dominated by needle-leaved evergreen trees up to 45 m in height and moderately closed to nearly sparse (20-100%). Although cold-deciduous trees are relatively rare, they can be prominent in some regional variants or seral stands. Stands may be so tightly stocked that little light reaches the forest floor and understory layers are depauperate. In stands with somewhat more open canopies, a moderately dense shrub layer may be present, dominated by ericaceous or cold-deciduous species. The herbaceous layer is dominated by perennial forbs or sod-forming graminoids, and herbaceous cover increases with increasing light availability and/or soil moisture. There is often significant cover of mosses and sometimes lichens on the forest floor and on downed woody material.

Floristics: Canopy cover is open to moderately closed and dominated by *Abies lasiocarpa* or *Picea engelmannii*. Canopy associates may include *Pseudotsuga menziesii* and occasionally *Pinus strobiformis*. Understories are distinctly shrubby. Dominant shrubs may include *Acer glabrum*, *Holodiscus dumosus*, *Jamesia americana*, *Juniperus communis*, and *Symphoricarpos oreophilus*. The herbaceous layer is poorly represented and may have sparse to moderate cover. The most common species is *Leymus triticoides*.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance is restricted to upper elevations above 3020 m and occurs on steep slopes with cobbly soils derived from talus and scree.

Dynamics: *Picea engelmannii* is susceptible to infestations by the spruce beetle (*Dendroctonus rufipennis*) or the spruce budworm (*Choristoneura occidentalis*), which can cause high mortality during outbreaks.

DISTRIBUTION

Geographic Range: Little is known about the full distribution of this alliance. Currently it is documented from the Arizona-New Mexico Mountains and the central and southern Rocky Mountains.

Nations: US

States/Provinces: AZ, MT, NM, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- >< *Abies lasiocarpa*-*Picea engelmannii* Series (Johnston 1987)
- >< *Picea* series (Pfister et al. 1977)
- >< Engelmann Spruce - Subalpine Fir: 206 (Eyre 1980)
- >< Western Needleleaf Forests: 15: Western Spruce-Fir Forest (*Picea-Abies*) (Küchler 1964)
- >< Western Needleleaf Forests: 21: Southwestern Spruce-Fir Forest (*Picea-Abies*) (Küchler 1964)

LOWER LEVEL UNITS**Associations:**

- CEG000925 *Abies lasiocarpa* Scree Woodland
- CEG000918 *Abies lasiocarpa* / *Holodiscus dumosus* Scree Woodland
- CEG000362 *Picea engelmannii* / *Leymus triticoides* Forest

AUTHORSHIP

Primary Concept Source: E. Muldavin, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Eyre 1980, Faber-Langendoen et al. 2017b, Johnston 1987, Küchler 1964, Pfister et al. 1977

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

G219. Rocky Mountain Subalpine Dry-Mesic Spruce - Fir Forest & Woodland

A3643. *Abies lasiocarpa* - *Picea engelmannii* Rocky Mountain Dry-Mesic Forest Alliance

Type Concept Sentence: This alliance is characterized by forests and woodlands with broad distributions throughout the southern, central and northern Rocky Mountains and eastern Cascades dominated by *Abies lasiocarpa* and/or *Picea engelmannii*.

OVERVIEW

Scientific Name: *Abies lasiocarpa* - *Picea engelmannii* Rocky Mountain Dry-Mesic Forest Alliance

Common Name (Translated Scientific Name): Subalpine Fir - Engelmann Spruce Rocky Mountain Dry-Mesic Forest Alliance

Colloquial Name: Rocky Mountain Dry-Mesic Subalpine Fir - Engelmann Spruce Forest

Type Concept: This alliance is characterized by forests and woodlands with broad distributions in the upper montane or subalpine zone throughout the southern, central and northern Rocky Mountains and eastern Cascades dominated by *Abies lasiocarpa* and/or *Picea engelmannii*. Canopies may be open to closed. Common associated conifers can include *Abies concolor*, *Larix occidentalis*, *Picea pungens*, *Pinus albicaulis*, *Pinus aristata*, *Pinus contorta*, *Pinus flexilis*, *Pinus strobiformis*, and *Pseudotsuga menziesii*. Understories are highly variable across the range of this alliance and can be dominated by grasses, dry sedges, mesic forbs or shrubs. Common shrub species can include *Acer glabrum*, *Amelanchier alnifolia*, *Jamesia americana*, *Juniperus communis*, *Lonicera utahensis*, *Mahonia repens*, *Paxistima myrsinites*, *Physocarpus monogynus*, *Ribes montigenum*, *Ribes pinetorum*, *Rosa woodsii*, *Salix scouleriana*, *Shepherdia canadensis*, *Spiraea betulifolia*, *Symphoricarpos oreophilus*, *Vaccinium myrtillus*, and *Vaccinium scoparium*. Herbaceous layers may be forb-dominated as well. Species may include *Arnica cordifolia*, *Arnica latifolia*, *Astragalus miser*, *Chamerion angustifolium* (= *Epilobium angustifolium*), *Erigeron eximius*, *Eucephalus engelmannii* (= *Aster engelmannii*), *Frasera speciosa*, *Goodyera repens*, *Orthilia secunda*, *Pedicularis racemosa*, *Polemonium pulcherrimum*, and *Solidago multiradiata*. The most common graminoids include *Carex geyeri*, *Carex rossii*, *Luzula parviflora*, and *Poa nervosa*. This alliance occurs above the warmer and drier montane forests of the West, which are typically mixed-coniferous forests, but may extend down into the montane zone where there is cold-air drainage. Parent materials and soils are variable. Sites include gentle to very steep mountain slopes, ridgetops, plateaus, basins, alluvial terraces and benches. All aspects are represented, but northerly and easterly aspects predominate, and southerly aspects are found only at higher elevations. Soils are variable, but often gravelly or rocky, relatively shallow with thick duff layers and sometimes high moss or lichen cover.

Classification Comments: This alliance is based upon a series concept in which *Abies lasiocarpa* and/or *Picea engelmannii* may not be the dominant tree canopy species but are always present in the regeneration layer, and it is assumed would dominate the site should "climax" conditions be reached.

Internal Comments:

Other Comments:

Similar NVC Types: This alliance is distinguished in part from *Abies lasiocarpa* - *Picea engelmannii* Southern Rocky Mountain Dry-Mesic Forest Alliance (A3641) in having a much broader distribution throughout much of the Rocky Mountains.

- A3641 *Abies lasiocarpa* - *Picea engelmannii* Southern Rocky Mountain Dry-Mesic Forest Alliance: has a narrower distribution and species compositions more characteristic to the southern Rocky Mountains.

Diagnostic Characteristics: Needle-leaved evergreen forests and woodlands of the subalpine elevation zones of the Rocky Mountains with dry to mesic moisture regimes. Canopies are dominated by *Abies lasiocarpa* and/or *Picea engelmannii*. Understories are highly variable across the range of this alliance and can be dominated by grasses, dry sedges, mesic forbs or shrubs.

VEGETATION

Physiognomy and Structure: These are forests and woodlands dominated by needle-leaved evergreen trees up to 30 m in height and with open to closed canopy cover (20-100%). Although cold-deciduous trees are relatively rare, they can be prominent in some early-successional stands. Stands may have such high tree density that little light reaches the forest floor and understory layers are depauperate. In stands with somewhat more open canopies, a moderately dense shrub layer may be present, dominated by ericaceous or, less commonly, cold-deciduous species. The ground layer is dominated by perennial forbs or sod-forming graminoids, and herbaceous cover increases with increasing light availability and/or soil moisture. A nonvascular layer of predominantly mosses may be present. Old-growth stands will have hummocky topography, downed logs and snags, and lichens or fungi may cover rotting woody debris.

Floristics: These subalpine forests are characterized by a canopy typically dominated by *Abies lasiocarpa* and/or *Picea engelmannii*. In early- to mid-successional stands, other conifers can be dominant or codominant, but *Picea engelmannii* and *Abies lasiocarpa* are the most abundant seedlings and saplings. In the Northern Rockies and Cascades other important conifers can include *Larix occidentalis*, *Pinus contorta*, *Pinus flexilis*, and *Pseudotsuga menziesii*. On the east side of the Continental Divide, only *Pseudotsuga* and *Pinus contorta* are important, but in northwestern Wyoming and Utah, *Pinus flexilis* or *Pinus albicaulis* can codominate stands at higher elevations. In the southern stands of Colorado and Arizona, other important canopy species may include *Abies concolor*, *Abies lasiocarpa* var. *arizonica*, *Picea pungens*, *Pinus aristata*, *Pinus flexilis*, and *Pinus strobiformis*. The shrub layer is often sparse, but where canopies are more open can be dominated by ericaceous, cold-deciduous or evergreen species such as *Acer glabrum*, *Amelanchier alnifolia*, *Jamesia americana*, *Juniperus communis*, *Lonicera utahensis*, *Mahonia repens*, *Paxistima myrsinites*, *Physocarpus monogynus*, *Ribes montigenum*, *Ribes pinetorum*, *Rosa woodsii*, *Salix scouleriana*, *Shepherdia canadensis*, *Spiraea betulifolia*, *Symphoricarpos oreophilus*, *Vaccinium myrtillus*, and *Vaccinium scoparium*. The herbaceous layer can be either depauperate or species-rich, and is most often dominated by perennial forbs. Important to dominant species include *Arnica cordifolia*, *Arnica latifolia*, *Astragalus miser*, *Chamerion angustifolium* (= *Epilobium angustifolium*), *Erigeron eximius*, *Eucephalus engelmannii* (= *Aster engelmannii*), *Frasera speciosa*, *Goodyera repens*, *Orthilia secunda*, *Pedicularis racemosa*, *Polemonium pulcherrimum*, and *Solidago multiradiata*. The most common graminoids include *Carex geyeri*, *Carex rossii*, *Luzula parviflora*, and *Poa nervosa*. One association has a depauperate understory, with only mosses having significant cover, such as *Hypnum revolutum*.

ENVIRONMENT & DYNAMICS

Environmental Description: These upper montane or subalpine forests occur in much of the Rocky Mountains and eastern Cascades where they are often the matrix forests and woodlands. They occur above the warmer and drier montane forests of the West, which are typically mixed-coniferous forests. In the Cascade Range, they occupy areas with pronounced rainshadow effects from mountains to the west, where precipitation is more limited than in the surrounding areas. Average temperatures are fairly uniform across the alliance's range, with mean July and January temperatures of 12° and -10°C, respectively (Burns and Honkala 1990a). Snowpacks can be deep, but often melt quickly, and summers are cool. Summer frosts are characteristic, especially on sites where cold air pools. Elevations of occurrence increase with decreasing latitude, ranging from less than 970-1800 m in the Cascades, from 900 m to well over 3200 m in the Northern Rockies of Montana, Idaho and Wyoming, and up to 3350 m in the Colorado Rockies. Sites where these forests and woodlands are found include gentle to very steep mountain slopes, high-elevation ridgetops and upper slopes, plateau-like surfaces, basins, alluvial terraces, and well-drained benches. In some locations where there is cold-air drainage, these forests may extend down in elevation into the montane zone, where they will occupy dry stream terraces, toeslopes, or mesic sites with cooler temperature regimes such as northern aspects. Parent materials and soils are variable across the distribution of the alliance. Parent materials include ash, tuff, lava, basalt, granitics, quartzite, dolomite, rhyolite, and other sedimentary rock types. Stands can also occur on colluvium or alluvium. Soils are typically not deep, poorly developed, and can have significant amounts of rock and gravel in the profile. Subalpine soils, such as found associated with these forests, often show evidence of podzolization processes, especially in the north, and poorly decomposed organic layers are common.

Dynamics: *Picea engelmannii* can be very long-lived, reaching 500 years of age. *Abies lasiocarpa* decreases in importance relative to *Picea engelmannii* with increasing distance from the region of Montana and Idaho where maritime air masses influence the climate. Fire is an important disturbance factor, but fire regimes have a long return interval and so are often stand-replacing. *Picea engelmannii* can rapidly recolonize and dominate burned sites, or can succeed to other species such as *Pinus contorta* or *Populus tremuloides*. Due to great longevity, *Pseudotsuga menziesii* may persist in stands of this alliance for long periods without

regeneration. Old-growth characteristics in *Picea engelmannii* forests will include treefall and windthrow gaps in the canopy, with large downed logs, rotting woody material, tree seedling establishment on logs or on mineral soils unearthed in root balls, and snags. *Picea engelmannii* is susceptible to infestations by the spruce beetle (*Dendroctonus rufipennis*) or the spruce budworm (*Choristoneura occidentalis*), which can cause high mortality during outbreaks. In the Southwest, *Arceuthobium microcarpum* is a common cause of mortality for the species. *Abies lasiocarpa* forests develop on sites with limited, short growing seasons and relatively deep winter snowpacks. Tree growth is very slow in these habitats, and forests are rapidly colonized by much more rapidly growing shade-intolerant species, such as *Pseudotsuga menziesii*, *Pinus contorta*, or *Populus tremuloides*, following fire, clearcut logging, or windthrow disturbance. *Abies lasiocarpa* is among the most shade-tolerant trees in the Rocky Mountains, but seedlings compete poorly in greater than 50% full sunlight (Burns and Honkala 1990a). In Oregon and Washington, many communities are bottomland, moist, upper montane forests that rarely burn. Fire is important in many of the more open sites, as well as those on steep slopes. Snow avalanches occur frequently at upper elevations, and can result in a mosaic of varying stand ages on sites affected by this disturbance type.

DISTRIBUTION

Geographic Range: This alliance occupies the subalpine elevation zones of the central, southern and northern Rocky Mountains, east to the Cascades and west to the Wyoming Basins.

Nations: US

States/Provinces: AZ, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- >< *Abies lasiocarpa*-*Picea engelmannii* Series (Johnston 1987)
- >< *Picea* series (Pfister et al. 1977)
- >< Engelmann Spruce - Subalpine Fir: 206 (Eyre 1980)
- >< Western Needleleaf Forests: 15: Western Spruce-Fir Forest (*Picea-Abies*) (Küchler 1964)
- >< Western Needleleaf Forests: 21: Southwestern Spruce-Fir Forest (*Picea-Abies*) (Küchler 1964)

LOWER LEVEL UNITS

Associations:

- CEG000301 *Abies lasiocarpa* - *Picea engelmannii* / *Calamagrostis rubescens* Forest
- CEG0005638 *Abies lasiocarpa* - (*Pinus contorta*) / *Juniperus communis* - *Lomatium martindalei* Woodland
- CEG000298 *Abies lasiocarpa* - *Picea engelmannii* / *Arnica cordifolia* Forest
- CEG000323 *Abies lasiocarpa* / *Osmorhiza berteroi* Forest
- CEG000326 *Abies lasiocarpa* / *Physocarpus malvaceus* Forest
- CEG000318 *Abies lasiocarpa* / *Mahonia repens* Forest
- CEG000344 *Abies lasiocarpa* - *Picea engelmannii* / *Vaccinium scoparium* Forest
- CEG000368 *Picea engelmannii* / *Hypnum revolutum* Forest
- CEG0002676 *Picea engelmannii* / *Physocarpus malvaceus* Forest
- CEG000305 *Abies lasiocarpa* / *Carex rossii* Forest
- CEG000919 *Abies lasiocarpa* - *Picea engelmannii* / *Juniperus communis* Woodland
- CEG000381 *Picea engelmannii* / *Vaccinium scoparium* Forest
- CEG000304 *Abies lasiocarpa* - *Picea engelmannii* / *Carex geyeri* Forest
- CEG000306 *Abies lasiocarpa* / *Clematis columbiana* var. *columbiana* Forest
- CEG000324 *Abies lasiocarpa* / *Paxistima myrsinites* Woodland
- CEG000299 *Abies lasiocarpa* - *Picea engelmannii* / *Arnica latifolia* Forest
- CEG000355 *Picea engelmannii* / *Arnica cordifolia* Forest
- CEG0005925 *Picea engelmannii* / *Juniperus communis* Forest
- CEG000379 *Picea engelmannii* / *Vaccinium myrtillus* Forest
- CEG000343 *Abies lasiocarpa* - *Picea engelmannii* / *Vaccinium myrtillus* Forest
- CEG000325 *Abies lasiocarpa* / *Pedicularis racemosa* Forest

AUTHORSHIP

Primary Concept Source: B.C. Johnston (1987)

Author of Description: M.E. Hall

Acknowledgments:**Version Date:** 2014/03/14**REFERENCES**

References: Burns and Honkala 1990a, Eyre 1980, Faber-Langendoen et al. 2017b, Horton 1971, Johnson and Simon 1987, Johnston 1987, Küchler 1964, Pfister et al. 1977

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

G219. Rocky Mountain Subalpine Dry-Mesic Spruce - Fir Forest & Woodland

A3641. *Abies lasiocarpa* - *Picea engelmannii* Southern Rocky Mountain Dry-Mesic Forest Alliance

Type Concept Sentence: This alliance is known from the Colorado Plateau, Arizona - New Mexico Mountains and southern Rocky Mountains and consists of forests dominated by *Abies lasiocarpa* and/or *Picea engelmannii*.

OVERVIEW

Scientific Name: *Abies lasiocarpa* - *Picea engelmannii* Southern Rocky Mountain Dry-Mesic Forest Alliance

Common Name (Translated Scientific Name): Subalpine Fir - Engelmann Spruce Southern Rocky Mountain Dry-Mesic Forest Alliance

Colloquial Name: Southern Rocky Mountain Dry-Mesic Subalpine Fir - Engelmann Spruce Forest & Woodland

Type Concept: These upper montane or subalpine conifer forests occur in many of the mountainous areas of the Colorado Plateau, Arizona - New Mexico Mountains and southern Rocky Mountains where they are often the matrix forests of the subalpine zone. *Abies lasiocarpa* and *Picea engelmannii* generally are dominant singly or in combination. *Picea engelmannii* will often be prominent on more moist sites or in more mature stands. Associates vary geographically. Common associated trees species, particularly in seral stands, may include *Pinus aristata*, *Pinus contorta*, *Pinus flexilis*, *Populus tremuloides*, and *Pseudotsuga menziesii*. Forest understories are highly variable across the range of this alliance and can be dominated by dry sedges, grasses, forbs or shrubs. Dominant shrubs may include *Acer glabrum*, *Jamesia americana*, *Juniperus communis*, *Lonicera utahensis*, *Paxistima myrsinites*, *Ribes pinetorum*, *Rubus idaeus*, *Salix scouleriana*, *Sambucus racemosa* var. *melanocarpa* (= *Sambucus melanocarpa*), *Symphoricarpos oreophilus*, *Vaccinium cespitosum*, *Vaccinium myrtillus*, and *Vaccinium scoparium*. Common and dominant graminoids may include *Bromus ciliatus* var. *richardsonii* (= *Bromus richardsonii*), *Carex siccata* (= *Carex foenea*), *Poa fendleriana*, and *Poa pratensis*. Forb cover is relatively low to moderate and may consist of *Actaea rubra* ssp. *arguta* (= *Actaea arguta*), *Aquilegia* spp., *Campanula rotundifolia*, *Galium* spp., *Lathyrus lanszwertii* var. *leucanthus* (= *Lathyrus arizonicus*), *Ligusticum porteri*, *Mertensia franciscana*, *Oreochrysum parryi* (= *Solidago parryi*), *Orthilia secunda* (= *Ramischia secunda*), *Osmorhiza depauperata*, *Packera sanguisorboides* (= *Senecio sanguisorboides*), *Pteridium aquilinum*, *Senecio* spp., *Trisetum spicatum* (= *Trisetum montanum*), *Vicia americana*, *Viola canadensis*, and *Woodsia* spp., These forests occur above the warmer and drier montane forests of the West, which are typically mixed-coniferous forests, but may extend down into the montane zone where there is cold-air drainage. Parent materials and soils are variable. Sites include gentle to very steep mountain slopes, ridgetops, plateaus, basins, alluvial terraces and benches. All aspects are represented, but northerly and easterly aspects predominate, and southerly aspects are found only at higher elevations. Typically, soils are not deep, poorly developed and rocky.

Classification Comments:**Internal Comments:****Other Comments:**

Similar NVC Types: This alliance is distinguished from *Abies lasiocarpa* - *Picea engelmannii* Rocky Mountain Dry-Mesic Forest Alliance (A3643) in being characterized by associations with species compositions more characteristic to the southern Rocky Mountains.

- A3643 *Abies lasiocarpa* - *Picea engelmannii* Rocky Mountain Dry-Mesic Forest Alliance: has a much broader distribution throughout much of the Rocky Mountains.

Diagnostic Characteristics: Needle-leaved evergreen forests and woodlands of the southern Rocky Mountains dominated by *Abies lasiocarpa* and/or *Picea engelmannii*. Diagnostic of forests in this alliance is that they are upland forests (non-flooded) with average tree canopy cover greater than 60%. Understories are distinguished from those of similar alliances in species compositions with distributions centered in the southern Rocky Mountains as opposed to the more ubiquitous species distributed more broadly to the north.

VEGETATION

Physiognomy and Structure: These are forests dominated by needle-leaved evergreen trees up to 45 m in height and of high cover (60-100%). Although cold-deciduous trees are relatively rare, they can be prominent in some regional variants or seral stands. Stands

may be so tightly stocked that little light reaches the forest floor and understory layers are depauperate. In stands with somewhat more open canopies, a moderately dense shrub layer may be present, dominated by ericaceous or cold-deciduous species. The herbaceous layer is dominated by perennial forbs or sod-forming graminoids, and herbaceous cover increases with increasing light availability and/or soil moisture. There is often significant cover of mosses and sometimes lichens on the forest floor and on downed woody material.

Floristics: These subalpine forests are characterized by a canopy varying from 20-45 m in height dominated by *Picea engelmannii* and/or *Abies lasiocarpa*. In early- to mid-successional stands, other conifers can be dominant or codominant, but *Picea engelmannii* and *Abies lasiocarpa* are the most abundant seedlings and saplings. Important, but usually seral, tree species include *Pinus contorta*, *Pseudotsuga menziesii*, and *Populus tremuloides*. Other trees in these stands include *Picea pungens*, *Pinus aristata*, *Pinus flexilis*, and *Pinus strobiformis*. Forest understories are highly variable across the range of this alliance and can be dominated by dry sedges, grasses, forbs or shrubs. The shrub layer may be sparse to well-developed. Dominant shrubs may include *Acer glabrum*, *Jamesia americana*, *Juniperus communis*, *Lonicera utahensis*, *Paxistima myrsinites*, *Ribes pinetorum*, *Rubus idaeus*, *Salix scouleriana*, *Sambucus racemosa* var. *melanocarpa* (= *Sambucus melanocarpa*), *Symphoricarpos oreophilus*, *Vaccinium cespitosum*, *Vaccinium myrtillosum*, and *Vaccinium scoparium*. Common and dominant graminoids may include *Bromus ciliatus* var. *richardsonii* (= *Bromus richardsonii*), include *Carex siccata* (= *Carex foenea*), *Poa fendleriana*, and *Poa pratensis*. Forb cover is low to moderate and may consist of *Actaea rubra* ssp. *arguta* (= *Actaea arguta*), *Aquilegia* spp., *Campanula rotundifolia*, *Galium* spp., *Lathyrus lanszwertii* var. *leucanthus* (= *Lathyrus arizonicus*), *Ligusticum porteri*, *Mertensia franciscana*, *Oreochrysum parryi* (= *Solidago parryi*), *Orthilia secunda* (= *Ramischia secunda*), *Osmorhiza depauperata*, *Packera sanguisorboides* (= *Senecio sanguisorboides*), *Pteridium aquilinum*, *Senecio* spp., *Trisetum spicatum* (= *Trisetum montanum*), *Vicia americana*, *Viola canadensis*, and *Woodsia* spp.

ENVIRONMENT & DYNAMICS

Environmental Description: These upper montane or subalpine forests occur in many of the mountainous areas of the Colorado Plateau, Arizona - New Mexico Mountains and southern Rocky Mountains, where they are often the matrix forests of the subalpine zone. They occur above the warmer and drier montane forests of the West, which are typically mixed-coniferous forests. Average temperatures are fairly uniform across the alliance's range, with mean July and January temperatures of 12° and -10°C, respectively (Burns and Honkala 1990a). Snowpacks can be deep, but often melt quickly, and summers are cool. Summer frosts are characteristic, especially on sites where cold air pools. Elevations range from 2600-3500 m. Sites include gentle to very steep mountain slopes, ridgetops, and plateaus. In some locations where there is cold-air drainage, these forests may extend down in elevation into the montane zone, where they will occupy dry stream terraces, toeslopes, with cooler temperature regimes such as northern aspects. Parent materials and soils are variable across the distribution of the alliance. Parent materials include ash, tuff, lava, basalt, granitics, quartzite, dolomite, rhyolite, and other sedimentary rock types. Stands can also occur on colluvium or alluvium. Soils are typically not deep, poorly developed, and can have significant amounts of rock and gravel in the profile. Subalpine soils, such as those found associated with these forests, often show evidence of podzolization processes, especially in the north, and poorly decomposed organic layers are common.

Dynamics: *Abies lasiocarpa* and *Picea engelmannii* forests develop on sites with limited, short growing seasons and relatively deep winter snowpacks. Tree growth is very slow in these habitats, and forests are rapidly colonized by much more rapidly growing shade-intolerant species, such as *Pseudotsuga menziesii*, *Pinus contorta*, or *Populus tremuloides*, following fire, clearcut logging, or windthrow disturbance. *Abies lasiocarpa* is among the most shade-tolerant trees in the Rocky Mountains, but seedlings compete poorly in greater than 50% full sunlight (Burns and Honkala 1990a). Snow avalanches occur frequently at upper elevations, and can result in a mosaic of varying stand ages on sites affected by this disturbance type. *Picea engelmannii* is susceptible to infestations by the spruce beetle (*Dendroctonus rufipennis*) or the spruce budworm (*Choristoneura occidentalis*), which can cause high mortality during outbreaks. In the Southwest, *Arceuthobium microcarpum* is a common cause of mortality for the species.

DISTRIBUTION

Geographic Range: This alliance occurs in the Colorado Plateau, Arizona - New Mexico Mountains and southern Rocky Mountains of Arizona, Colorado, Nevada, Wyoming, New Mexico and possibly Utah.

Nations: US

States/Provinces: AZ, CO, NM, NV, UT?, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- >< *Abies lasiocarpa*-*Picea engelmannii* Series (Johnston 1987)
- >< *Picea* series (Pfister et al. 1977)
- >< Engelmann Spruce - Subalpine Fir: 206 (Eyre 1980)
- >< Western Needleleaf Forests: 15: Western Spruce-Fir Forest (*Picea-Abies*) (Küchler 1964)
- >< Western Needleleaf Forests: 21: Southwestern Spruce-Fir Forest (*Picea-Abies*) (Küchler 1964)

LOWER LEVEL UNITS**Associations:**

- CEGLO00333 *Abies lasiocarpa* / *Packera sanguisorboides* Forest
- CEGLO00371 *Picea engelmannii* / Moss Forest
- CEGLO00321 *Abies lasiocarpa* - *Picea engelmannii* / Moss Forest
- CEGLO00303 *Abies lasiocarpa* - *Picea engelmannii* / *Carex siccata* Forest
- CEGLO00313 *Abies lasiocarpa* / *Lathyrus lanszwertii* var. *leucanthus* Forest
- CEGLO00312 *Abies lasiocarpa* / *Jamesia americana* Forest

AUTHORSHIP

Primary Concept Source: M.S. Reid and D. Sarr, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Burns and Honkala 1990a, Eyre 1980, Faber-Langendoen et al. 2017b, Johnston 1987, Küchler 1964, Pfister et al. 1977

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

G219. Rocky Mountain Subalpine Dry-Mesic Spruce - Fir Forest & Woodland

A3645. *Abies lasiocarpa* - *Populus tremuloides* Rocky Mountain Dry-Mesic Forest Alliance

Type Concept Sentence: This forest alliance of the southern and central Rocky Mountains and Intermountain West is composed of forests with mixed canopies dominated by *Abies lasiocarpa* and *Populus tremuloides*.

OVERVIEW

Scientific Name: *Abies lasiocarpa* - *Populus tremuloides* Rocky Mountain Dry-Mesic Forest Alliance

Common Name (Translated Scientific Name): Subalpine Fir - Quaking Aspen Rocky Mountain Dry-Mesic Forest Alliance

Colloquial Name: Rocky Mountain Dry-Mesic Subalpine Fir - Aspen Forest

Type Concept: Stands included in this mixed evergreen-deciduous forest alliance have been described from mountain slopes and plateaus in the central Rocky Mountains and Intermountain West. The mixed coniferous and deciduous tree canopy is open to moderately closed and dominated by *Populus tremuloides* and *Abies lasiocarpa* or *Picea engelmannii*. Several other species of conifers may be scattered within the stands, including *Abies concolor*, *Picea pungens*, *Pinus contorta*, *Pinus flexilis*, and *Pseudotsuga menziesii*. Younger stands typically have dense *Populus tremuloides*, with *Abies lasiocarpa* or *Picea engelmannii* mixed in. As the stands age in this typically seral forest alliance, *Populus tremuloides* is slowly reduced until conifers become dominant. Mixed stands must have at least 25% relative tree cover of both aspen (deciduous) and conifers. The understory is typically composed of a short-shrub layer often dominated by *Juniperus communis*, *Shepherdia canadensis*, or *Symphoricarpos oreophilus*. Other shrubs may include *Mahonia repens*, *Paxistima myrsinites*, *Physocarpus malvaceus*, and *Rosa woodsii*. If present, the tall-shrub layer often consists of scattered *Amelanchier alnifolia*, *Acer grandidentatum*, and *Prunus virginiana*. The relatively sparse herbaceous layer is a mixture of graminoids and forbs and is often dominated by *Bromus carinatus*, *Calamagrostis rubescens*, *Carex geyeri*, *Carex rossii*, *Pedicularis racemosa*, or *Thalictrum fendleri*. Stands occur on gentle to steep slopes on all aspects but are most common on cooler and more mesic, north and east aspects. Soils are derived from alluvium and colluvium from sedimentary, metamorphic and igneous parent materials.

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Diagnostic of these seral forests is the open to moderately closed, mixed coniferous and deciduous tree canopy codominated by *Populus tremuloides* and *Abies lasiocarpa* or *Picea engelmannii*. Stands must have at least 25% relative tree cover of both aspen (deciduous) and conifers.

VEGETATION

Physiognomy and Structure: Vegetation included in this minor alliance has a moderately dense to dense upper canopy of mixed deciduous broad-leaved and evergreen needle-leaved trees (5-20 m tall). The understory has a moderate to sparse short-shrub layer typically dominated by evergreen, scale-leaved or deciduous broad-leaved shrub species. A sparse tall-shrub layer, dominated by deciduous broad-leaved shrubs, may be present. A moderate to sparse herbaceous layer may also be present, dominated by perennial forbs or graminoids.

Floristics: Seral forests are included in this Rocky Mountain alliance. The open to moderately closed, mixed evergreen needle-leaved and deciduous broad-leaved tree canopy is composed of short to moderately tall trees and is codominated by *Populus tremuloides* and *Abies lasiocarpa* or *Picea engelmannii*. Several other species of conifers may be scattered within the stands, including *Abies concolor*, *Picea pungens*, *Pinus contorta*, *Pinus flexilis*, and *Pseudotsuga menziesii*. Younger stands typically have dense *Populus tremuloides*, with *Abies lasiocarpa* or *Picea engelmannii* mixed in. As the stands age in this typically seral forest alliance, *Populus tremuloides* is slowly reduced until conifers become dominant (Mueggler 1988). Mixed stands must have at least 25% relative tree cover of both aspen (deciduous) and conifers. The understory is typically moderately dense to sparse and becomes sparser as *Abies lasiocarpa* or *Picea engelmannii* become more dominant. The understory is typically dominated by a short-shrub layer, with sparse tall-shrub and herbaceous layers. The short-shrub layer is often dominated by *Juniperus communis* or *Shepherdia canadensis*. Other shrubs may include *Mahonia repens*, *Paxistima myrsinites*, *Physocarpus malvaceus*, and *Rosa woodsii*. If present, the tall-shrub layer often consists of scattered *Amelanchier alnifolia*, *Acer grandidentatum*, and *Prunus virginiana*. The relatively sparse herbaceous layer is a mixture of graminoids and forbs and is often dominated by *Bromus carinatus*, *Calamagrostis rubescens*, *Carex geyeri*, *Carex rossii*, *Pedicularis racemosa*, or *Thalictrum fendleri*. Other common graminoids include *Achnatherum occidentale* (= *Stipa occidentalis*), *Bromus ciliatus*, *Elymus glaucus*, and *Elymus trachycaulus*. Forbs such as *Achillea millefolium*, *Arnica cordifolia*, *Chamerion angustifolium* (= *Epilobium angustifolium*), *Eucephalus engelmannii* (= *Aster engelmannii*), *Fragaria vesca*, *Geranium* spp., *Lathyrus* spp., *Lupinus* spp., *Osmorhiza berteroi* (= *Osmorhiza chilensis*), *Senecio serra*, and *Pseudostellaria jamesiana* (= *Stellaria jamesiana*) are common. The exotic species *Poa pratensis* and *Taraxacum officinale* are common in livestock-impacted stands (Mueggler 1988). Annuals are typically uncommon.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands included in this mixed evergreen-deciduous forest alliance have been described from mountain slopes and plateaus in the central Rocky Mountains and parts of the Intermountain West. Elevations range from 1700 to 3000 m. Climate is temperate with cold winters. Mean annual precipitation is greater than 38 cm and typically greater than 50 cm. Sites occur on gentle to steep slopes on all aspects but are most common on north and east aspects. Soils are derived from alluvium and colluvium from sedimentary, metamorphic and igneous parent materials.

Dynamics: Stems of *Populus tremuloides* are thin-barked and readily killed by fire. It is a fire-adapted species that generally needs fire or some other stand-replacing disturbance to establish and maintain dominance in a forest. These mixed forests are seral and in the absence of disturbance will slowly convert to late-successional forests dominated by *Abies lasiocarpa* or *Picea engelmannii* (Mueggler 1988). Most of the stands sampled by Mueggler (1988) have had a history of livestock grazing as evidenced by relative abundance of the exotic plants *Taraxacum officinale* and *Poa pratensis* and the scarcity of grazing-susceptible plants (Mueggler 1988).

DISTRIBUTION

Geographic Range: Forests included in this alliance are scattered in the mountains and plateaus of Utah, Wyoming, Colorado, and Idaho

Nations: US

States/Provinces: CO, ID, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Abies lasiocarpa* Series (Mauk and Henderson 1984) [Early-seral stands in this habitat type may have significant *Populus tremuloides*.]

- >< Aspen: 217 (Eyre 1980)
- >< Engelmann Spruce - Subalpine Fir: 206 (Eyre 1980)

LOWER LEVEL UNITS

Associations:

- C EGL000525 *Populus tremuloides* - *Abies lasiocarpa* / *Carex geyeri* - *Calamagrostis rubescens* Forest
- C EGL000526 *Populus tremuloides* - *Abies lasiocarpa* / *Carex rossii* Forest
- C EGL000524 *Populus tremuloides* - *Abies lasiocarpa* / *Amelanchier alnifolia* Forest
- C EGL000528 *Populus tremuloides* - *Abies lasiocarpa* / *Pedicularis racemosa* Forest
- C EGL000527 *Populus tremuloides* - *Abies lasiocarpa* / *Juniperus communis* Forest
- C EGL000529 *Populus tremuloides* - *Abies lasiocarpa* / *Shepherdia canadensis* Forest

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Eyre 1980, Faber-Langendoen et al. 2017b, Mauk and Henderson 1984, Mueggler 1988, Mueggler and Campbell 1986

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

1.B.2.Nb.5.d. M020 Rocky Mountain Subalpine-High Montane Conifer Forest

G222. Rocky Mountain Subalpine-Montane Aspen Forest & Woodland

Type Concept Sentence: This group consists of upland forests dominated by *Populus tremuloides* without significant conifer cover and an understory structure of complex multiple shrub and herbaceous layers, or simply just an herbaceous layer. It is widespread in the southern and central Rocky Mountains but occurs in the montane and subalpine zones throughout much of the western U.S., south into northern Mexico and north into Canada.

OVERVIEW

Scientific Name: *Populus tremuloides* Rocky Mountain Forest & Woodland Group

Common Name (Translated Scientific Name): Quaking Aspen Rocky Mountain Forest & Woodland Group

Colloquial Name: Bigtooth Maple Montane Forest

Type Concept: This widespread group is more common in the southern and central Rocky Mountains but occurs in the montane and subalpine zones throughout much of the western U.S., south into northern Mexico and north into Canada. An eastern extension occurs along the Rocky Mountains foothill front, in mountain "islands" in Montana (Big Snowy and Highwood mountains), and the Black Hills of South Dakota. In California, this group is in the Sierra Nevada adjacent to the Great Basin. Large stands are found in the Inyo and White mountains, while small stands occur on the Modoc Plateau. Elevations generally range from 1525 to 3050 m (5000-10,000 feet), but occurrences can be found at lower elevations in some regions. Distribution of this group is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand. Secondly, it is limited by the length of the growing season or low temperatures. These are upland forests and woodlands dominated by *Populus tremuloides* without a significant conifer component (<25% relative tree cover). The understory structure may be complex with multiple shrub and herbaceous layers, or simple with just an herbaceous layer. The herbaceous layer may be dense or sparse, dominated by graminoids and/or forbs. Associated shrub species include *Symphoricarpos* spp. (*Symphoricarpos oreophilus* being the most widespread and *Symphoricarpos albus* and *Symphoricarpos mollis* having limited distribution), *Rubus parviflorus*, *Amelanchier alnifolia*, *Prunus virginiana*, and *Arctostaphylos uva-ursi*.

Classification Comments: This group differs from Northwestern Great Plains Aspen Woodland Group (G328), which is limited to plains environments. The scattered occurrences in the Trans-Pecos of Texas are of interest as they represent disjunct outliers of the type occurring under highly limited circumstances. In Alberta and interior British Columbia, these forests transition to Alaskan-Yukon Boreal Dry Aspen Forest Group (G349). Associations where aspen is mixed with one or more Rocky Mountain conifers in the canopy, or even in the undergrowth, are placed into their respective conifer forest groups (e.g., into a spruce-fir group, or a mixed montane conifer group). Typically, in those associations, the floristics and species richness are more similar to conifer forest groups, than to the aspen group.

Similar NVC Types:

- G328 Northwestern Great Plains Aspen Woodland

Diagnostic Characteristics: Open to dense canopies of broad-leaved deciduous trees dominated by *Populus tremuloides*. It has Rocky Mountain floristics associated with it, as opposed to boreal floristics. The herbaceous layer may be dense or sparse, dominated by graminoids or forbs. Common shrubs include *Acer glabrum*, *Amelanchier alnifolia*, *Artemisia tridentata*, *Juniperus communis*, *Prunus virginiana*, *Rosa woodsii*, *Rhamnus alnifolia*, *Lonicera utahensis*, *Shepherdia canadensis*, *Symphoricarpos oreophilus*, and the dwarf-shrubs *Mahonia repens* and *Vaccinium* spp. The herbaceous layers may be lush and diverse. Common graminoids may include *Bromus carinatus*, *Calamagrostis rubescens*, *Carex siccata*, *Carex geyeri*, *Carex rossii*, *Elymus glaucus*, *Elymus trachycaulus*, *Festuca thurberi*, and *Hesperostipa comata*. Associated forbs may include *Achillea millefolium*, *Eucephalus engelmannii*, *Delphinium* spp., *Aconitum columbianum*, *Geranium viscosissimum*, *Heracleum sphondylium*, *Ligusticum filicinum*, *Lupinus argenteus*, *Osmorhiza berteroi*, *Pteridium aquilinum*, *Rudbeckia occidentalis*, *Thalictrum fendleri*, *Valeriana occidentalis*, *Wyethia amplexicaulis*, and many others.

VEGETATION

Physiognomy and Structure: Occurrences typically have a somewhat closed canopy of trees 5-20 m tall that is dominated by the cold-deciduous, broad-leaved tree *Populus tremuloides*. Conifers may contribute up to 15% of the canopy cover. The open-spaced stems of *Populus tremuloides* often give way to a lush understory consisting of complex multiple shrub and herbaceous layers, or just an herbaceous layer.

Floristics: Occurrences have a somewhat closed canopy of trees of 5-20 m tall that is dominated by the cold-deciduous, broad-leaved tree *Populus tremuloides*. Conifers that may be present but typically in minor amounts include *Abies concolor*, *Abies lasiocarpa*, *Picea engelmannii*, *Picea pungens*, *Pinus contorta*, *Pinus ponderosa*, and *Pseudotsuga menziesii*. Conifer species may contribute up to 15% of the tree canopy before the occurrence is reclassified as a mixed occurrence. Because of the open growth form of *Populus tremuloides*, enough light can penetrate for lush understory development. Depending on available soil moisture and other factors such as disturbance, the understory structure may be complex with multiple shrub and herbaceous layers, or simple with just an herbaceous layer. The herbaceous layer may be dense or sparse, dominated by graminoids or forbs. Common shrubs include *Acer glabrum*, *Amelanchier alnifolia*, *Artemisia tridentata*, *Juniperus communis*, *Prunus virginiana*, *Rosa woodsii*, *Rhamnus alnifolia*, *Lonicera utahensis*, *Shepherdia canadensis*, *Symphoricarpos oreophilus*, and the dwarf-shrubs *Mahonia repens* and *Vaccinium* spp. The herbaceous layers may be lush and diverse. Common graminoids may include *Bromus carinatus*, *Calamagrostis rubescens*, *Carex siccata* (= *Carex foenea*), *Carex geyeri*, *Carex rossii*, *Elymus glaucus*, *Elymus trachycaulus*, *Festuca thurberi*, and *Hesperostipa comata*. Associated forbs may include *Achillea millefolium*, *Eucephalus engelmannii* (= *Aster engelmannii*), *Delphinium* spp., *Aconitum columbianum*, *Geranium viscosissimum*, *Heracleum sphondylium*, *Ligusticum filicinum*, *Lupinus argenteus*, *Osmorhiza berteroi* (= *Osmorhiza chilensis*), *Pteridium aquilinum*, *Rudbeckia occidentalis*, *Thalictrum fendleri*, *Valeriana occidentalis*, *Wyethia amplexicaulis*, and many others. In California, *Symphyotrichum spathulatum* (= *Aster occidentalis*) is a common forb. Exotic grasses such as the perennials *Poa pratensis* and *Bromus inermis* and the annual *Bromus tectorum* are often common in occurrences due to grazing disturbance.

ENVIRONMENT & DYNAMICS

Environmental Description: Topography is variable; sites range from level to steep slopes. Aspect varies according to the limiting factors. Occurrences at high elevations are restricted by cold temperatures and are found on warmer southern aspects. At lower elevations, occurrences are restricted by lack of moisture and are found on cooler north aspects and mesic microsites.

Climate: Climate is temperate with a relatively long growing season, typically cold winters and deep snow. Mean annual precipitation is greater than 38 cm (15 inches) and typically greater than 51 cm (20 inches), except in semi-arid environments where occurrences are restricted to mesic microsites such as seeps or where large snow drifts develop. Distribution of this group is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand (Mueggler 1988). Secondarily, its range is limited by the length of the growing season or low temperatures (Mueggler 1988).

Soil/substrate/hydrology: The soils are typically deep and well-developed with rock often absent from the soil. Soil texture ranges from sandy loam to clay loam. Parent materials are variable and may include sedimentary, metamorphic or igneous rocks, but it appears to grow best on limestone, basalt, and calcareous or neutral shales (Mueggler 1988).

Dynamics: Occurrences in this group often originate from, and are likely maintained by, stand-replacing disturbances such as avalanche, crownfire, disease and windthrow, or clearcutting by man or flooding by beaver. The stems of these thin-barked, clonal trees are easily killed by surface fires, but they can quickly and vigorously resprout in densities of up to 30,000 stems per hectare (Knight 1994). The stems are relatively short-lived (100-150 years), and the occurrences often succeed to longer-lived conifer forest if undisturbed. Occurrences are favored by fire in the conifer zone (Mueggler 1988). With adequate disturbance, a clone may live many centuries. Although *Populus tremuloides* produces abundant seeds, seedling survival is rare because the long moist conditions required to establish them are rare in the habitats where they occur. Superficial soil drying will kill seedlings (Knight 1994).

DISTRIBUTION

Geographic Range: This group is more common in the southern and central Rocky Mountains but occurs in the montane and subalpine zones throughout much of the western U.S., south into northern Mexico and north into Canada. An eastern extension occurs along the Rocky Mountains foothill front, in mountain "islands" in Montana (Big Snowy and Highwood mountains), and the Black Hills of South Dakota. In California, this group is in the Sierra Nevada adjacent to the Great Basin. Large stands are found in the Inyo and White mountains, while small stands occur on the Modoc Plateau. Very small occurrences may be found in a few scattered locations of the Trans-Pecos of Texas.

Spatial Scale & Pattern [optional]: Large patch

Nations: CA, MX, US

States/Provinces: AB, AZ, BC, CA, CO, ID, MT, NM, NV, OR, SD, TX, UT, WA, WY

TNC Ecoregions [optional]: 1:P, 3:C, 4:P, 5:P, 7:C, 8:C, 9:C, 11:C, 12:P, 18:C, 19:C, 20:C, 21:P, 25:C, 26:C, 81:P

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313D:CC, 315H:PP, 321A:CC, 322A:CC, 331A:CC, 331F:CC, 331G:CC, 331I:C?, 331J:CC, 331K:CP, 331N:CP, 332F:??, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342A:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CP, 342J:CC, M242B:CP, M242C:CC, M242D:CC, M261D:CC, M261E:CC, M261G:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CP, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CP, M333D:CC, M334A:CC, M341A:CC, M341B:CC, M341C:CC, M341D:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low. USNVC Confidence from peer reviewer, not AE.

SYNONYMY

- < Aspen Woodland (411) (Shiflet 1994)
- < Aspen: 217 (Eyre 1980)
- > Douglas-fir-White Fir (=Mixed Conifer) Series, *Populus tremuloides* subclimax Association - 122.314 (Brown et al. 1979)
- > Engelmann Spruce-Alpine Fir Series, *Populus tremuloides* subclimax Association - 121.316 (Brown et al. 1979)
- > Pine Series, *Populus tremuloides* subclimax Association - 122.326 (Brown et al. 1979)

LOWER LEVEL UNITS

Alliances:

- A3371 *Acer grandidentatum* Montane Forest Alliance
- A2036 *Populus tremuloides* Rocky Mountain Forest & Woodland Alliance
- A3367 *Betula papyrifera* Rocky Mountain Forest & Woodland Alliance
- A4078 *Populus tremuloides* Southern Rocky Mountain Woodland & Scrub Alliance

AUTHORSHIP

Primary Concept Source: F.H. Eyre (1980)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 06/05/2013

Classif Resp Region: West

Internal Author: MEH 2-10, 6-13, mod. GK 12-15

REFERENCES

References: Bartos 1979, Bartos and Campbell 1998, Bartos and Mueggler 1979, Brown 1982a, Brown et al. 1979, DeByle and Winokur 1985, DeVelice et al. 1986, Eyre 1980, Faber-Langendoen et al. 2017a, Henderson et al. 1977, Hess and Wasser 1982, Johnston and Hendzel 1985, Knight 1994, Mueggler 1988, Powell 1988a, Shepperd et al. 2006, Shiflet 1994, Swanson et al. 2010, Youngblood and Mauk 1985

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

G222. Rocky Mountain Subalpine-Montane Aspen Forest & Woodland

A3371. *Acer grandidentatum* Montane Forest Alliance

Type Concept Sentence: This alliance includes mainly deciduous forests dominated by *Acer grandidentatum* occurring in relatively moist lower montane areas of the Utah-Wyoming Rocky Mountains and Columbia Plateau.

OVERVIEW

Scientific Name: *Acer grandidentatum* Montane Forest Alliance

Common Name (Translated Scientific Name): Bigtooth Maple Montane Forest Alliance

Colloquial Name: Bigtooth Maple Montane Forest

Type Concept: This alliance includes mainly deciduous forests dominated by *Acer grandidentatum* occurring in relatively moist lower montane areas of the Utah-Wyoming Rocky Mountains and Columbia Plateau. Forests in this alliance are dominated by a dense canopy of *Acer grandidentatum*, often occurring with *Quercus* spp. and *Juniperus* spp. Shrub and herb strata are relatively sparse throughout the range of the alliance and are composed of short shrubs and annual or perennial graminoids and forbs. Tree and shrub associates include *Amelanchier alnifolia*, *Artemisia tridentata*, *Paxistima myrsinites*, *Physocarpus malvaceus*, *Populus tremuloides*, *Prunus virginiana*, *Quercus gambelii*, and *Symphoricarpos* spp. The alliance can occur on all aspects but is best developed on north-facing valleys or canyons with moderate insolation and favorable soil moisture. In the southern part of the range, these communities are typically associated with protected topographic positions with relatively moist soils and lower fire frequencies than surrounding hillsides. Elevations range from 1200-2600 m.

Classification Comments: This alliance excludes associations of *Acer grandidentatum* found in Trans-Pecos Texas.

Internal Comments:

Other Comments:

Similar NVC Types:

- A3214 *Acer grandidentatum* - *Quercus muehlenbergii* - *Juglans major* Forest & Woodland Alliance
- A3109 *Acer grandidentatum* - *Quercus gravesii* - *Quercus muehlenbergii* Forest & Woodland Alliance

Diagnostic Characteristics: Forests in this alliance are dominated by a dense canopy of *Acer grandidentatum*, often occurring with *Quercus* spp. and *Juniperus* spp.

VEGETATION

Physiognomy and Structure: This alliance is characterized by a closed canopy of tall cold-deciduous or broad-leaved evergreen shrubs or short trees 6-8 m in height. Short evergreen shrubs may also be present. The herbaceous understory is typically sparse and composed of annual or perennial graminoids and forbs.

Floristics: These forests are dominated by a dense canopy of *Acer grandidentatum*, often occurring with *Quercus* spp. and *Juniperus* spp. In Rocky Mountain stands, tree and shrub associates include *Amelanchier alnifolia*, *Artemisia tridentata*, *Paxistima myrsinites*, *Physocarpus malvaceus*, *Populus tremuloides*, *Prunus virginiana*, *Quercus gambelii*, and *Symphoricarpos* spp. Shrub and herb strata are relatively sparse. Forests in this alliance grade to slightly less mesic mixed evergreen-deciduous forests, woodlands, or brushfields on adjacent hillsides.

ENVIRONMENT & DYNAMICS

Environmental Description: Vegetation within this alliance occurs in relatively moist lower montane areas of the southern and central Rocky Mountains. These forests occur from 1200-2600 m in elevation. Annual precipitation generally exceeds 40 cm with a large proportion falling during the growing season. The alliance can occur on all aspects but is best developed on north-facing valleys or canyons which have moderate insolation and favorable soil moisture.

Dynamics: In southern stands, these communities are typically associated with protected topographic positions with relatively moist soils and lower fire frequencies than surrounding hillsides.

DISTRIBUTION

Geographic Range: This alliance is known from the Utah-Wyoming Rocky Mountains, Utah High Plateaus, and Colorado Plateau.

Nations: US

States/Provinces: ID, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEGLO00559 *Acer grandidentatum* / *Quercus gambelii* Forest
- CEGLO00558 *Acer grandidentatum* / *Calamagrostis rubescens* Forest

AUTHORSHIP

Primary Concept Source: D. Sarr, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Diamond 1993, Faber-Langendoen et al. 2017b

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

G222. Rocky Mountain Subalpine-Montane Aspen Forest & Woodland

A2036. *Populus tremuloides* Rocky Mountain Forest & Woodland Alliance

Type Concept Sentence: This alliance is widespread in the southern, central and northern Rocky Mountains, west to the Sierra Nevada and east to the Black Hills and defined by a canopy dominated by *Populus tremuloides*.

OVERVIEW

Scientific Name: *Populus tremuloides* Rocky Mountain Forest & Woodland Alliance

Common Name (Translated Scientific Name): Quaking Aspen Rocky Mountain Forest & Woodland Alliance

Colloquial Name: Rocky Mountain Aspen Forest & Woodland

Type Concept: This alliance is widespread in the montane and subalpine zones Rocky Mountains and adjacent regions, including the Sierra Nevada and Black Hills. Stands are found on a variety of landscape positions, but are consistently in mesic habitats. Stands in this alliance often originate following disturbance. The dominant species of the canopy is *Populus tremuloides*. Scattered conifer trees such as *Pseudotsuga menziesii* and species of *Pinus*, *Picea*, and *Abies* may also be present. Common shrubs include *Acer glabrum*, *Amelanchier alnifolia*, *Artemisia tridentata*, *Juniperus communis*, *Prunus virginiana*, *Rosa woodsii*, *Shepherdia canadensis*, *Symphoricarpos oreophilus*, and the dwarf-shrubs *Mahonia repens* and *Vaccinium myrtillus*. The herbaceous layer may be lush and diverse. Common graminoids may include *Bromus carinatus*, *Calamagrostis rubescens*, *Carex siccata* (= *Carex foenea*), *Carex geyeri*, *Carex rossii*, *Elymus glaucus*, *Elymus trachycaulus*, *Festuca thurberi*, and *Hesperostipa comata* (= *Stipa comata*). Associated forbs may include *Achillea millefolium*, *Eucephalus engelmannii* (= *Aster engelmannii*), *Delphinium x occidentale*, *Geranium viscosissimum*, *Heracleum sphondylium*, *Ligusticum filicinum*, *Lupinus argenteus*, *Osmorhiza berteroi* (= *Osmorhiza chilensis*), *Pteridium aquilinum*, *Rudbeckia occidentalis*, *Thalictrum fendleri*, *Valeriana occidentalis*, *Wyethia amplexicaulis*, and many others. Elevations generally range from 1525 to 3050 m (5000-10,000 feet), but occurrences can be found at lower elevations in some regions. Topographic positions are variable, but occurrences tend to occupy cooler, moist aspects.

Classification Comments: This alliance may eventually be split into two or more alliances based on floristics or regional characteristics.

Internal Comments: MEH 1-14: AB, AZ, BC, CA, CO, ID, MT, NM, OR, SD, TX?, UT, WA, WY added & MB, ON, SK removed.

Other Comments:

Similar NVC Types:

- A3209 *Betula papyrifera* - *Populus tremuloides* - *Quercus macrocarpa* Forest Alliance

Diagnostic Characteristics: Highly variable and widely distributed alliance is characterized by stands dominated by the broad-leaved deciduous tree *Populus tremuloides*. Coniferous species may be present but not codominant. Physiognomy varies from open woodlands to dense forests. Understories are dominated by a combination of broad-leaved deciduous shrubs, evergreen shrubs, grasses and occasionally forbs.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a moderately dense to dense tree canopy dominated by cold-deciduous broad-leaved trees (5-20 m tall). Evergreen needle-leaved trees may be present, but do not codominate the tree canopy. The understory is variable. Sparse to dense, tall- and short-shrub layers may be present and are typically dominated by deciduous

broad-leaved species; however, a scale-leaved short shrub dominates the understory of some stands. Sparse to dense tall or short herbaceous layers may also be present and may be dominated by perennial forbs or graminoids.

Floristics: *Populus tremuloides* is typically the sole dominant canopy tree, and stands may have open to closed cover. Other canopy associates may include *Abies lasiocarpa*, *Picea engelmannii*, *Populus angustifolia*, *Populus balsamifera*, and *Pseudotsuga menziesii*. Common shrubs include *Acer glabrum*, *Amelanchier alnifolia*, *Artemisia tridentata*, *Juniperus communis*, *Mahonia repens*, *Prunus virginiana*, *Rosa woodsii*, *Shepherdia canadensis*, *Symphoricarpos oreophilus*, and *Vaccinium myrtillus*. The herbaceous layer may be lush and diverse. Common graminoids may include *Bromus carinatus*, *Calamagrostis rubescens*, *Carex siccata* (= *Carex foenea*), *Carex geyeri*, *Carex rossii*, *Elymus glaucus*, *Elymus trachycaulus*, *Festuca thurberi*, and *Hesperostipa comata* (= *Stipa comata*). Associated forbs may include *Achillea millefolium*, *Eucephalus engelmannii* (= *Aster engelmannii*), *Delphinium x occidentale*, *Geranium viscosissimum*, *Heracleum sphondylium*, *Ligusticum filicinum*, *Lupinus argenteus*, *Osmorhiza berteroi* (= *Osmorhiza chilensis*), *Pteridium aquilinum*, *Rudbeckia occidentalis*, *Thalictrum fendleri*, *Valeriana occidentalis*, *Wyethia amplexicaulis*, and many others. Exotic grasses, such as the perennial *Poa pratensis* and the annual *Bromus tectorum*, are often common in stands disturbed by grazing.

ENVIRONMENT & DYNAMICS

Environmental Description: Sites include variable topographic positions with slopes ranging from level to steep with variable aspects, with occurrences on warmer aspects at higher elevations and cooler aspects are lower elevations. The soils are typically deep and well-developed with rock often absent from the soil. Soil texture ranges from sandy loam to clay loam. Parent materials are variable and may include sedimentary, metamorphic or igneous rocks, but this vegetation appears to grow best on limestone, basalt, and calcareous or neutral shales (Mueggler 1988).

Dynamics: Stands in this alliance often originate and are likely maintained by stand-replacing disturbances such as crown fire, disease and windthrow, or cutting by man or beaver. The stems of these thin-barked, clonal trees are easily killed by surface fires, but they can quickly and vigorously resprout in densities of up to 30,000 stems per hectare (Knight 1993). The stems are relatively short-lived (100-150 years), and the stand will succeed to longer-lived conifer forest if undisturbed. Stands are favored by fire in the conifer zone (Mueggler 1988). With adequate disturbance a clone may live many centuries. Although *Populus tremuloides* produces abundant seeds, seedling survival is rare because of the long moist conditions required to establish are rare in the habitats that it occurs in. Superficial soil drying will kill seedlings (Knight 1994).

DISTRIBUTION

Geographic Range: This alliance is more common in the southern and central Rocky Mountains, but occurs in the montane and subalpine zones throughout much of the western U.S., south into northern Mexico and north into Canada. An eastern extension occurs along the Rocky Mountains foothill front, in mountain "islands" in Montana (Big Snowy and Highwood mountains), the Black Hills of South Dakota and also west to the Sierra Nevada.

Nations: CA, US

States/Provinces: AB, AZ, BC, CA, CO, ID, MT, NM, NV, OR, SD, TX?, UT, WA, WY

TNC Ecoregions [optional]: 11:C

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: NPS (Great Basin)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEGLO02816 *Populus tremuloides* / *Amelanchier alnifolia* - *Symphoricarpos oreophilus* / Mixed Graminoid Forest
- CEGLO00614 *Populus tremuloides* / *Symphoricarpos oreophilus* / *Festuca thurberi* Forest
- CEGLO00575 *Populus tremuloides* / *Calamagrostis rubescens* Forest
- CEGLO00611 *Populus tremuloides* / *Symphoricarpos oreophilus* / *Bromus carinatus* Forest
- CEGLO00583 *Populus tremuloides* / *Corylus cornuta* Forest
- CEGLO00619 *Populus tremuloides* / *Thalictrum fendleri* Forest
- CEGLO00620 *Populus tremuloides* / *Vaccinium myrtillus* Forest
- CEGLO00586 *Populus tremuloides* / *Heracleum sphondylium* Forest
- CEGLO00568 *Populus tremuloides* / *Amelanchier alnifolia* - *Symphoricarpos oreophilus* / Tall Forbs Forest
- CEGLO00585 *Populus tremuloides* / *Festuca thurberi* Forest
- CEGLO00593 *Populus tremuloides* / *Lupinus argenteus* Forest

CBR alliances

- CEGLO00603 *Populus tremuloides* / *Rudbeckia occidentalis* Forest
- CEGLO00613 *Populus tremuloides* / *Symphoricarpos oreophilus* / *Carex rossii* Forest
- CEGLO00567 *Populus tremuloides* / *Amelanchier alnifolia* - *Symphoricarpos oreophilus* / *Calamagrostis rubescens* Forest
- CEGLO03146 *Populus tremuloides* / *Artemisia tridentata* / *Monardella odoratissima* - *Kelloggia galioides* Forest
- CEGLO00607 *Populus tremuloides* / *Spiraea betulifolia* Forest
- CEGLO00597 *Populus tremuloides* / *Pteridium aquilinum* Forest
- CEGLO00592 *Populus tremuloides* / *Lonicera involucrata* Forest
- CEGLO00602 *Populus tremuloides* / *Rubus parviflorus* Forest
- CEGLO00588 *Populus tremuloides* / *Juniperus communis* / *Carex geyeri* Forest
- CEGLO00579 *Populus tremuloides* / *Carex geyeri* Forest
- CEGLO00580 *Populus tremuloides* / *Carex rossii* Forest
- CEGLO00578 *Populus tremuloides* / *Carex siccata* Forest
- CEGLO00606 *Populus tremuloides* / *Shepherdia canadensis* Forest
- CEGLO00572 *Populus tremuloides* / *Artemisia tridentata* Forest
- CEGLO00610 *Populus tremuloides* / *Symphoricarpos oreophilus* Forest
- CEGLO00564 *Populus tremuloides* / *Amelanchier alnifolia* Forest
- CEGLO00565 *Populus tremuloides* / *Amelanchier alnifolia* / *Pteridium aquilinum* Forest
- CEGLO00589 *Populus tremuloides* / *Juniperus communis* / *Lupinus argenteus* Forest
- CEGLO05932 *Populus tremuloides* / *Physocarpus monogynus* Forest
- CEGLO00581 *Populus tremuloides* / *Ceanothus velutinus* Forest
- CEGLO00617 *Populus tremuloides* / *Symphoricarpos oreophilus* / *Wyethia amplexicaulis* Forest
- CEGLO05624 *Populus tremuloides* / *Prunus virginiana* Central Rocky Mountain Forest
- CEGLO00587 *Populus tremuloides* / *Juniperus communis* Forest
- CEGLO00563 *Populus tremuloides* / *Acer glabrum* Forest
- CEGLO00598 *Populus tremuloides* / *Quercus gambelii* / *Symphoricarpos oreophilus* Forest
- CEGLO00608 *Populus tremuloides* / *Hesperostipa comata* Forest
- CEGLO00566 *Populus tremuloides* / *Amelanchier alnifolia* - *Symphoricarpos oreophilus* / *Bromus carinatus* Forest
- CEGLO00615 *Populus tremuloides* / *Symphoricarpos oreophilus* / Tall Forbs Forest
- CEGLO00618 *Populus tremuloides* / Tall Forbs Forest
- CEGLO00595 *Populus tremuloides* / *Heracleum maximum* Forest
- CEGLO00605 *Populus tremuloides* / *Sambucus racemosa* Forest
- CEGLO00571 *Populus tremuloides* / *Amelanchier alnifolia* / *Thalictrum fendleri* Forest
- CEGLO00945 *Populus tremuloides* / *Physocarpus malvaceus* - *Amelanchier alnifolia* Scree Woodland
- CEGLO00594 *Populus tremuloides* / *Mahonia repens* Forest
- CEGLO00604 *Populus tremuloides* / *Salix scouleriana* Forest
- CEGLO00946 *Populus tremuloides* / *Symphoricarpos albus* / *Elymus glaucus* Woodland
- CEGLO00569 *Populus tremuloides* / *Amelanchier alnifolia* - *Symphoricarpos oreophilus* / *Thalictrum fendleri* Forest
- CEGLO00570 *Populus tremuloides* / *Amelanchier alnifolia* / Tall Forbs Forest
- CEGLO00612 *Populus tremuloides* / *Symphoricarpos oreophilus* / *Calamagrostis rubescens* Forest
- CEGLO00616 *Populus tremuloides* / *Symphoricarpos oreophilus* / *Thalictrum fendleri* Forest
- CEGLO00591 *Populus tremuloides* / *Ligusticum filicinum* Forest
- CEGLO00622 *Populus tremuloides* / *Wyethia amplexicaulis* Forest
- CEGLO00573 *Populus tremuloides* / *Bromus carinatus* Forest
- CEGLO00609 *Populus tremuloides* / *Symphoricarpos albus* Forest
- CEGLO05848 *Populus tremuloides* / *Symphoricarpos occidentalis* Forest
- CEGLO05849 *Populus tremuloides* / *Urtica dioica* Forest
- CEGLO03748 *Populus tremuloides* / Invasive Perennial Grasses Forest
- CEPS009589 *Populus tremuloides* / *Ribes* spp. Woodland [Park Special]
- CEGLO03145 *Populus tremuloides* / *Monardella odoratissima* Forest

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/01/08

REFERENCES

References: Faber-Langendoen et al. 2017b, Knight 1994, Mueggler 1988

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

G222. Rocky Mountain Subalpine-Montane Aspen Forest & Woodland

A4078. Populus tremuloides Southern Rocky Mountain Woodland & Scrub Alliance

Type Concept Sentence: This alliance is known only from Grand Canyon National Park and El Malpais National Monument and characterized by open woodland or regenerating stands of *Populus tremuloides*.

OVERVIEW

Scientific Name: *Populus tremuloides* Southern Rocky Mountain Woodland & Scrub Alliance

Common Name (Translated Scientific Name): Quaking Aspen Southern Rocky Mountain Woodland & Scrub Alliance

Colloquial Name: Southern Rocky Mountain Quaking Aspen Woodland & Scrub

Type Concept: Communities of this alliance are characterized by open woodlands or regenerating stands of *Populus tremuloides*. Conifers such as *Pinus ponderosa* and *Pseudotsuga menziesii* from the surrounding mixed conifer stands can be interspersed in the canopy. In the open canopy, shrub cover is often dense and may include *Ceanothus fendleri*, *Holodiscus dumosus*, *Rhus trilobata*, *Ribes leptanthum*, *Robinia neomexicana*, and *Symphoricarpos oreophilus*. The herbaceous layer ranges from sparse to dense and is typically graminoid-dominated. Species include *Carex rossii*, *Carex siccata*, *Piptatheropsis micrantha* (= *Piptatherum micranthum*), and *Poa fendleriana*. This alliance is known only from Grand Canyon National Park and El Malpais National Monument on plateaus and gentle to steep slopes. Elevations range from to 2350-2690 m. Communities occur on all aspects and slopes may be gentle to steep.

Classification Comments: This alliance is provisional and represents stands of *Populus tremuloides* that occupy sites with conditions that prohibit the development of forest vegetation or burned areas.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Open woodland stands dominated by *Populus tremuloides* or post-burn shrubland vegetation where *Populus tremuloides* was the dominant. Shrub vegetation tends to be dense as a result of the open canopy. The herbaceous component is typically graminoid-dominated and may be open to dense. Forbs do not contribute substantial cover.

VEGETATION

Physiognomy and Structure: Communities in this alliance are variable in structure and may be short-statured woodlands with 40-60% cover not exceeding 5 m in height. Other stands are found in post-burn areas where *Populus tremuloides* was the dominant tree. Shrub cover is dense in these open stands and in post-burn areas shrubs form thickets and are the dominant vegetation.

Floristics: Communities of this alliance are characterized by open woodlands or regenerating stands of *Populus tremuloides*. Conifers such as *Pinus ponderosa* and *Pseudotsuga menziesii* from the surrounding mixed conifer stands can be interspersed in the canopy. Trees typically do not exceed 5 m in the height or 60% in cover. In the open canopy, shrub cover is often dense and may include *Ceanothus fendleri*, *Holodiscus dumosus*, *Rhus trilobata*, *Ribes leptanthum*, *Robinia neomexicana*, and *Symphoricarpos oreophilus*. The herbaceous layer ranges from sparse to dense and is typically graminoid-dominated. Species include *Carex rossii*, *Carex siccata*, *Piptatheropsis micrantha* (= *Piptatherum micranthum*), and *Poa fendleriana*. Forbs are typically present but are not dominant. Associates may include *Achillea millefolium*, *Arabis fendleri* (= *Boechera fendleri*), *Arenaria lanuginosa*, *Artemisia campestris*, *Chamerion angustifolium*, *Chenopodium* sp., *Conyza canadensis*, *Erigeron divergens*, *Erigeron formosissimus*, *Fragaria vesca*, *Gayophytum diffusum*, *Lotus utahensis*, *Machaeranthera canescens*, *Packera neomexicana* var. *mutabilis*, *Pseudognaphalium macounii*, *Pseudostellaria jamesiana*, and *Solidago velutina*.

ENVIRONMENT & DYNAMICS

Environmental Description: Positions include plateaus and side slopes. Elevations range from to 2350-2690 m. Communities occur on all aspects, and slopes may be gentle to steep. Some sites include areas that have experienced high-intensity fires. Substrates include silty loams, sandy loams or cinder.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is known only from Grand Canyon National Park in Arizona and El Malpais National Monument in New Mexico.

Nations: US

States/Provinces: AZ, NM

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEGLO05503 *Populus tremuloides* / *Robinia neomexicana* Woodland
- CEGLO05034 *Populus tremuloides* / Mixed Shrubs / Cinder Woodland
- CEGLO05504 *Populus tremuloides* - *Ceanothus fendleri* / *Carex* spp. Scrub

AUTHORSHIP

Primary Concept Source: Muldavin et al. (2013c); Kearsley et al. (2013)

Author of Description: M. E. Hall

Acknowledgments:

Version Date: 2014/01/07

REFERENCES

References: Faber-Langendoen et al. 2017b, Kearsley et al. 2015, Muldavin et al. 2013c

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

1.B.2.Nb.5.h. M020 Rocky Mountain Subalpine-High Montane Conifer Forest

G224. Intermountain Basins Subalpine Limber Pine - Bristlecone Pine Woodland

Type Concept Sentence: This group consists of open woodlands ranging from krummholz to over 10 m in height with *Pinus flexilis* and/or *Pinus longaeva* as the dominant conifer with an herbaceous layer that is typically sparse. It is commonly found on steep slopes and ridges between 2530 and 3600 m (8300-12,000 feet) elevation, and extends from the Mojave Desert and eastern Sierra Nevada across the central Great Basin to the high plateaus of southwestern and central Utah.

OVERVIEW

Scientific Name: *Pinus flexilis* - *Pinus longaeva* Intermountain Basins Subalpine Woodland Group

Common Name (Translated Scientific Name): Limber Pine - Great Basin Bristlecone Pine Intermountain Basins Subalpine Woodland Group

Colloquial Name: Intermountain Basins Limber Pine Forest & Woodland

Type Concept: This group extends from the Mojave Desert and eastern Sierra Nevada across the central Great Basin to the high plateaus of southwestern and central Utah. These open woodlands are typically found on high-elevation ridges and rocky slopes above subalpine forests and woodlands, sometimes extending down into the montane zone. Site are harsh, exposed to desiccating winds with rocky substrates and a short growing season that limit plant growth. Parent materials include dolomitic, limestone or granitic rocks. Occurrences can be found on all aspects but are more common on southwestern exposures on steep convex slopes and ridges between 2530 and 3600 m (8300-12,000 feet) elevation. Vegetation is characterized by a typically open tree canopy (<25% cover) with heights ranging from 1-2 m (krummholz) to over 10 m. *Pinus flexilis* and/or *Pinus longaeva* dominate the tree canopy, alone or in combination. *Pinus longaeva* stands tend to occur at higher elevation with less mixed canopies. Other trees present to codominant include *Picea engelmannii*, *Pseudotsuga menziesii*, *Populus tremuloides*, or *Abies concolor*. In the Sierra Nevada stands, *Pinus albicaulis*, *Pinus balfouriana*, and/or *Pinus contorta* var. *murrayana* may be present. Understory layers, if present, are sparse to moderately dense and composed of xeric shrubs, graminoids and cushion plants. Characteristic shrubs include *Arctostaphylos patula*, *Artemisia arbuscula*, *Artemisia tridentata* ssp. *vaseyana*, *Ericameria discoidea*, *Juniperus communis*, *Ribes cereum*, and *Ribes montigenum*. *Cercocarpus intricatus*, *Cercocarpus ledifolius*, or *Chrysolepis sempervirens* frequently occur in stands in the Sierra Nevada. The herbaceous layer is typically sparse. Associated herbaceous species are diverse given the wide elevational range, with alpine species occurring near the upper treeline and montane and subalpine species below.

Classification Comments: Rocky Mountain Subalpine-Montane Limber Pine - Bristlecone Pine Woodland Group (G221) is similar to Intermountain Basins Subalpine Limber Pine - Bristlecone Pine Woodland Group (G224) because *Pinus flexilis* can dominate stands; however, the groups are geographically separate. Intermountain Basins Subalpine Limber Pine - Bristlecone Pine Woodland Group (G224) is restricted to the eastern Sierra Nevada and ranges into the northern Mojave Desert and Great Basin, extending east to the high plateaus of southwestern and central Utah, roughly following the range of distribution for *Pinus longaeva*, and Rocky Mountain Subalpine-Montane Limber Pine - Bristlecone Pine Woodland Group (G221) is limited to the Rocky Mountains extending west into the southern Colorado Plateau.

~Rocky Mountain Foothill-Rock Outcrop Limber Pine - Juniper Woodland Group (G209) is also similar to Intermountain Basins Subalpine Limber Pine - Bristlecone Pine Woodland Group (G224) in that stands may be dominated by *Pinus flexilis*, but are geographically separate, occurring mostly in isolated low mountains, hills, and escarpments of the western Great Plains where soil moisture is slightly higher than surrounding grasslands, and lower foothills in northern Colorado, Wyoming and Montana. The foothill stands are typically juniper-dominated and occur below the zone of continuous *Pinus ponderosa* or *Pseudotsuga menziesii* woodlands and forests.

Stands may occur adjacent to Rocky Mountain Subalpine Dry-Mesic Spruce - Fir Forest & Woodland Group (G219) and Southern Rocky Mountain White Fir - Douglas-fir Dry Forest Group (G226), but are distinguished by dominance of *Pinus flexilis* or *Pinus aristata*.

Similar NVC Types:

- G209 Rocky Mountain Foothill-Rock Outcrop Limber Pine - Juniper Woodland
- G221 Rocky Mountain Subalpine-Montane Limber Pine - Bristlecone Pine Woodland

Diagnostic Characteristics: *Pinus flexilis* and/or *Pinus longaeva* are the dominant and diagnostic species of this woodland group. The understory is variable, but is characterized by xeric shrubs and grasses found in subalpine zones in the Sierra Nevada and ranges of the Great Basin.

VEGETATION

Physiognomy and Structure: Conifer-dominated woodlands with a typically open tree canopy that is often patchy. Shrub and herbaceous layers, if present, generally have low cover as substrates are characteristically rocky. Higher elevation stands often have cushion plants present.

Floristics: This woodland group is characterized by a typically open tree canopy (<25% cover) with heights ranging from 1-2 m (krummholz) to over 10 m. *Pinus flexilis* and/or *Pinus longaeva* dominate the tree canopy, alone or in combination. *Pinus longaeva* stands tend to occur at higher elevation with less mixed canopies. Other trees present to codominant include *Picea engelmannii*, *Pseudotsuga menziesii*, *Populus tremuloides*, or *Abies concolor*. In the Sierra Nevada stands, *Pinus albicaulis*, *Pinus balfouriana*, and/or *Pinus contorta* var. *murrayana* may be present. Scattered *Pinus monophylla* may also be present in lowest elevation stands. Understory layers, if present, are sparse to moderately dense and composed of xeric shrubs, graminoids and cushion plants. Characteristic shrubs include *Arctostaphylos patula*, *Artemisia arbuscula*, *Arctostaphylos patula*, *Artemisia tridentata* ssp. *vaseyana*, *Ericameria discoidea*, *Juniperus communis*, *Ribes cereum*, and *Ribes montigenum*. *Acer glabrum*, *Cercocarpus intricatus*, *Cercocarpus ledifolius*, and *Chrysolepis sempervirens* frequently occur in stands in the Sierra Nevada. The herbaceous layer is typically sparse. Associated herbaceous species are diverse given the wide elevational range, with alpine species occurring near the upper treeline and montane and subalpine species below. Common species may include *Antennaria rosea*, *Aquilegia scopulorum*, *Arabis drummondii*, *Arenaria congesta*, *Arenaria kingii*, *Astragalus kentrophyta*, *Astragalus platytropis*, *Calamagrostis rubescens*, *Carex rossii*, *Cirsium eatonii*, *Cymopterus cinerarius*, *Cymopterus nivalis*, *Elymus elymoides*, *Eriogonum gracilipes*, *Eriogonum holmgrenii*, *Eriogonum ovalifolium*, *Erigeron pygmaeus*, *Erigeron tener*, *Festuca brachyphylla*, *Koeleria macrantha*, *Linanthus pungens* (= *Leptodactylon pungens*), *Packera wernerifolia*, *Penstemon leiophyllus*, *Poa fendleriana*, *Phlox pulvinata*, *Trifolium gymnocarpon*, and *Trisetum spicatum*. *Selaginella watsonii* is common in some high-elevation stands.

ENVIRONMENT & DYNAMICS

Environmental Description: The bristlecone pine-limber pine woodland group denotes some of the driest and windiest sites capable of supporting trees other than *Juniperus*. Sites are typically xeric on exposed, windswept rocky slopes and ridges. It can be found on all aspects but is more common on southwestern exposures on steep convex slopes and ridges between 2530 and 3600 m (8300-12,000 feet) elevation. It commonly represents a topographic or edaphic climax within the *Abies lasiocarpa* and upper *Pseudotsuga menziesii* zones.

This group occurs on a variety of substrates but is best represented on colluvium derived from limestone and dolomite or Tertiary and Cretaceous sandstone. A characteristic feature is the predominance of bare soil; almost all sites have between 25 and 50% bare ground. Consequently, litter accumulations are slight and intermittent. Most sites are droughty, with gravel in the shallow subsurface horizons. Surface textures vary depending upon parent material. Steep slopes, high-intensity summer convection storms, and only partial ground cover for interception often result in severe sheet erosion of fine particles. This usually leads to the

development of gravel pavements. Additional erosion can be expected from wind action. High insolation and wind during the winter usually result in reduced snowpack accumulations. However, soils can be expected to freeze.

The sparsity of shrubs, forbs, grasses, and litter in addition to the widely spaced trees usually means that fire does not carry easily. Individual trees may be ignited from lightning, but seldom is an entire occurrence burned.

Dynamics: Both *Pinus longaeva* and *Pinus flexilis* are slow-growing, long-lived trees that are intolerant of shade. *Pinus longaeva* may attain nearly 4900 years in age and 12 m in height, whereas *Pinus flexilis* may live 1000 years and attain 18 m in height. Bristlecone pine branches retain needles for as long as 30 years, whereas limber pine needles are lost after several years. Bristlecone pine trees produce dense, resinous wood that is resistant to rot and disease. Mature trees have massive, contorted trunks with mostly dead and gnarled wood. (Sawyer et al. 2009).

Natural regeneration of both species appears to be closely associated with caching of the large wingless seeds, primarily by Clark's nutcracker (*Nucifraga columbiana*) (Lanner and Vander Wall 1980). Germination of cached seeds often results in the multi-stemmed clumps characteristic of these sites, although the species may produce multiple stems from boles damaged near the ground. Germination and rooting will sometimes be restricted to crevices in rock. *Pinus longaeva* has smaller winged seeds and should be wind-disseminated. However, caching by nutcrackers does take place, especially when other *Pinus* species are also available (Dr. R. Lanner pers. comm.). The longevity of individuals enables stands to persist for centuries between times of favorable seedling establishment (Keeley and Zedler 1998). Fires seldom destroy this group due to the sparse nature of the canopy cover of trees and abundant bare ground.

DISTRIBUTION

Geographic Range: This woodland group extends from mountains ranges in the Mojave Desert and Sierra Nevada across the Great Basin to the high plateaus of southwestern Utah, central Wasatch and extreme western Uinta Mountains.

Spatial Scale & Pattern [optional]: Large patch

Nations: CA, US

States/Provinces: CA, NV, UT

TNC Ecoregions [optional]: 9:?, 11:C, 12:C, 18:C, 19:C

USFS Ecoregions (2007): 322A:CC, 341A:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342B:CC, 342J:C?, M261E:CC, M261G:C?, M331D:PP, M341A:CC, M341D:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > Bristlecone Pine Forest (#86400) (Holland 1986b)
- > Bristlecone Pine Series (Sawyer and Keeler-Wolf 1995)
- < Bristlecone Pine: 209 (Eyre 1980)
- > Limber Pine Forest (#86700) (Holland 1986b)
- > Limber Pine Series (Sawyer and Keeler-Wolf 1995)
- >< Limber Pine: 219 (Eyre 1980)

LOWER LEVEL UNITS

Alliances:

- A0518 *Pinus longaeva* Forest & Woodland Alliance
- A2035 *Pinus flexilis* Intermountain Basins Forest & Woodland Alliance

AUTHORSHIP

Primary Concept Source: R.F. Holland (1986b)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 03/17/2010

Classif Resp Region: West

Internal Author: KAS 3-10, mod. GK 12-15

REFERENCES

References: Eyre 1980, Faber-Langendoen et al. 2017a, Graybosch and Buchanan 1983, Holland 1986b, Holland and Keil 1995, Keeley and Zedler 1998a, LaMarche and Mooney 1972, Lanner and Vander Wall 1980, Lanner pers. comm., Nachlinger and Reese 1996, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

G224. Intermountain Basins Subalpine Limber Pine - Bristlecone Pine Woodland

A2035. *Pinus flexilis* Intermountain Basins Forest & Woodland Alliance

Type Concept Sentence: Forests and woodlands of the central Great Basin, Columbia Plateau, middle and southern Rocky Mountains and Wyoming Basins solely dominated or codominated by the evergreen needle-leaved tree *Pinus flexilis*.

OVERVIEW

Scientific Name: *Pinus flexilis* Intermountain Basins Forest & Woodland Alliance

Common Name (Translated Scientific Name): Limber Pine Intermountain Basins Forest & Woodland Alliance

Colloquial Name: Intermountain Basins Limber Pine Forest & Woodland

Type Concept: These forests and woodlands occur from the central Great Basin, east and north to the Columbia Plateau, middle and southern Rocky Mountains and Wyoming Basins. Canopies are solely dominated or codominated by the evergreen needle-leaved tree *Pinus flexilis*. Other trees present to codominant include *Abies concolor*, *Picea engelmannii*, *Populus tremuloides*, and *Pseudotsuga menziesii*. The understory is sparse to moderately dense and composed of xeric shrubs, graminoids and cushion plants. The most common dominant shrubs include *Arctostaphylos patula*, *Cercocarpus ledifolius*, and *Symphoricarpos oreophilus*. Herbaceous layers are sparse but, given the broad geographic range of these forests and woodlands, are highly variable. The most common species are graminoids such as *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Bouteloua gracilis*, *Calamagrostis purpurascens*, *Carex rossii*, *Festuca campestris*, *Festuca idahoensis*, *Koeleria macrantha*, *Leucopoa kingii* (= *Festuca kingii*), and *Pseudoroegneria spicata*. Scattered forbs may include species of *Achillea*, *Antennaria*, *Arenaria*, *Arnica*, *Astragalus*, *Erigeron*, *Eriogonum*, *Hymenopappus*, *Hymenoxys*, *Liatris*, *Sedum*, *Solidago*, and *Thermopsis*. Sites include high-elevation ridges and rocky slopes above subalpine forests and woodlands, sometimes extending down into the montane zone. They are harsh, exposed to desiccating winds with rocky substrates and a short growing season that limit plant growth. Parent materials include dolomitic, limestone or granitic rocks. Occurrences can be found on all aspects but are more common on southwestern exposures on steep convex slopes and ridges between 2530 and 3600 m (8300-12,000 feet) elevation.

Classification Comments: It may be difficult to determine which tree species are dominant in a mixed, montane or subalpine forest stand, especially when *Pinus flexilis* is seral on *Pseudotsuga menziesii* habitat type sites. Some stands included in this alliance are too sparse to be classified as woodlands, especially those growing on lava (Eggler 1941).

Internal Comments:

Other Comments:

Similar NVC Types: This alliance is similar to *Pinus flexilis* Rocky Mountain Woodland Alliance (A0540), but distinguished by having distributions in the intermountain basins and ranges of the West rather than the Rocky Mountains.

- A0540 *Pinus flexilis* Rocky Mountain Woodland Alliance: of the Rocky Mountains.

Diagnostic Characteristics: *Pinus flexilis* is the dominant and diagnostic species of this woodland group. The understory is variable, but is characterized by xeric shrubs and grasses found in subalpine zones in the intermountain basins and ranges of the West.

VEGETATION

Physiognomy and Structure: The structure of vegetation included in this alliance is variable and has a tree canopy that ranges from very open to dense with heights from to 3-20 m tall. The canopy is dominated by evergreen needle-leaved trees although broad-leaved deciduous species may codominate on some sites. Sparse to moderately sparse tall- and short-shrub layers may be present (1-3 m and <1 m tall, respectively). If present, both shrub layers may be dominated by broad-leaved or microphyllous deciduous shrubs. A sparse to moderately dense herbaceous layer dominated by perennial graminoids is present. Perennial forbs have sparse cover. Annual forbs and grasses may be seasonally present.

Floristics: Vegetation of this alliance has an open to moderately dense canopy 3-20 m tall. The stands are solely dominated or codominated by the evergreen needle-leaved tree *Pinus flexilis*. Other trees species that may be present to codominant vary by geography and elevation zones throughout the woodland's range. Other trees present to codominant include *Abies concolor*, *Picea engelmannii*, *Populus tremuloides*, and *Pseudotsuga menziesii*. The understory is sparse to moderately dense and composed of xeric shrubs, graminoids and cushion plants. The most common dominant shrubs include *Arctostaphylos patula*, *Cercocarpus ledifolius*, and *Symphoricarpos oreophilus*. Other characteristic shrubs may include *Arctostaphylos uva-ursi*, *Artemisia arbuscula*, *Artemisia nova*, *Artemisia tridentata*, *Jamesia americana*, *Juniperus communis*, *Mahonia repens*, *Purshia tridentata*, *Rhus trilobata*, *Shepherdia canadensis*, and *Yucca glauca*. Herbaceous layers are sparse but, given the broad geographic range of these forests and woodlands, are highly variable. The most common species are graminoids such as *Achnatherum hymenoides* (= *Oryzopsis hymenoides*),

Buteloua gracilis, *Calamagrostis purpurascens*, *Carex rossii*, *Festuca campestris*, *Festuca idahoensis*, *Koeleria macrantha*, *Leucopoa kingii* (= *Festuca kingii*), and *Pseudoroegneria spicata*. Scattered forbs may include species of *Achillea*, *Antennaria*, *Arenaria*, *Arnica*, *Astragalus*, *Erigeron*, *Eriogonum*, *Hymenopappus*, *Hymenoxys*, *Liatris*, *Sedum*, *Solidago*, and *Thermopsis*.

ENVIRONMENT & DYNAMICS

Environmental Description: These forests and woodlands occur throughout a great portion of the Intermountain West between 2530 and 3600 m elevation. Sites are xeric, harsh and exposed to desiccating winds with rocky substrates and a short growing season that limit plant growth. Parent materials include dolomitic, limestone or granitic rocks. Occurrences can be found on all aspects but are more common on southwestern exposures on steep convex slopes and ridges. A characteristic of these forests and woodlands is the prominence of bare ground and, therefore, litter accumulation is low. Steep slopes and often low ground cover often result in high rates of surface erosion.

Dynamics: Although some of the conifers that are typically codominant in *Pinus flexilis* stands are late-successional species, they are not likely to displace *Pinus flexilis*. This is because most of these stands occur on harsh sites where *Pinus flexilis* is more competitive than most other conifer species. These stands are generally considered to be topographic or edaphic "climax" stands (Cooper 1975, Eyre 1980). Birds and small mammals often eat and cache the large, wingless pine seeds. Most important is the Clark's nutcracker, which can transport the seeds long distances and cache them on exposed windswept sites (Lanner and Vander Wall 1980). This results in the regeneration of pines in clumps from forgotten caches (Eyre 1980, Steele et al. 1983).

DISTRIBUTION

Geographic Range: Stands included in this forest and woodland alliance occur intermittently throughout the intermountain regions of the central Great Basin, Columbia Plateau, middle and southern Rocky Mountains and Wyoming Basins.

Nations: US

States/Provinces: CA, ID, MT, NV, UT, WY

TNC Ecoregions [optional]: 11:C, 12:C, 16:C

USFS Ecoregions (2007): 341D:CC, 341Ff:CCC, M261E:CC, M262B:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Pinus flexilis* / *Agropyron spicatum* Habitat Type (Girard et al. 1989)
- = *Pinus flexilis* (Limber pine woodland) Alliance (Sawyer et al. 2009) [87.160.00]
- ? *Pinus flexilis* Habitat Type (USFS 1992)
- ? *Pinus flexilis* Habitat Type (Steele et al. 1983)
- ? *Pinus flexilis* Series (Girard et al. 1989)
- ? *Pinus flexilis* Series (Johnston 1987)
- = *Pinus flexilis* Woodland Alliance (Evens et al. 2014)
- = *Pinus flexilis* Woodland Alliance (CNPS 2017) [87.160.00]
- >< Limber Pine Forest (#86700) (Holland 1986b)
- ? Limber Pine Woodland (Barrows et al. 1977) [included in Desert Montane and Forests and Woodlands]
- >< Limber Pine: 219 (Eyre 1980)
- = Limber pine series (Sawyer and Keeler-Wolf 1995)
- >< Southern California Subalpine Forest (#86500) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEGLO05434 *Pinus flexilis* - (*Populus tremuloides*) / *Arctostaphylos patula* Forest
- CEPP009588 *Pinus flexilis* / *Artemisia tridentata* Woodland
- CEGLO05321 *Pinus flexilis* / *Symphoricarpos oreophilus* Woodland
- CEGLO00804 *Pinus flexilis* / *Cercocarpus ledifolius* Woodland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Barney 1980, Barrows et al. 1977, CNPS 2017, Cheng 2004, Cooper 1975, Egger 1941, Evens et al. 2014, Eyre 1980, Faber-Langendoen et al. 2017b, Girard et al. 1989, Griffin and Critchfield 1972, Hanes 1976, Holland 1986b, Johnson 2001, Johnston 1987, Keeler-Wolf et al. 2003a, Klein and Evens 2006, Lanner and Vander Wall 1980, Paysen et al. 1980, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Steele 1990, Steele et al. 1983, Taylor 1979, Thomas et al. 2004, Thorne 1977, Thorne 1982, Thorne et al. 2007, USFS 1992, Vasek and Thorne 1977

1. Forest & Woodland

1.B.2.Nb. Rocky Mountain Forest & Woodland

G224. Intermountain Basins Subalpine Limber Pine - Bristlecone Pine Woodland

A0518. *Pinus longaeva* Forest & Woodland Alliance

Type Concept Sentence: This widely scattered subalpine forest and woodland alliance occurs on mountain slopes throughout the Great Basin and is solely dominated by *Pinus longaeva*, although some stands may be codominated by *Abies concolor* and *Pinus ponderosa*.

OVERVIEW

Scientific Name: *Pinus longaeva* Forest & Woodland Alliance

Common Name (Translated Scientific Name): Great Basin Bristlecone Pine Forest & Woodland Alliance

Colloquial Name: Great Basin Bristlecone Pine Forest & Woodland

Type Concept: This widely scattered subalpine forest and woodland alliance occurs on mountain slopes throughout the Great Basin. Canopies are typically solely dominated by *Pinus longaeva*, although some stands may be codominated by *Abies concolor* (= *var. concolor*) and *Pinus ponderosa*. Other canopy associates occurring at low cover may include *Juniperus osteosperma*, *Juniperus scopulorum*, *Picea engelmannii*, *Pinus edulis*, *Pinus flexilis*, *Populus tremuloides*, and *Pseudotsuga menziesii*. Shrubs are infrequent to conspicuous. Characteristic shrubs may include *Amelanchier utahensis*, *Arctostaphylos patula*, *Cercocarpus intricatus*, *Ericameria discoidea*, *Ericameria nauseosa*, *Eriogonum corymbosum*, *Purshia tridentata*, and *Ribes montigenum*. The herbaceous is very sparse to open (5-35% cover) and may be dominated by graminoids or forbs. The most common graminoids are *Carex rossii*, *Leymus salinus*, and *Poa fendleriana*. A variety of forbs may be present and may include *Aquilegia scopulorum*, *Arabis drummondii*, *Astragalus platytropis*, *Castilleja nana*, *Cymopterus nivalis*, *Erigeron jonesii*, *Oxytropis oreophila*, *Penstemon leiophyllus var. franciscipennellii*, *Tetranuris acaulis*, *Trifolium gymnocarpon*, and *Trisetum spicatum*. These forests and woodlands grow on all slopes, especially ridges and upper slopes below timberline. They grow on dolomitic, limestone- or granite-derived soils. This woodland may occur under the driest conditions of the California subalpine woodlands. The growing season is limited by drought in the summer and cold in the winter. Precipitation, mostly as snow, falls in the winter. Stands are found between 2600 and 3600 m elevation.

Classification Comments:

Internal Comments: MEH 9-13: CA added.

Other Comments: *Pinus longaeva* is perhaps the longest living species on the planet. Individuals have been found that are more than 4000 years old. Usually, the oldest trees are found on the poorest sites. Plot data exist for California and Nevada stands.

Similar NVC Types:

Diagnostic Characteristics: The alliance is distinguished by an open canopy, typically 10-15 m tall of *Pinus longaeva* trees that range in cover from 15 to 60%. These forests and woodlands are small patch in size and occur near treeline on exposed, windswept positions of the Great Basin.

VEGETATION

Physiognomy and Structure: This rounded-crowned, temperate or subpolar, needle-leaved evergreen forest and woodland forms an open tree canopy less than 18 m in height. Shrubs are infrequent to conspicuous. The herbaceous layer is sparse.

Floristics: Canopies are typically solely dominated by *Pinus longaeva*, although some stands may be codominated by *Abies concolor* (= *var. concolor*) and *Pinus ponderosa*. Canopy cover ranges from 15-60%. Other canopy associates occurring at low cover may include *Juniperus osteosperma*, *Juniperus scopulorum*, *Picea engelmannii*, *Pinus edulis*, *Pinus flexilis*, *Populus tremuloides*, and *Pseudotsuga menziesii*. Shrubs are infrequent to conspicuous. Characteristic shrubs may include *Amelanchier utahensis*, *Arctostaphylos patula*, *Cercocarpus intricatus*, *Ericameria discoidea*, *Ericameria nauseosa*, *Eriogonum corymbosum*, *Juniperus communis*, *Purshia tridentata*, *Ribes cereum*, *Ribes montigenum*, *Rubus idaeus*, and *Symphoricarpos oreophilus*. The herbaceous layer is very sparse to open (5-35% cover) and may be dominated by graminoids or forbs. The most common graminoids are *Carex rossii*, *Leymus salinus*, and *Poa fendleriana*. A variety of forbs may be present and may include *Aquilegia scopulorum*, *Arabis*

drummondii, *Astragalus platytropis*, *Castilleja nana*, *Cymopterus nivalis*, *Erigeron jonesii*, *Oxytropis oreophila*, *Penstemon leiophyllus* var. *francisci-pennellii*, *Tetraneuris acaulis*, *Trifolium gymnocarpon*, and *Trisetum spicatum*.

ENVIRONMENT & DYNAMICS

Environmental Description: This widely scattered subalpine forest and woodland alliance grows on all slopes, especially ridges and upper slopes below timberline. It grows on dolomitic, limestone- or granite-derived soils. Soils are rapidly drained with low to moderate cover of rocks and gravel. This woodland may occur under the driest conditions of the California subalpine woodlands. The growing season is limited by drought in the summer and cold in the winter. Precipitation, mostly as snow, falls in the winter. Stands are found between 2600 and 3600 m elevation.

Dynamics: This alliance is subject to long, intense droughts. Tree-ring data over the last 4000 years indicate that droughts of 200 years or more have occurred.

DISTRIBUTION

Geographic Range: Scattered stands of this subalpine woodland occur in California and Nevada's White Mountains, in the Desert Range, and in isolated pockets throughout the Intermountain West.

Nations: US

States/Provinces: CA, NV, UT

TNC Ecoregions [optional]: 11:C, 17:C, 18:C, 19:C

USFS Ecoregions (2007): 341B:CC, 341D:CC, 341Fb:CCC, 341Ff:CCC, M341A:CC, M341C:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Bryce Canyon, Capitol Reef, Cedar Breaks, Death Valley, Great Basin); USFS (Dixie, Inyo)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Pinus longaeva* (Bristlecone pine woodland) Alliance (Sawyer et al. 2009) [87.140.00]
- = *Pinus longaeva* Woodland Alliance (Evens et al. 2014)
- = *Pinus longaeva* Woodland Alliance (CNPS 2017) [87.140.00]
- = Bristlecone Pine Forest (#86400) (Holland 1986b)
- = Bristlecone pine series (Sawyer and Keeler-Wolf 1995)
- >< Western Needleleaf Forests: 5: Mixed Conifer Forest (*Abies-Pinus-Pseudotsuga*) (Küchler 1964)

LOWER LEVEL UNITS

Associations:

- CEGLO03073 *Pinus longaeva* - *Pinus flexilis* Woodland [Placeholder]
- CEGLO02736 *Abies concolor* - *Pinus ponderosa* - *Pinus longaeva* Forest
- CEGLO02380 *Pinus longaeva* Woodland
- CEGLO05447 *Pinus longaeva* / (*Ericameria discoidea*, *Ribes montigenum*) Woodland
- CEPS009592 *Pinus longaeva* / *Artemisia tridentata* ssp. *vaseyana* Woodland [Park Special]
- CEPS009593 *Pinus longaeva* / *Symphoricarpos oreophilus* Woodland [Park Special]
- CEPS009591 *Pinus longaeva* / *Arctostaphylos patula* Woodland [Park Special]

AUTHORSHIP

Primary Concept Source: M. Schindel, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Beasley and Klemmedson 1980, Billings and Thompson 1957, Brown et al. 1980, CNPS 2017, Cheng 2004, Evens et al. 2014, Faber-Langendoen et al. 2017b, Griffin and Critchfield 1972, Hawksworth and Bailey 1980, Holland 1986b, Howard 2004c, Küchler 1964, Lloyd and Mitchell 1973, Mooney 1973, Mooney et al. 1962, Paysen et al. 1980, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Schulz and Hall 2011, Taylor 1979, Thorne 1976, Thorne et al. 2007, Vasek and Thorne 1977, Wright and Mooney 1965

1.B.2.Nc. Western North American Pinyon - Juniper Woodland & Scrub

These pinyon pine- and juniper-dominated woodlands, scrub, and savannas generally occur just above semi-desert shrublands and grasslands or shortgrass prairies and below montane forest vegetation throughout the semi-arid Intermountain West and western Great Plains of North America.

M026. Intermountain Singleleaf Pinyon - Juniper Woodland

This broadly defined pinyon and juniper woodland, savanna and scrub macrogroup occurs in dry foothills in the interior western U.S. and is characterized by an open to closed tree canopy composed of *Juniperus occidentalis*, *Juniperus osteosperma*, *Pinus edulis*, *Pinus monophylla*, and/or *Cercocarpus ledifolius*.

1. Forest & Woodland

1.B.2.Nc. Western North American Pinyon - Juniper Woodland & Scrub

1.B.2.Nc.1.a. M026 Intermountain Singleleaf Pinyon - Juniper Woodland

G246. Colorado Plateau-Great Basin Juniper Open Woodland

Type Concept Sentence: This widespread juniper woodland and savanna group occurs in the Colorado Plateau and Great Basin and is characterized by dominance of *Juniperus osteosperma* trees in an open tree canopy with high cover of perennial bunchgrasses and forbs (savannas) or an open to closed canopy often with a shrub understory (woodlands) and the lack of pinyon trees *Pinus edulis* and *Pinus monophylla*, which occur outside the ecological or geographic range of this type.

OVERVIEW

Scientific Name: *Juniperus osteosperma* Open Woodland Group

Common Name (Translated Scientific Name): Utah Juniper Open Woodland Group

Colloquial Name: Utah Juniper / Herb Open Woodland

Type Concept: This widespread juniper woodland and savanna group occupies dry foothills and sandsheets of the Colorado Plateau and eastern Great Basin from the western Colorado to Nevada and southern Idaho, and south to northwestern New Mexico and northern Arizona. The vegetation ranges from savanna, often with inclusions of denser patches of juniper, to open to dense woodland. The savanna stands are characterized by an open tree canopy of *Juniperus osteosperma* trees with high cover of perennial bunchgrasses and forbs, with *Achnatherum hymenoides*, *Bouteloua gracilis*, *Hesperostipa comata*, *Leymus salinus*, and *Pleuraphis jamesii* being most common. Woodland stands are generally open, but range from an open to closed canopy often with shrubs between trees depending on size of gaps. Characteristic shrubs include *Artemisia nova*, *Artemisia tridentata*, *Cercocarpus intricatus*, *Coleogyne ramosissima*, and *Ephedra* spp. Pinyon trees are typically not present because sites are outside the ecological or geographic range of *Pinus edulis* and *Pinus monophylla*. These juniper woodlands and wooded grasslands are generally found at lower elevations and on more xeric sites than Great Basin Pinyon - Juniper Woodland Group (G247) or Colorado Plateau Pinyon - Juniper Woodland Group (G250). Elevation ranges from 1500-2300 m. Stands occur on lower mountain slopes, hills, plateaus, basins and more recently on flats where juniper is expanding into semi-desert grasslands and steppe.

Classification Comments: *Juniperus californica* savannas in the Central Valley of California and around the fringes of the Mojave Desert are not part of this group. In many cases, they are the result of some disturbance removing an oak component from one of the several oak woodland and savanna systems of California. This group does not extend north into the Columbia Plateau where *Juniperus occidentalis* dominates the Columbia Plateau Western Juniper Open Woodland Group (G248). This Utah juniper savanna and woodland group does not include sparse juniper stands on rock outcrops or woodlands. It corresponds to both the *Juniperus osteosperma*-dominated portion of the *pinyon-juniper savanna* type (low to moderate cover of trees, well-developed graminoid understory, generally a minor shrub component, growing on deeper soils) and well as the *Juniperus osteosperma*-dominated portion of the *persistent pinyon-juniper woodland* type (occurs on rocky uplands with shallow, coarse-textured, and often skeletal soils that support relatively sparse herbaceous cover and rarely burn) described in Romme et al. (2009).

Similar NVC Types:

- G250 Colorado Plateau Pinyon - Juniper Woodland
- G247 Great Basin Pinyon - Juniper Woodland

Diagnostic Characteristics: These woodlands and savannas are characterized by the dominance of *Juniperus osteosperma* in the tree layer and absence of *Pinus monophylla* and *Pinus edulis*. If stand is a savanna, then there is a lush perennial grass layer with scattered *Juniperus osteosperma* trees. Characteristic grasses include *Achnatherum hymenoides*, *Hesperostipa comata*, *Leymus salinus*, and *Pleuraphis jamesii*. *Juniperus occidentalis* is absent (or accidental) as it is restricted to Columbia Plateau Western Juniper Woodland & Savanna Group (G248).

VEGETATION

Physiognomy and Structure: This group includes both open to closed woodlands dominated by the evergreen sclerophyllous tree *Juniperus osteosperma*, as well as savannas characterized by a lush perennial grass layer (20-90% cover) with tree layer dominated by *Juniperus osteosperma*. Woodland stands may have shrubs present to dense forming a layer.

Floristics: The vegetation is typically open savanna, although there may be inclusions of denser patches of juniper. This savanna is typically dominated by *Juniperus osteosperma* trees with high cover of perennial bunchgrasses and forbs, with *Bouteloua gracilis*, *Hesperostipa comata*, *Leymus salinus*, *Pleuraphis jamesii*, *Pleuraphis mutica*, and *Pseudoroegneria spicata* being most common. Pinyon trees are typically not present because sites are outside the ecological or geographic range of *Pinus edulis* and *Pinus monophylla*. Scattered shrubs may be present with low cover relative to the perennial herbaceous layer. Characteristic shrubs include *Artemisia arbuscula*, *Artemisia nova*, *Artemisia tridentata*, *Cercocarpus intricatus*, *Cercocarpus montanus*, *Coleogyne ramosissima*, *Ephedra viridis*, *Mahonia fremontii*, *Purshia tridentata*, and *Symphoricarpos oreophilus*. *Juniperus scopulorum* may codominate or replace *Juniperus osteosperma* in upper elevation stands, near washes, and in the cooler northern extent.

ENVIRONMENT & DYNAMICS

Environmental Description: This widespread juniper woodland and savanna group occupies dry foothills and sandsheets of the Colorado Plateau and eastern Great Basin. These wooded grasslands are generally found at lower elevations and on more xeric sites than Great Basin Pinyon - Juniper Woodland Group (G247) or Colorado Plateau Pinyon - Juniper Woodland Group (G250). Elevation ranges from 1500-2300 m. Stands occur on lower mountain slopes, hills, plateaus, basins and more recently on flats where juniper is expanding into semi-desert grasslands and steppe. Soils are generally calcareous and alkaline, and often shallow and rocky, but may be acidic.

Dynamics: Some researchers believe that at one time the juniper savanna was more common than juniper woodlands (West and Young 2000). These savanna communities depend on periodic fire (once every 10-30 years) to maintain the juniper savanna structure by thinning trees that invade the interspaces between larger fire-resistant trees and create woodlands (Wright et al. 1979, West and Young 2000). Juniper trees less than 1.2 m (4 feet) tall are readily killed by fires (Wright et al. 1979). Heavy grazing by livestock reduces the fine fuel layer (grasses), which decreases the fire frequency resulting in increased juniper density (Wright et al. 1979, West and Young 2000). Over the last century, a reduction in fire frequency has caused a conversion of some juniper savanna to juniper woodland as well as invasion of juniper trees from areas of naturally low fire frequency, e.g., rocky ridges into adjacent communities, especially sagebrush steppe (Wright et al. 1979, West and Young 2000).

DISTRIBUTION

Geographic Range: This *Juniperus osteosperma* woodland and savanna group occupies dry foothills and sandsheets of the Colorado Plateau and Great Basin from western Colorado to Nevada and southern Idaho, and south to northwestern New Mexico and northern Arizona. Where it occurs in California, it is found only in the far eastern edges of the state within or adjacent to the Great Basin.

Spatial Scale & Pattern [optional]: Large patch

Nations: US

States/Provinces: AZ, CA, CO, ID, NM, NV, UT

TNC Ecoregions [optional]: 9:C, 10:C, 11:C, 18:C, 19:C, 20:C, 21:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313C:CC, 313D:CC, 315H:CC, 321A:CC, 322A:CC, 341A:C?, 341D:C?, 341E:C?, 341F:C?, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CP, 342G:CC, 342J:CC, M313A:CC, M331D:CC, M331E:C?, M331G:CP, M331H:CC, M331I:CP, M331J:CP, M332E:CC, M341A:CC, M341D:CP

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = Juniper steppe woodland (*Juniperus - Artemisia - Agropyron*) (Küchler 1964)
- = Utah Juniper Series (Dick-Peddie 1993)

LOWER LEVEL UNITS

Alliances:

- A3497 *Juniperus osteosperma* / Herbaceous Understory Open Woodland Alliance
- A3496 *Juniperus osteosperma* / Shrub Understory Woodland Alliance

AUTHORSHIP

Primary Concept Source: A.W. Kuchler (1964)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 11/09/2015

Classif Resp Region: West

Internal Author: KAS 1-10, 6-23, 11-15

REFERENCES

References: Bassett et al. 1987, Blackburn and Tueller 1970, Brown 1982a, Brown et al. 1979, Dick-Peddie 1993, Eyre 1980, Faber-Langendoen et al. 2017a, Fitzhugh et al. 1987, Francis 1986, K uchler 1964, Larson and Moir 1986, Larson and Moir 1987, Romme et al. 2009, Sawyer et al. 2009, Shiflet 1994, Tuhy et al. 2002, West 1999a, West 1999b, West and Young 2000, West et al. 1998, Wright et al. 1979

1. Forest & Woodland

1.B.2.Nc. Western North American Pinyon - Juniper Woodland & Scrub

G246. Colorado Plateau-Great Basin Juniper Open Woodland

A3497. *Juniperus osteosperma* / Herbaceous Understory Open Woodland Alliance

Type Concept Sentence: This juniper woodland and savanna alliance is characterized by an open to moderately dense, short (<15 m) tree canopy strongly dominated by *Juniperus osteosperma* or *Juniperus scopulorum* (at higher elevations) with an understory dominated by an open to dense layer of perennial grasses and lacking significant cover of shrubs. It occurs in the Colorado Plateau, but it extends out into adjacent ecoregions primarily west into the Great Basin and north and east into the foothills of the central and southern Rocky Mountains.

OVERVIEW

Scientific Name: *Juniperus osteosperma* / Herbaceous Understory Open Woodland Alliance

Common Name (Translated Scientific Name): Utah Juniper / Herbaceous Understory Open Woodland Alliance

Colloquial Name: Utah Juniper / Herb Open Woodland

Type Concept: Stands have a typically open to moderately dense tree canopy with an understory characterized by herbaceous vegetation. Tree canopy is dominated by *Juniperus osteosperma* with *Juniperus scopulorum* becoming important at higher elevations and along drainages. *Pinus* species are absent or accidental. Perennial grasses typically dominate the herbaceous layer although forbs are present and can be diverse. Characteristic species include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Hesperostipa comata*, *Hesperostipa neomexicana*, *Leymus salinus*, *Pleuraphis jamesii*, *Pleuraphis mutica*, and *Pseudoroegneria spicata*. The non-native, invasive annual grass *Bromus tectorum* may be abundant in disturbed stands and dominate the herbaceous layer of highly disturbed stands. The core distribution of this juniper alliance is the Colorado Plateau, but it extends out into adjacent ecoregions primarily west into the Great Basin and north and east into the foothills of the central and southern Rocky Mountains. Stands occur on level to moderately steep alluvial fans and terraces, colluvial slopes, benches, hills, and badlands. Elevation of most stands ranges from 1423 to 1880 m (4670-6165 feet) but may occur as high as 2200 m (7215 feet) on warmer southwest-facing slopes. Sites may be oriented to any aspect. Stands have been observed on north-facing steep slopes along bluffs of the Snake River in southeastern Idaho. Soils are well-drained sands, sandy clays, or clay loams derived from shales, sandstones, or a mix of the two. Less frequently substrates are derived from eolian sands.

Classification Comments: This alliance may include stands with *Juniperus monosperma* present to codominant in northeastern Arizona. There is a transition zone between the ranges of the two species of *Juniperus* in the southern Colorado Plateau.

Internal Comments: mjr 12-14: CA added for MOJN. KAS-1-14: *Juniperus osteosperma* / *Pleuraphis mutica* Woodland (CEGL000736) is included in this alliance because it is reported in the Southern Colorado Plateau north of the Mogollon Rim, but needs further review as it has presence of warm desert indicator species.

Other Comments:

Similar NVC Types: This alliance has similarities to other pinyon-juniper and juniper woodland and savanna alliances in several other groups, such as G200, G247, G248, G250, G252, G253, and G487.

- A3134 *Juniperus coahuilensis* - *Juniperus deppeana* - *Juniperus monosperma* / Grass Understory Open Woodland Alliance: is similar in that it is a juniper savanna, but Madrean and warm desert floristic species overlap very little with Intermountain West floristics.
- A3426 *Juniperus osteosperma* - *Juniperus scopulorum* / Shrub Understory Central Rocky Mountain Woodland Alliance
- A3572 *Pinus edulis* - *Juniperus osteosperma* / Herbaceous Understory Open Woodland Alliance: is similar except overstory is characterized by *Pinus edulis* with 5% or more cover.
- A3575 *Juniperus monosperma* / Herbaceous Understory Open Woodland Alliance: is similar except overstory is dominated by *Juniperus monosperma*.
- A3500 *Juniperus occidentalis* / Herbaceous Understory Open Woodland Alliance: is similar except overstory is dominated by *Juniperus occidentalis*.
- A3496 *Juniperus osteosperma* / Shrub Understory Woodland Alliance: is similar but understory has a shrub layer (>10% cover) or, if less, shrub cover exceeds herbaceous cover.

- A2109 *Pinus monophylla* - *Juniperus osteosperma* / Herbaceous Understory Open Woodland Alliance: is similar except overstory is characterized by *Pinus monophylla* with 5% or more cover.

Diagnostic Characteristics: Stands have an open to moderately dense tree canopy dominated by *Juniperus osteosperma* with *Juniperus scopulorum* present to dominant at higher elevations. Understory is characterized by dominant and diagnostic perennial grass species *Bouteloua gracilis*, *Hesperostipa comata*, *Hesperostipa neomexicana*, *Leymus ambiguus*, *Leymus salinus*, *Pleuraphis jamesii*, *Pleuraphis mutica*, *Poa fendleriana*, *Poa secunda*, and *Pseudoroegneria spicata*. Shrub cover is sparse and does not form a layer. Forbs are present generally with low cover. This alliance also includes disturbed stands with the understory dominated by introduced annual grass *Bromus tectorum*.

VEGETATION

Physiognomy and Structure: These are sparsely to moderate dense (5-30% cover) wooded communities dominated by scale-leaved evergreen trees of low stature (<15 m). Evergreen or cold-deciduous shrubs occupy the interstices between trees, interspersed with caespitose graminoids. In total, the herbaceous layer is usually of moderate cover (25-50%), but may also be low (5% cover) when it exceeds shrub cover. Occasionally shrubs may be present, but do not form a layer (<10% cover).

Floristics: Stands have a short (<15 m tall), typically open to moderately dense tree canopy with an understory characterized by herbaceous vegetation. Tree canopy is dominated by *Juniperus osteosperma* with *Juniperus scopulorum* becoming important at higher elevations and along drainages. *Pinus* species, such as *Pinus monophylla*, *Pinus edulis*, *Pinus flexilis*, *Pinus ponderosa*, or *Pseudotsuga menziesii* are absent or accidental. The open to dense herbaceous layer is typically dominated by perennial grasses. Characteristic species include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Hesperostipa comata*, *Hesperostipa neomexicana*, *Leymus ambiguus*, *Leymus salinus*, *Pleuraphis jamesii*, *Pleuraphis mutica*, *Poa fendleriana*, *Poa secunda*, and *Pseudoroegneria spicata*. Forbs are present in the herbaceous layer and can be diverse but contribute little cover, including *Arenaria hookeri*, *Arenaria fendleri*, *Calochortus gunnisonii*, *Chaetopappa ericoides*, *Cymopterus bulbosus*, *Cymopterus purpureus*, *Eriogonum umbellatum*, *Hymenoxys richardsonii*, *Linanthus pungens* (= *Leptodactylon pungens*), *Lepidium montanum*, *Machaeranthera grindelioides*, *Mirabilis multiflora*, *Oenothera pallida*, *Petradoria pumila*, *Phlox austromontana*, *Phlox hoodii*, *Sphaeralcea coccinea*, *Streptanthella longirostris*, *Stenotus acaulis*, *Tetraneuris acaulis* (= *Hymenoxys acaulis*), and *Xylorhiza venusta*. The non-native, invasive annual grass *Bromus tectorum* may be abundant in disturbed stands and dominate the herbaceous layer of highly disturbed stands. Scattered shrubs such as *Artemisia tridentata*, *Artemisia nova*, *Atriplex* spp., *Chrysothamnus* spp., *Cercocarpus* spp. (on thin soils near rock outcrops), *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, and *Opuntia* spp. may be present but do not form a layer or exceed the herbaceous cover.

ENVIRONMENT & DYNAMICS

Environmental Description: This savanna and open woodland alliance is distributed across the Intermountain West from the foothills of the eastern Sierra Nevada to the foothills of the central and southern Rocky Mountains. Climate is temperate with freezing temperatures during winter. Distribution of the alliance is often correlated with "thermal belts" which occur above the areas of cold-air drainage in high intermountain basins. Average annual precipitation is between 25 and 50 cm; however, seasonal distribution is variable across the range of the alliance. Stands occur on alluvial fans and terraces, colluvial slopes, benches, hills, and badlands. Sites are on level to moderately steep (3-46% slope) terrain that may be oriented to any aspect. Elevation of most stands ranges from 1423 to 1880 m (4670-6165 feet) but may occur as high as 2200 m (7215 feet). Sites tend to occur on cooler north and east aspects at lower elevations and warmer/drier south and west aspects at higher elevations. Soils are well-drained sands, sandy clays, or clay loams derived from shales, sandstones, or a mix of the two. Less frequently substrates are derived from eolian sands. Parent materials include Mesozoic marine shales of the Morrison Formation, Chinle Formation or Mancos shale, Kayenta Formation and Cedar Mesa sandstone. Colluvium from sandstone cliffs or outcrops upslope is common on the ground surface.

Dynamics: Within the distribution of *Pinus edulis*, this alliance typically occurs at lower elevation and on more xeric sites than *Pinus edulis* - (*Juniperus* spp.) woodlands. There is elevational overlap between this alliance and *Pinus monophylla* woodlands as this pinyon can occur on more xeric sites than *Pinus edulis*. *Juniperus osteosperma* also occurs on sites outside the ranges of *Pinus edulis* and *Pinus monophylla*. There has been significant expansion of this alliance over the last century into sagebrush-dominated shrublands. An altered fire regime (such as fire suppression, thus longer return intervals) is considered a primary cause of this expansion.

DISTRIBUTION

Geographic Range: The core distribution of this juniper alliance is the Colorado Plateau, but it extends out into adjacent ecoregions primarily west into the Great Basin and north and east into the foothills of the central and southern Rocky Mountains.

Nations: US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- >< *Juniperus osteosperma* (Utah juniper woodland) Alliance (Sawyer et al. 2009) [89.300.00]
- >< Utah Juniper Series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS

Associations:

- CEG002815 *Juniperus osteosperma* / *Hesperostipa comata* Open Woodland
- CEG002817 *Juniperus osteosperma* / *Bromus tectorum* Ruderal Woodland
- CEG000740 *Juniperus osteosperma* / *Hesperostipa neomexicana* Open Woodland
- CEG000736 *Juniperus osteosperma* / *Pleuraphis mutica* Open Woodland
- CEG000738 *Juniperus osteosperma* / *Pseudoroegneria spicata* Open Woodland
- CEG005618 *Juniperus osteosperma* / *Festuca idahoensis* Open Woodland
- CEG001488 *Juniperus osteosperma* / *Leymus salinus ssp. salmonis* Wooded Grassland
- CEG002361 *Juniperus osteosperma* / *Bouteloua gracilis* Open Woodland
- CEG003109 *Juniperus osteosperma* / *Leymus salinus* Open Woodland
- CEG002362 *Juniperus osteosperma* / *Pleuraphis jamesii* Open Woodland
- CEG001489 *Juniperus osteosperma* / *Hesperostipa comata* Wooded Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by M. Jennings, M.S. Reid, and D. Sarr.

Version Date: 2014/03/14

REFERENCES

References: Baker 1983b, Baker 1984a, Baker and Kennedy 1985, Barney and Frischknecht 1974, Blackburn 1967, Blackburn et al. 1968a, Blackburn et al. 1968c, Blackburn et al. 1969a, Blackburn et al. 1969e, Blackburn et al. 1971, Brotherson and Evenson 1983, Bunting 1987, Caicco and Wellner 1983c, Dastrup 1963, Despain 1973a, Donart et al. 1978b, Everett 1986, Faber-Langendoen et al. 2017b, Isaacson 1967, Jameson et al. 1962, Johnsen 1962, Johnston 1987, Jones 1989b, Kline 1973, Knight et al. 1987, Komarkova et al. 1988b, Koniak 1985, Larson and Moir 1986, Larson and Moir 1987, Lesica and DeVelice 1992, Marriott and Jones 1989, Moir and Carleton 1987, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, USFS 1983a, USFS 1985c, West et al. 1978, Wight 1965, Wight and Fisser 1968, Wright et al. 1979

1. Forest & Woodland

1.B.2.Nc. Western North American Pinyon - Juniper Woodland & Scrub

G246. Colorado Plateau-Great Basin Juniper Open Woodland

A3496. *Juniperus osteosperma* / Shrub Understory Woodland Alliance

Type Concept Sentence: This juniper woodland alliance is characterized by an open to moderately dense, short (<15 m) tree canopy that is strongly dominated by *Juniperus osteosperma* or *Juniperus scopulorum* (at higher elevations) with an understory characterized by an open dense layer of shrubs (<10% cover). If understory is sparse then shrubs exceed herbaceous cover. It occurs in the Colorado Plateau, but it extends out into adjacent ecoregions primarily west into the Great Basin and north and east into the foothills of the central and southern Rocky Mountains.

OVERVIEW

Scientific Name: *Juniperus osteosperma* / Shrub Understory Woodland Alliance

Common Name (Translated Scientific Name): Utah Juniper / Shrub Understory Woodland Alliance

Colloquial Name: Utah Juniper / Shrub Woodland

Type Concept: Stands have a short, typically open to moderately dense tree canopy with an understory characterized by shrubs. Tree canopy is dominated by *Juniperus osteosperma* with *Juniperus scopulorum* becoming important and sometimes dominant at higher elevations and on relatively mesic sites such as along drainages. *Pinus* species are absent or accidental with very low cover. Shrubs typically dominate the understory and form an open to moderately dense layer. Scattered shrubs frequently characterize the sparse and rocky understory. Characteristic shrubs are many, including *Artemisia arbuscula*, *Artemisia nova*, *Artemisia tridentata*, *Cercocarpus intricatus*, *Cercocarpus montanus*, *Coleogyne ramosissima*, *Mahonia fremontii*, *Quercus gambelii*, and *Symphoricarpos*

oreophilus. The herbaceous layer is sparse to moderate and composed of grasses and often diverse forbs. Common species may include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Hesperostipa comata*, *Hesperostipa neomexicana*, *Leymus salinus*, *Pleuraphis jamesii*, and *Pseudoroegneria spicata*. The non-native, invasive annual grass *Bromus tectorum* may be abundant and dominate the herbaceous layer of highly disturbed stands. This alliance also includes sparse understory stands often with scattered shrubs and grasses. The core distribution of this juniper alliance is semi-arid canyons, foothills, plateaus and low mountains in the Colorado Plateau, but it extends out into adjacent ecoregions primarily west into the Great Basin and north and east into the foothills of the central and southern Rocky Mountains. Stands have been observed on north-facing steep slopes along bluffs of the Snake River in southeastern Idaho. Stands occur on a variety of sites, including alluvial fans and stream terraces, colluvial slopes, benches, ledges, hills, ridges, mesas, and badlands. Sites range from level to steep terrain that may be oriented to any aspect. Elevation of most stands ranges from 1220 to 2260 m (4000-7400 feet). Soils are often calcareous, shallow, poorly developed, rapidly to well-drained sands, sandy clays, or clay loams derived from shales, sandstones, or a mix of the two.

Classification Comments: This alliance may include stands with *Juniperus monosperma* present to codominant in northeastern Arizona. There is a transition zone between the ranges of the two species of *Juniperus* in the southern Colorado Plateau. Scattered shrubs frequently characterize the sparse and rocky understory of stands and so are included in this alliance.

Internal Comments:

Other Comments:

Similar NVC Types: This alliance has similarities to other pinyon-juniper and juniper woodland and savanna alliances in several other groups, such as G200, G247, G248, G250, G252, G253, and G487.

- A3133 *Juniperus coahuilensis* - *Juniperus deppeana* - *Juniperus monosperma* / Shrub Understory Open Woodland Alliance: is similar in that it is a juniper woodland, but Madrean and warm desert floristic species overlap very little with southern Rocky Mountain and western Great Plains floristics.
- A3427 *Juniperus osteosperma* - *Juniperus scopulorum* / Grass Understory Central Rocky Mountain Woodland Alliance
- A2109 *Pinus monophylla* - *Juniperus osteosperma* / Herbaceous Understory Open Woodland Alliance
- A2108 *Pinus monophylla* - *Juniperus osteosperma* / Shrub Understory Woodland Alliance: is similar except overstory is characterized by *Pinus monophylla* with 5% or more cover.
- A3497 *Juniperus osteosperma* / Herbaceous Understory Open Woodland Alliance: is similar but understory lacks a shrub layer and is dominated by an herbaceous layer (>10% cover) or, if less, grass cover exceeds shrub cover.
- A3571 *Pinus edulis* - *Juniperus osteosperma* / Shrub Understory Foothill & Lower Montane Dry-Mesic Woodland Alliance: is similar except overstory is characterized by *Pinus edulis* with 5% or more cover.

Diagnostic Characteristics: Stands have an open to moderately dense tree canopy dominated by *Juniperus osteosperma* with *Juniperus scopulorum* present to dominant at higher elevations. Understory is characterized by dominant and diagnostic shrub species such as *Artemisia arbuscula*, *Artemisia bigelovii*, *Artemisia nova*, *Artemisia tridentata*, *Atriplex confertifolia*, *Atriplex confertifolia*, *Cercocarpus intricatus*, *Cercocarpus montanus*, *Chrysothamnus viscidiflorus*, *Coleogyne ramosissima*, *Ephedra nevadensis*, *Ephedra viridis*, *Ericameria teretifolia*, *Eriogonum fasciculatum*, *Fendlera rupicola*, *Fraxinus anomala*, *Grayia spinosa*, *Gutierrezia sarothrae*, *Mahonia fremontii*, *Purshia glandulosa*, *Purshia tridentata*, *Quercus gambelii*, *Rhus trilobata*, *Salvia dorrii*, *Symphoricarpos oreophilus*, *Tetradymia axillaris*, and *Yucca* spp.

VEGETATION

Physiognomy and Structure: These are sparsely to densely (5-80% cover) wooded communities dominated by scale-leaved evergreen trees of low stature (<15 m). Evergreen or cold-deciduous shrubs occupy the interstices between trees, interspersed with caespitose graminoids. In total, the shrub layer is usually open to moderate (10-50% cover), but may also be sparse (<10% cover) or when shrubs exceeds herbaceous cover.

Floristics: Stands have a short (<15 m tall), open to moderately dense tree canopy with an understory characterized by shrubs. Tree canopy is dominated by *Juniperus osteosperma* with *Juniperus scopulorum* becoming important and sometimes dominant at higher elevations and on relatively mesic sites such as along drainages. *Pinus* species, such as *Pinus monophylla*, *Pinus edulis*, *Pinus flexilis*, *Pinus ponderosa*, or *Pseudotsuga menziesii* are absent or accidental. Shrubs typically dominate the understory and form an open to moderately dense layer. Characteristic shrubs are many, including *Artemisia arbuscula*, *Artemisia bigelovii*, *Artemisia nova*, *Artemisia tridentata*, *Atriplex confertifolia*, *Atriplex confertifolia*, *Cercocarpus intricatus*, *Cercocarpus montanus*, *Chrysothamnus viscidiflorus*, *Coleogyne ramosissima*, *Ephedra nevadensis*, *Ephedra viridis*, *Ericameria teretifolia*, *Eriogonum fasciculatum*, *Fendlera rupicola*, *Fraxinus anomala*, *Grayia spinosa*, *Gutierrezia sarothrae*, *Mahonia fremontii*, *Purshia glandulosa*, *Purshia tridentata*, *Quercus gambelii*, *Rhus trilobata*, *Salvia dorrii*, *Symphoricarpos oreophilus*, *Tetradymia axillaris*, and *Yucca* spp. The herbaceous layer is typically sparse to low in terms of cover but high in species diversity. Common graminoids provide sparse to moderate cover and include *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua gracilis*, *Bouteloua curtipendula*, *Bromus tectorum*, *Elymus elymoides*, *Hesperostipa comata*, *Hesperostipa neomexicana*, *Leymus salinus*, *Pleuraphis jamesii*, *Poa fendleriana*, *Poa secunda*, and

Pseudoroegneria spicata. Associated forbs may include *Chamaesyce fendleri*, *Cryptantha* spp., *Eriogonum inflatum*, *Eriogonum alatum*, *Gayophytum racemosum*, *Hymenoxys richardsonii*, *Hymenopappus filifolius*, *Lepidium montanum*, *Linanthus pungens* (= *Leptodactylon pungens*), *Machaeranthera canescens*, *Mirabilis multiflora*, *Packera multilobata* (= *Senecio multilobatus*), *Phlox hoodii*, *Plantago patagonica*, *Stenotus acaulis* (= *Haplopappus acaulis*), and *Tetraneuris acaulis* (= *Hymenoxys acaulis*). The non-native, invasive annual grass *Bromus tectorum* may be abundant and dominate the herbaceous layer of highly disturbed stands. This alliance also includes sparse understory stands often with scattered shrubs and grasses. The lack of understory can be caused by harsh substrate (rockland, shale badland) or dense tree canopy resulting from lack of fire that shades out understory.

ENVIRONMENT & DYNAMICS

Environmental Description: This open to dense woodland alliance occurs in semi-arid canyons, foothills, plateaus and low mountains across the Intermountain West from the eastern Sierra Nevada to the central and southern Rocky Mountains. Climate is temperate with freezing temperatures during winter. Distribution of the alliance is often correlated with "thermal belts" which occur above the areas of cold-air drainage in high intermountain basins. Average annual precipitation is between 25 and 50 cm; however, seasonal distribution is variable across the range of the alliance. Stands occur on a variety of sites, including alluvial fans and stream terraces, colluvial slopes, benches, ledges, hills, ridges, mesas, and badlands. Sites range from level to steep terrain that may be oriented to any aspect, and most sites are on cooler north and east aspects at lower elevations and warmer/drier south and west aspects at higher elevations. Elevation of most stands ranges from 1220 to 2260 m (4000-7400 feet). Soils are often calcareous, shallow, poorly developed, rapidly to well-drained sands, sandy clays, or clay loams derived from shales, sandstones, or a mix of the two. Less frequently substrates are derived sandy loams from eolian sands. Parent materials are sandstones, shale, and Precambrian gneiss. The unvegetated ground surface often has a high percentage of rock, exposed bedrock or bare ground, but in undisturbed stands, the cover of cryptobiotic crusts may be high.

Dynamics: Within the distribution of *Pinus edulis*, this alliance typically occurs at lower elevation and on more xeric sites than *Pinus edulis* - (*Juniperus* spp.) woodlands. There is elevational overlap between this alliance and *Pinus monophylla* woodlands as this pinyon can occur on more xeric sites than *Pinus edulis*. *Juniperus osteosperma* also occurs on sites outside the ranges of *Pinus edulis* and *Pinus monophylla*. There has been significant expansion of this alliance over the last century into sagebrush-dominated shrublands. An altered fire regime (such as fire suppression, thus longer return intervals) is considered a primary cause of this expansion.

Fires in this alliance are thought to be infrequent because *Juniperus osteosperma* and many shrubs such as *Artemisia tridentata* are easily killed by burns and do not resprout (Barney and Frischknecht 1974, Everett 1986). In addition, many stands have an open canopy with insufficient understory to carry fire. Shrubs will often re-establish relatively quickly (about 10-20 years) if a seed source is nearby (Barney and Frischknecht 1974, Bunting 1987). However, *Juniperus osteosperma* is relatively slow to recover following fire, and shrubs such as sagebrush may dominate the sites for decades (Jameson et al. 1962). Fire, drought and competition with grasses are thought to have kept *Juniperus* spp. communities restricted to rocky areas that do not burn frequently (Wright et al. 1979).

DISTRIBUTION

Geographic Range: The core distribution of this juniper alliance is the Colorado Plateau, but it extends out into adjacent ecoregions primarily west into the Great Basin and north and east into the foothills of the central and southern Rocky Mountains. Stands have been observed on north-facing steep slopes along bluffs of the Snake River in southeastern Idaho.

Nations: US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, UT, WY

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007): 322Aj:CCC, 322Al:CCC, 341Ff:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Mojave); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- >< *Juniperus osteosperma* (Utah juniper woodland) Alliance (Sawyer et al. 2009) [89.300.00]
- = *Juniperus osteosperma* Woodland Alliance (Evens et al. 2014)

LOWER LEVEL UNITS

Associations:

- CEGLO00735 *Juniperus osteosperma* / *Cercocarpus montanus* Woodland
- CEGLO05754 *Juniperus osteosperma* / *Eriogonum fasciculatum* - *Yucca baccata* Woodland
- CEGLO02967 *Juniperus scopulorum* - *Quercus gambelii* Woodland
- CEGLO05616 *Juniperus osteosperma* / *Artemisia tridentata* ssp. *tridentata* / *Pseudoroegneria spicata* Woodland

CBR alliances

- CEG002964 *Juniperus osteosperma* Wooded Shrubland [Placeholder]
- CEG000741 *Juniperus osteosperma* / *Symphoricarpos oreophilus* Woodland
- CEG000733 *Juniperus osteosperma* / *Cercocarpus intricatus* Woodland
- CEG000729 *Juniperus osteosperma* / *Artemisia nova* / Rock Woodland
- CEG005598 *Juniperus (osteosperma, scopulorum)* / *Artemisia tridentata* ssp. *wyomingensis* - *Chamaebatiaria millefolium* Woodland
- CEG005599 *Juniperus (scopulorum, osteosperma)* / *Ericameria nana* Wooded Grassland
- CEG000728 *Juniperus osteosperma* / *Artemisia nova* Woodland
- CEG000730 *Juniperus osteosperma* / *Artemisia tridentata* Woodland
- CEG000737 *Juniperus osteosperma* - *Juniperus monosperma* / Sparse Understory Woodland
- CEG000731 *Juniperus osteosperma* / *Artemisia tridentata* / *Achnatherum hymenoides* Woodland
- CEG005617 *Juniperus osteosperma* / *Artemisia tridentata* ssp. *wyomingensis* Woodland
- CEG005619 *Juniperus osteosperma* / *Purshia tridentata* / *Poa secunda* Woodland
- CEG002909 *Juniperus osteosperma* / *Coleogyne ramosissima* Woodland
- CEG000732 *Juniperus osteosperma* / Sparse Understory Woodland
- CEG000727 *Juniperus osteosperma* Woodland
- CEG002266 *Juniperus osteosperma* / Mixed Shrubs Talus Woodland
- CEG002360 *Juniperus osteosperma* / *Artemisia tridentata* ssp. *tridentata* Woodland
- CEG003965 *Juniperus osteosperma* / *Mahonia fremontii* Woodland
- CEG003774 *Juniperus osteosperma* - (*Pinus edulis*) / *Coleogyne ramosissima* - *Purshia stansburiana* - *Quercus havardii* var. *tuckeri* Wooded Shrubland
- CEG005600 *Juniperus osteosperma* / *Artemisia tridentata* ssp. *wyomingensis* / *Hesperostipa comata* Wooded Shrubland
- CEPP005694 *Juniperus osteosperma* / *Quercus havardii* - *Artemisia filifolia* - *Ephedra cutleri* Sandsheet Scrub
- CEPP005696 *Juniperus osteosperma* / *Quercus gambelii* Woodland
- CEPP006716 *Juniperus osteosperma* / *Gutierrezia microcephala* Woodland
- CEG002757 *Juniperus osteosperma* / *Artemisia arbuscula* Woodland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by M. Jennings and M.S. Reid.

Version Date: 2016/09/29

REFERENCES

References: Evens et al. 2014, Faber-Langendoen et al. 2017b, Keeler-Wolf and Thomas 2000, Sawyer et al. 2009

1. Forest & Woodland

1.B.2.Nc. Western North American Pinyon - Juniper Woodland & Scrub

1.B.2.Nc.1.b. M026 Intermountain Singleleaf Pinyon - Juniper Woodland

G248. Columbia Plateau Western Juniper Open Woodland

Type Concept Sentence: This woodland and savanna group is centered on the Columbia Plateau and extends from the eastern foothills of the Cascades and the Modoc Plateau across the northern margin of the Great Basin and is characterized by an open to closed canopy of *Juniperus occidentalis* that is sometime codominated by *Cercocarpus ledifolius* and typically has a shrubby understory dominated by *Artemisia tridentata*.

OVERVIEW

Scientific Name: *Juniperus occidentalis* Open Woodland Group

Common Name (Translated Scientific Name): Western Juniper Open Woodland Group

Colloquial Name: Western Juniper / Shrub Woodland

Type Concept: This woodland group is found on the Columbia Plateau and extends to the northern and western margins of the Great Basin, from southwestern Idaho, along the eastern foothills of the Cascades, south to the Modoc Plateau of northeastern California. *Juniperus occidentalis* is typically the only tree species with *Pinus monophylla* absent. *Pinus ponderosa* or *Pinus jeffreyi* may be present in higher elevation stands. The tree form of *Cercocarpus ledifolius* may occasionally codominate. In the understory, *Artemisia tridentata* is the most common shrub; others are *Cercocarpus ledifolius* (shrub form), *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Purshia tridentata*, *Ribes cereum*, and *Tetradymia* spp. Graminoids commonly include *Carex filifolia*, *Festuca idahoensis*, *Poa secunda*, and *Pseudoroegneria spicata*. This group occurs over a wide elevation range from under 200 m along the Columbia River in central Washington to over 1500 m in the Blue Mountains. In the middle of its distribution in central Oregon,

stands occur on all aspects and slope positions. Older woodlands are generally found in rocky areas where fire frequency is low. Generally soils are medium-textured, with abundant coarse fragments, and derived from volcanic parent materials. Throughout much of its range, fire exclusion and removal of fine fuels by grazing livestock have reduced fire frequency and allowed *Juniperus occidentalis* seedlings to colonize adjacent alluvial soils and expand into the shrub-steppe and grasslands. *Juniperus occidentalis* savanna may occur on the drier edges of woodlands where trees are intermingling with or invading the surrounding grasslands and where local edaphic or climatic conditions favor grasslands over shrublands. Where this group grades into relatively mesic forest or grassland habitats, these woodlands become restricted to rock outcrops or escarpments with excessively drained soils.

Classification Comments: This woodland group includes two very different ecological types. There are old-growth *Juniperus occidentalis* woodlands with trees and stands often over 1000 years old, with large, fairly well-spaced trees with rounded crowns. There are also large areas where juniper has expanded into sagebrush steppe and bunchgrass-dominated areas, with young, pointed-crowned trees growing closely together. Currently, these two very different types are about equally distributed across the landscape, with *Juniperus occidentalis* continuing to expand, either from the combination of fire exclusion, past grazing or climate change. *Juniperus occidentalis* has also expanded into *Pinus ponderosa* and *Pinus ponderosa* - *Pinus contorta* stands in central Oregon. These two types correspond to the *Juniperus occidentalis*-dominated portion of the *persistent pinyon-juniper woodlands* (open to denser of tree canopy occurring on shallow rocky soils) and *wooded shrublands* (open tree canopy with well-developed shrub stratum and variable grass-forb cover) described by Romme et al. (2009).

Woodland stands dominated by *Juniperus grandis* (= *Juniperus occidentalis* var. *australis*) occur in the subalpine Sierra Nevada and forested uplands of the northern Coast Ranges of California, southward to San Bernardino, San Gabriel and various desert mountain ranges and westward into Nevada are included in Sierra-Cascade Cold-Dry Subalpine Woodland Group (G243).

Similar NVC Types:

- G243 Sierra-Cascade Cold-Dry Subalpine Woodland

Diagnostic Characteristics: *Juniperus occidentalis* is the diagnostic and typically dominant species of this woodland and savanna group. This juniper species is largely restricted to the Columbia Plateau ecoregion. *Cercocarpus ledifolius* may codominate some stands. *Pinus monophylla* is not present in this region. The understory of stands included in this group is variable and ranges from perennial grass-dominated tree savannas and open woodlands to open and moderately dense woodlands with a shrub-dominated understory to wooded shrublands with a sparse *Juniperus occidentalis* tree layer (5-10% cover).

VEGETATION

Physiognomy and Structure: This woodland and savanna group has an open to dense canopy that includes two very different tree canopy structures: (1) an old-growth *Juniperus occidentalis* woodland with large, fairly well-spaced trees with rounded crowns, and (2) relatively young, often dense junipers trees with pointed crowns. The structure of the understory ranges from perennial grass-dominated tree savannas and open woodlands to shrublands with a very open tree canopy (wooded shrublands) and open to moderately dense woodlands with a shrub-dominated understory. Cover of understory species sharply declines when tree canopy cover exceeds 40% (Young et al. 1982). Many of the tree savannas have a sparse shrub layer present.

Floristics: Stands have a typically open tree canopy that is dominated by *Juniperus occidentalis* trees, although *Pinus ponderosa* or *Pinus jeffreyi* may be present in some stands. *Pinus monophylla* is not present in this region. The tree form of *Cercocarpus ledifolius* may occasionally codominate. In the understory, *Artemisia tridentata* is the most common shrub; others are *Purshia tridentata*, *Ericameria nauseosa*, *Cercocarpus ledifolius* (shrub form), *Chrysothamnus viscidiflorus*, *Ribes cereum*, and *Tetradymia* spp. Graminoids commonly include *Carex filifolia*, *Festuca idahoensis*, *Poa secunda*, and *Pseudoroegneria spicata*.

ENVIRONMENT & DYNAMICS

Environmental Description: This woodland group is found on the Columbia Plateau and extends to the northern and western margins of the Great Basin. Elevations range from under 200 m along the Columbia River in central Washington to over 1500 m. In central Oregon, the center of distribution, all aspects and slope positions occur. Old-growth stands are largely restricted to rocky outcrops, upper slopes and ridges, and rims of mesa and canyon that are fire-safe. Younger seral stands have invaded adjacent shrublands and grasslands and now occur on lower slopes, valleys and plains. Soils are generally medium-textured, with abundant coarse fragments, and derived from volcanic parent materials. Where this group grades into relatively mesic forest or grassland habitats, these woodlands become restricted to dry sites such as rock outcrops or escarpments with excessively drained soils. **Soil/substrate/hydrology:** Soils are generally medium-textured, with abundant coarse fragments, and derived from volcanic parent materials. In central Oregon, the center of distribution, all aspects and slope positions occur. Where this group grades into relatively mesic forest or grassland habitats, these woodlands become restricted to dry sites such as rock outcrops or escarpments with excessively drained soils.

Dynamics: *Juniperus occidentalis* is a long-lived tree that can exceed 3000 years in age in rocky, fire-protected areas such as along rimrock (Waigchler et al. 2001, Thorne et al. 2007). These fire-sensitive trees do not sprout following fire and are typically killed by moderate to severe fires (Tirmenstein 1999h, Sawyer et al. 2009). Young junipers have thin bark and are readily killed by surface fires (Martin et al. 1978), whereas mature trees with thicker bark are described as "moderately resistant" (Fowells 1965). Reproductive age begins at about 20 years, peaks after 50 years and continues for many years (Miller and Rose 1995, Tirmenstein 1999h). Following stand-replacing fire, recovery time is relatively slow and depends on stand maturity, the size and season of burn, fire severity and juniper mortality, the persistence of the seeds in the seed bank, location of seed source, the presence of animal dispersers such as Clark's nutcrackers, competition from herbaceous species and shrubs, and the amount of post-fire precipitation (Burkhardt and Tisdale 1976, Tirmenstein 1999h). Large burns and long distances from seed sources slow recovery rates because seed dispersal is dependent on water and animals (Tirmenstein 1999h).

DISTRIBUTION

Geographic Range: This woodland and savanna group is found along the northern and western margins of the Great Basin, from southwestern Idaho, along the eastern foothills of the Cascades, south to the Modoc Plateau of northeastern California. It also occurs in scattered localities of northern Nevada and south-central Washington.

Spatial Scale & Pattern [optional]: Large patch

Nations: US

States/Provinces: CA, ID, NV, OR, WA

TNC Ecoregions [optional]: 4:C, 6:C, 8:C

USFS Ecoregions (2007): 341G:CC, 342B:CC, 342C:CC, 342D:CP, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M261A:C?, M261D:CC, M261E:CP, M261G:CC, M332G:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = *Juniperus occidentalis* Zone (Franklin and Dyrness 1973)
- = Northern Juniper Woodlands (Holland and Keil 1995)
- = Western Juniper: 238 (Eyre 1980)

LOWER LEVEL UNITS

Alliances:

- A3500 *Juniperus occidentalis* / Herbaceous Understory Open Woodland Alliance
- A3499 *Juniperus occidentalis* / Shrub Understory Woodland Alliance

AUTHORSHIP

Primary Concept Source: J.F. Franklin and C.T. Dyrness (1973)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 11/09/2015

Classif Resp Region: West

Internal Author: KAS 1-10, 5-13, 11-15

REFERENCES

References: Barbour and Major 1988, Burkhardt and Tisdale 1976, Eyre 1980, Faber-Langendoen et al. 2017a, Fowells 1965, Franklin and Dyrness 1973, Holland and Keil 1995, Johnson and Clausnitzer 1992, Martin et al. 1978, Miller and Rose 1995, Romme et al. 2009, Sawyer et al. 2009, Shiflet 1994, Thorne et al. 2007, Tirmenstein 1999h, Volland 1976, Waigchler et al. 2001, Young et al. 1982

1. Forest & Woodland

1.B.2.Nc. Western North American Pinyon - Juniper Woodland & Scrub

G248. Columbia Plateau Western Juniper Open Woodland

G247. Great Basin Pinyon - Juniper Woodland

Type Concept Sentence: This woodland group occurs on dry mountain ranges of the Great Basin region and eastern foothills of the Sierra Nevada and is characterized by an open to moderately dense tree canopy typically composed of a mix of *Pinus monophylla* and *Juniperus osteosperma*, but either tree species may dominate as long as there is significant presence of *Pinus monophylla* (not accidental) to characterize the stand as a pinyon-juniper stand and not the more xeric, typically lower-elevation *Juniperus osteosperma* woodland and savanna.

OVERVIEW

Scientific Name: *Pinus monophylla* - *Juniperus osteosperma* Woodland Group

Common Name (Translated Scientific Name): Singleleaf Pinyon - Utah Juniper Woodland Group

Colloquial Name: Great Basin Singleleaf Pinyon - Utah Juniper / Herb Open Woodland

Type Concept: This woodland group occurs on dry mountain ranges of the Great Basin region and eastern foothills of the Sierra Nevada, and south in scattered locations throughout southern California. The vegetation is characterized by an open to moderately dense tree canopy typically composed of a mix of *Pinus monophylla* and *Juniperus osteosperma*, but either tree species may dominate as long as there is significant presence of *Pinus monophylla* (not accidental) to characterize the stand as a pinyon-juniper stand and not the more xeric, typically lower-elevation *Juniperus osteosperma* woodland and savanna. In some regions of southern California, *Juniperus osteosperma* is replaced by *Juniperus californica*. *Cercocarpus ledifolius* is a common associate and may occur in tree or shrub form. On the east slope of the Sierra Nevada in California, *Pinus jeffreyi* and *Juniperus grandis* (= *Juniperus occidentalis* var. *australis*) may be minor components of higher elevation stands in these woodlands. The understory layers are variable, but shrubs such as *Artemisia tridentata* frequently form a moderately dense short-shrub layer. Other associated shrubs include *Arctostaphylos patula*, *Artemisia arbuscula*, *Artemisia nova*, *Cercocarpus ledifolius*, *Cercocarpus intricatus*, *Coleogyne ramosissima*, *Juniperus californica*, *Quercus chrysolepis*, *Quercus gambelii*, *Quercus john-tuckeri*, *Quercus turbinella*, and *Yucca brevifolia*. Bunchgrasses such as *Bouteloua gracilis*, *Festuca idahoensis*, *Hesperostipa comata*, *Leymus cinereus* (= *Elymus cinereus*), *Poa fendleriana*, *Poa secunda*, and *Pseudoroegneria spicata* are commonly present and may form an herbaceous layer. These woodlands are typically found at lower elevations, but range from 1500-2600 m. Stands occur on warm, dry sites on mountain slopes, mesas, plateaus and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. These woodlands occur at lower elevation than Colorado Plateau Pinyon - Juniper Woodland Group (G250) where sympatric.

Classification Comments: This group corresponds to the *Pinus monophylla*-dominated portion of the *persistent pinyon-juniper woodland* type from Romme et al. (2009) that occurs on rocky uplands with shallow, coarse-textured, and often skeletal soils that support relatively sparse herbaceous cover and rarely burn.

Similar NVC Types:

- G250 Colorado Plateau Pinyon - Juniper Woodland
- G246 Colorado Plateau-Great Basin Juniper Open Woodland

Diagnostic Characteristics: These woodlands are characterized by diagnostic tree species *Pinus monophylla* that forms an open to dense tree layer often with the wider ranging *Juniperus osteosperma* or, less frequently, *Juniperus californica* in southern California. *Juniperus osteosperma* also may dominate woodland stands within the range of *Pinus monophylla* as long as there is significant presence of *Pinus monophylla* (not accidental) to characterize the stand as a pinyon-juniper stand and not the more xeric, typically lower-elevation *Juniperus osteosperma* woodland and savanna. Understory diagnostic species are characteristic of the Great Basin, such as *Arctostaphylos patula*, *Artemisia nova*, *Artemisia tridentata*, *Cercocarpus intricatus*, *Cercocarpus ledifolius*, *Coleogyne ramosissima*, *Purshia stansburiana*, *Purshia tridentata*, *Pleuraphis jamesii*, *Pseudoroegneria spicata*, *Poa secunda*, or *Poa fendleriana*.

VEGETATION

Physiognomy and Structure: This vegetation group is characterized by an open to moderately dense, short (2-10 m tall) evergreen needle-leaved or scale-leaved tree canopy. Open to dense shrub and herbaceous layers may be present or absent. Herbaceous layers are usually sparse.

Floristics: These woodlands are characterized by an open to moderately dense tree canopy typically composed of a mix of *Pinus monophylla* and *Juniperus osteosperma*, but either tree species may dominate as long as there is significant presence of *Pinus monophylla* (not accidental) to characterize the stand as a pinyon-juniper stand and not the more xeric, typically lower-elevation *Juniperus osteosperma* woodland and savanna. In some regions of southern California, *Juniperus osteosperma* is replaced by *Juniperus californica*. *Cercocarpus ledifolius* is a common associate and may occur in tree or shrub form. On the east slope of the Sierra Nevada in California, *Pinus jeffreyi* and *Juniperus grandis* (= *Juniperus occidentalis* var. *australis*) may be minor components of these woodlands. Understory layers are variable, but shrubs such as *Artemisia tridentata* frequently form a moderately dense short-shrub layer. Other associated shrubs include *Amelanchier utahensis*, *Arctostaphylos patula*, *Arctostaphylos pungens*, *Artemisia arbuscula*, *Artemisia nova*, *Ceanothus greggii*, *Cercocarpus intricatus*, *Coleogyne ramosissima*, *Glossopetalon spinescens*, *Peraphyllum ramosissimum*, *Prunus virginiana*, *Purshia stansburiana*, *Purshia tridentata*, *Quercus chrysolepis*, *Quercus gambelii*, *Quercus john-tuckeri*, *Quercus turbinella*, *Shepherdia rotundifolia*, and *Yucca brevifolia*. Bunchgrasses such as *Bouteloua gracilis*, *Festuca idahoensis*, *Hesperostipa comata*, *Leymus cinereus* (= *Elymus cinereus*), *Poa fendleriana*, *Poa secunda*, and *Pseudoroegneria spicata* are commonly present and may form an herbaceous layer.

ENVIRONMENT & DYNAMICS

Environmental Description: This woodland group occurs on dry mountain ranges of the Great Basin region and eastern foothills of the Sierra Nevada, and south in scattered locations throughout southern California. It is typically found at lower elevations but ranges from 1500-2600 m. These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus and ridges. Substrates are variable but are often rocky with shallow soil. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides.

Dynamics: *Pinus monophylla*, *Juniperus osteosperma*, and *Juniperus scopulorum* are slow-growing, long-lived trees (about 650 years for *Juniperus osteosperma*, 300 years for *Juniperus scopulorum*, and 800 years for *Pinus monophylla* although older individuals are known) (Burns and Honkala 1990a, Zlatnik 1999e, Zouhar 2001b, Scher 2002, Sawyer et al. 2009). These trees are killed by severe fire because of thin bark and lack of self-pruning; however, mature trees can survive low-intensity fires (Zouhar 2001b, Sawyer et al. 2009). Although there is variation in fire frequency because of the diversity of site characteristics, stand-replacing fire was uncommon in this ecological system historically, with an average fire-return interval (FRI) of 100-1000 years occurring primarily during extreme fire behavior conditions and during long droughts (Zouhar 2001b) (Landfire 2007a, BpS model 1210190). Mixed-severity fire (average FRI of 100-500 years) was characterized as a mosaic of replacement and surface fires distributed through stands in patches at a fine scale (<0.1 acre) (LF BpS model 1210190).

DISTRIBUTION

Geographic Range: This woodland group occurs on dry mountain ranges of the Great Basin region and eastern foothills of the Sierra Nevada. It extends southwest in California to the northern Transverse Ranges (Ventura County) and San Jacinto Mountains (Riverside County). Stands do not occur in Mexico.

Spatial Scale & Pattern [optional]: Matrix

Nations: US

States/Provinces: CA, ID, NV, UT

TNC Ecoregions [optional]: 6:C, 11:C, 12:C, 18:C

USFS Ecoregions (2007): 313A:CC, 322A:CC, 322B:CC, 341A:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342J:CC, M242C:??, M261D:C?, M261E:CC, M261G:CC, M331D:CC, M341A:CC, M341C:CC, M341D:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = PIMO Series (West et al. 1998)

LOWER LEVEL UNITS

Alliances:

- A2109 *Pinus monophylla* - *Juniperus osteosperma* / Herbaceous Understory Open Woodland Alliance
- A2108 *Pinus monophylla* - *Juniperus osteosperma* / Shrub Understory Woodland Alliance

AUTHORSHIP

Primary Concept Source: N.E. West, R.J. Tausch, and P.T. Tueller (1998)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 11/09/2015

Classif Resp Region: West

Internal Author: KAS 1-10, 5-13, 11-15

REFERENCES

References: Barbour and Major 1977, Brown 1982a, Brown et al. 1979, Burns and Honkala 1990a, Eyre 1980, Faber-Langendoen et al. 2017a, Holland and Keil 1995, Küchler 1964, Landfire 2007a, Romme et al. 2009, Sawyer et al. 2009, Scher 2002, Shiflet 1994, Thorne et al. 2007, West 1999a, West et al. 1998, Zlatnik 1999e, Zouhar 2001b

1. Forest & Woodland

1.B.2.Nc. Western North American Pinyon - Juniper Woodland & Scrub

G247. Great Basin Pinyon - Juniper Woodland

A2109. *Pinus monophylla* - *Juniperus osteosperma* / Herbaceous Understory Open Woodland Alliance

Type Concept Sentence: This open woodland and savanna alliance is characterized by diagnostic tree species *Pinus monophylla* that forms an open to moderately dense tree layer often with *Juniperus osteosperma* or, less frequently, *Juniperus californica* in southern California, with an understory dominated by an open to dense layer of perennial grasses and lacking significant cover of shrubs. It occurs on dry mountain slopes, foothills, plateaus and ridges in the Great Basin region and eastern foothills of the Sierra Nevada, and south in scattered locations throughout southern California, including desert mountain ranges.

OVERVIEW

Scientific Name: *Pinus monophylla* - *Juniperus osteosperma* / Herbaceous Understory Open Woodland Alliance

Common Name (Translated Scientific Name): Singleleaf Pinyon - Utah Juniper / Herbaceous Open Woodland Alliance

Colloquial Name: Great Basin Singleleaf Pinyon - Utah Juniper / Herb Open Woodland

Type Concept: These open woodlands and tree savannas are characterized by diagnostic tree species *Pinus monophylla* which forms an open to moderately dense tree layer often with *Juniperus osteosperma* or, less frequently, *Juniperus californica* in southern California. *Juniperus osteosperma* may also dominate stands as long as there is significant presence of *Pinus monophylla* that characterizes the stand as a pinyon-juniper stand and not the more xeric, typically lower elevation *Juniperus osteosperma* / Shrub Understory Woodland Alliance (A3496). At higher elevations and on relatively mesic sites, such as along drainages, *Juniperus scopulorum* may be present and sometimes dominant. Other conifers are absent or accidental with very low cover. The understory is characterized by an open to dense herbaceous layer. Scattered shrubs may be present but do not form a layer and do not exceed cover of herbaceous layer. Perennial grasses typically dominate the herbaceous layer, although forbs species are present and can be diverse. Characteristic species include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus elymoides*, *Hesperostipa comata*, *Leymus cinereus*, *Pleuraphis jamesii*, *Poa fendleriana*, *Poa secunda*, and *Pseudoroegneria spicata*. The non-native, invasive annual grass *Bromus tectorum* may become abundant and dominate the understory of highly disturbed stands. This open woodland and savanna alliance occurs on dry mountain ranges of the Great Basin region and eastern foothills of the Sierra Nevada, and south in scattered locations throughout southern California, including desert mountain ranges. Stands occur on warm, dry sites on mountain slopes, foothills, plateaus and ridges in ranges of the Great Basin and southern California, usually on erosional terrain or upper alluvial slopes. Elevations range from 1000 to 2800 m. The climate is semi-arid, with approximately 20-45 cm of precipitation annually. Substrates are variable but often rocky with shallow soil.

Classification Comments: This alliance currently contains *Pinus monophylla* - *Juniperus osteosperma* / *Leymus cinereus* Wooded Grassland (CEGL000835) which was described qualitatively from a single location in southern Idaho. Vegetation similar in composition has been described from southern California (Barbour and Major 1977) and Nevada (Blackburn 1967, Blackburn et al. 1969). The low-elevation woody vegetation of the Great Basin has been traditionally lumped into *Pinus monophylla* (singleleaf pinyon) or pinyon-juniper woodlands, and further classification work is needed to differentiate true woodlands from the savanna-like stands in this alliance. It is likely that these savannas are much more widely distributed than presently documented.

Internal Comments:

Other Comments:

Similar NVC Types: This alliance has similarities to other pinyon-juniper and juniper woodland and savanna alliances in several other groups, such as G200, G246, G248, G250, G252, G253, and G487.

- A3497 *Juniperus osteosperma* / Herbaceous Understory Open Woodland Alliance: is similar except overstory lacks *Pinus monophylla* or has low cover <5%.
- A3496 *Juniperus osteosperma* / Shrub Understory Woodland Alliance
- A2108 *Pinus monophylla* - *Juniperus osteosperma* / Shrub Understory Woodland Alliance: is similar but understory has a shrub layer (>10% cover) or, if less, shrub cover exceeds herbaceous cover.

Diagnostic Characteristics: This alliance is characterized by the diagnostic tree species *Pinus monophylla* which forms an open to moderately dense tree layer often with *Juniperus osteosperma* or, less frequently, *Juniperus californica* in southern California. *Juniperus osteosperma* may also dominate stands as long as there is significant presence of *Pinus monophylla* with which to characterize the stand as pinyon-juniper. Characteristic species include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus elymoides*, *Hesperostipa comata*, *Poa fendleriana*, *Poa secunda*, *Pleuraphis jamesii*, and *Pseudoroegneria spicata*.

VEGETATION

Physiognomy and Structure: These are sparse savannas and open woodland (5-30% cover) characterized by needle-leaved evergreen trees of low stature (<20 m). Scale-leaved evergreen trees are often present and may be codominant in the tree layer. The herbaceous layer is usually of low to moderate cover (20-40%) and dominated by tall perennial bunch grasses (0.5-1.5 m tall).

Floristics: These open woodlands and tree savannas are characterized by diagnostic tree species *Pinus monophylla* which forms an open to moderately dense tree layer often with *Juniperus osteosperma* or, less frequently, *Juniperus californica* in southern California. *Juniperus osteosperma* may also dominate stands as long as there is significant presence of *Pinus monophylla* that characterizes the stand as a pinyon-juniper stand and not the more xeric, typically lower elevation *Juniperus osteosperma* / Shrub Understory Woodland Alliance (A3496). At higher elevations and on relatively mesic sites, such as along drainages, *Juniperus scopulorum* may be present and sometimes dominant. Other conifers such as *Abies concolor*, *Pinus aristata*, *Pinus flexilis*, and *Pinus ponderosa* are absent or accidental with very low cover. The understory is characterized by an open to dense herbaceous layer. Scattered shrubs and dwarf-shrubs, such as *Cercocarpus ledifolius*, *Gutierrezia sarothrae*, and *Opuntia* sp., may be present but do not form a layer and do not exceed cover of herbaceous layer. Perennial grasses typically dominate the herbaceous layer, although forbs species are present and can be diverse. Characteristic species include *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua gracilis*, *Elymus elymoides*, *Hesperostipa comata*, *Leymus cinereus*, *Pleuraphis jamesii*, *Poa fendleriana*, *Poa secunda*, and *Pseudoroegneria spicata*. Common forbs include *Penstemon linarioides*, *Eriogonum umbellatum*, and *Hymenoxys richardsonii*. The non-native, invasive annual grass *Bromus tectorum* may become abundant in disturbed stands and dominate the understory of highly disturbed stands.

ENVIRONMENT & DYNAMICS

Environmental Description: These woodlands occur on warm, dry sites on mountain slopes, foothills, plateaus and ridges in ranges of the Great Basin and southern California, usually on erosional terrain or upper alluvial slopes. Elevations range from 1000 to 2800 m. The climate of the region is characterized as semi-arid, with warm summers and cold winters. Average annual precipitation is 27 cm (20-45 cm), and shows a peak during April through June, when more than 30% of the annual total is received. Summers are typically dry and there is usually extreme variation in yearly totals. In the Great Basin, these woodlands occur on intermediate slopes above pools of cold-air drainage. Upper elevation limits are determined by local climate and/or the presence of competing tree species. Soils are variable, but generally coarse-textured and well-drained and derived from gneiss, schist, quartzite, and amphibolite. Soil pH is usually nearly neutral or alkaline.

Dynamics: *Pinus monophylla* is a slow-growing, long-lived tree and stands appear somewhat static over time compared to more productive forests. Regeneration occurs primarily under nurse shrubs or adult trees, where canopy shading minimizes drought stress for seedlings (Koniak 1985). These woodlands are expanding into adjacent steppe grasslands in many areas, reportedly in connection with livestock grazing and altered fire regimes. Many of these woodlands have been intensively altered to enhance livestock forage.

DISTRIBUTION

Geographic Range: The core distribution of this woodland alliance is the Great Basin, but it extends out into adjacent ecoregions primarily west into the foothills of the Sierra Nevada, south on scattered mountain ranges of the Mojave Desert and east into the transition zone with the Colorado Plateau. A second substantial range occurs along interior slopes in the Transverse and Peninsular ranges of southern California.

Nations: US

States/Provinces: AZ, CA, ID, NV, UT

TNC Ecoregions [optional]: 11:C

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: NPS (Great Basin)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- >< *Pinus monophylla* (Singleleaf pinyon woodlands) Alliance (Sawyer et al. 2009) [87.040.00]
- >< Singleleaf Pinyon Series (Sawyer and Keeler-Wolf 1995)
- >< Singleleaf Pinyon-Utah Juniper Series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS

Associations:

- CEGLO00835 *Pinus monophylla* - *Juniperus osteosperma* / *Leymus cinereus* Wooded Grassland
- CEGLO03154 *Pinus monophylla* / *Artemisia tridentata* / *Elymus elymoides* Open Woodland
- CEGLO02969 *Pinus monophylla* - *Juniperus osteosperma* / *Hesperostipa comata* Open Woodland
- CEGLO05440 *Pinus monophylla* - *Juniperus osteosperma* / *Poa (fendleriana, secunda)* Open Woodland
- CEGLO05396 *Pinus monophylla* - *Juniperus osteosperma* / *Bouteloua gracilis* Open Woodland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by M. Jennings and D. Sarr.

Version Date: 2014/03/14

REFERENCES

References: Armstrong 1969, Barrows et al. 1977, Beatley 1976, Blackburn 1967, Blackburn et al. 1968a, Blackburn et al. 1968c, Blackburn et al. 1969a, Blackburn et al. 1969c, Blackburn et al. 1969d, Blackburn et al. 1969e, Caicco and Wellner 1983a, Everett 1986, Faber-Langendoen et al. 2017b, Heinze et al. 1962, Koniak 1985, Kurzius 1981, Peterson 1984a, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shaw et al. 1995, West et al. 1998

1. Forest & Woodland

1.B.2.Nc. Western North American Pinyon - Juniper Woodland & Scrub

G247. Great Basin Pinyon - Juniper Woodland

A2108. *Pinus monophylla* - *Juniperus osteosperma* / Shrub Understory Woodland Alliance

Type Concept Sentence: This woodland alliance is characterized by diagnostic tree species *Pinus monophylla* that forms an open to dense tree layer often with *Juniperus osteosperma* or, less frequently, *Juniperus californica* in southern California, with an understory that is characterized by shrubs that typically form an open to moderately dense layer. It is found on dry mountain slopes, foothills, plateaus and ridges of the Great Basin region and eastern foothills of the Sierra Nevada, and south in scattered locations throughout southern California, including desert mountain ranges.

OVERVIEW

Scientific Name: *Pinus monophylla* - *Juniperus osteosperma* / Shrub Understory Woodland Alliance

Common Name (Translated Scientific Name): Singleleaf Pinyon - Utah Juniper / Shrub Understory Woodland Alliance

Colloquial Name: Great Basin Singleleaf Pinyon - Utah Juniper / Shrub Woodland

Type Concept: This woodland alliance is found on dry mountain ranges of the Great Basin region and eastern foothills of the Sierra Nevada, and south in scattered locations throughout southern California, including desert mountain ranges. *Pinus monophylla* forms an open to dense tree layer often with *Juniperus osteosperma* or, less frequently, *Juniperus californica* in southern California. *Juniperus osteosperma* may also dominate stands as long as there is significant presence of *Pinus monophylla* that characterizes the stand as a pinyon-juniper stand and not the more xeric, typically lower elevation *Juniperus osteosperma* / Shrub Understory Woodland Alliance (A3496). At higher elevations and on relatively mesic sites, such as along drainages, *Juniperus scopulorum* may be present and sometimes dominant. Other conifers are absent or accidental. The understory is characterized by shrubs that typically form an open to moderately dense layer. Similar scattered shrubs frequently characterize sparse and rocky understory woodlands and so those types are included in this alliance. Characteristic shrubs are many, including *Amelanchier utahensis*, *Arctostaphylos patula*, *Arctostaphylos pungens*, *Artemisia arbuscula*, *Artemisia nova*, *Artemisia tridentata* ssp. *tridentata*, *Artemisia tridentata* ssp. *vaseyana*, *Ceanothus greggii*, *Cercocarpus intricatus*, *Cercocarpus ledifolius*, *Coleogyne ramosissima*, *Ephedra* spp., *Ericameria* spp., *Glossopetalon spinescens*, *Gutierrezia sarothrae*, *Peraphyllum ramosissimum*, *Prunus virginiana*, *Purshia stansburiana*, *Quercus gambelii*, *Quercus turbinella*, *Ribes velutinum*, *Shepherdia rotundifolia*, and *Symphoricarpos oreophilus*. The herbaceous layer is sparse to moderate and composed of grasses and often diverse forbs. Common species may include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Hesperostipa comata*, *Poa fendleriana*, *Poa secunda*, *Pleuraphis jamesii*, and *Pseudoroegneria spicata*. The non-native, invasive annual grass *Bromus tectorum* may become abundant in disturbed stands and dominate the herbaceous layer of highly disturbed stands. This alliance also includes sparse understory stands often with scattered shrubs and grasses. Stands occur on warm, dry sites on mountain slopes, foothills, plateaus and ridges in ranges of the Great Basin and southern California, usually on erosional terrain or upper alluvial slopes. Elevations range from 1000 to 2800 m. The climate is semi-arid, with approximately 20-45 cm of precipitation annually. Substrates are variable but often rocky with shallow soil.

Classification Comments: Scattered shrubs frequently characterize sparse and rock understory stands and so are included in this alliance.

Internal Comments:

Other Comments:

Similar NVC Types: This alliance has similarities to other pinyon-juniper and juniper woodland and savanna alliances in several other groups, such as G200, G246, G248, G250, G252, G253, and G487.

- A2109 *Pinus monophylla* - *Juniperus osteosperma* / Herbaceous Understory Open Woodland Alliance: is similar but understory lacks a shrub layer and is dominated by an herbaceous layer (>10% cover) or, if less, grass cover exceeds shrub cover.
- A3574 *Juniperus monosperma* / Shrub Understory Woodland Alliance
- A3496 *Juniperus osteosperma* / Shrub Understory Woodland Alliance: is similar except overstory lacks *Pinus monophylla* or has low cover <5%.

Diagnostic Characteristics: This alliance is characterized by diagnostic tree species *Pinus monophylla* that forms an open to dense tree layer often with *Juniperus osteosperma* or, less frequently, *Juniperus californica* in southern California. *Juniperus osteosperma* may also dominate stands as long as there is significant presence of *Pinus monophylla* with which to characterize the stand as a pinyon-juniper stand and not the more xeric, typically lower elevation *Juniperus osteosperma* / Shrub Understory Woodland Alliance (A3496). Understory diagnostic species include *Amelanchier utahensis*, *Arctostaphylos patula*, *Arctostaphylos patula*, *Artemisia nova*, *Artemisia tridentata*, *Cercocarpus intricatus*, *Cercocarpus ledifolius*, *Coleogyne ramosissima*, *Purshia stansburiana*, *Purshia tridentata*, *Quercus gambelii*, *Quercus turbinella*, *Shepherdia rotundifolia*, and *Symphoricarpos oreophilus*. This alliance also includes sparse understory stands often with scattered shrubs and grasses. The lack of understory can be caused by harsh substrate (rockland, shale badland) or dense tree canopy resulting from lack of fire that shades out understory.

VEGETATION

Physiognomy and Structure: These are open to dense woodlands (10-70% cover), dominated by needle-leaved evergreen trees of low stature (<20 m). Scale-leaved evergreen trees or tall shrubs (2-10 m tall) are often present and may be codominant. Generally, evergreen or cold-deciduous shrubs occupy the interstices between trees, interspersed with caespitose graminoids. In total, the ground layer is usually of low to moderate cover (20-40%). This alliance also includes sparse understory stands often with scattered shrubs and grasses.

Floristics: *Pinus monophylla* forms an open to dense tree layer often with *Juniperus osteosperma* or, less frequently, *Juniperus californica* in southern California. *Juniperus osteosperma* may also dominate stands as long as there is significant presence of *Pinus monophylla* that characterizes the stand as a pinyon-juniper stand and not the more xeric, typically lower elevation *Juniperus osteosperma* / Shrub Understory Woodland Alliance (A3496). At higher elevations and on relatively mesic sites, such as along drainages, *Juniperus scopulorum* may be present and sometimes dominant. Other conifers such as *Abies concolor*, *Pinus aristata*, *Pinus flexilis*, *Pinus jeffreyi*, and *Pinus ponderosa* are absent or accidental with very low cover. The understory is characterized by shrubs that typically form an open to moderately dense layer. Similar scattered shrubs frequently characterize sparse and rocky understory woodlands and so those types are included in this alliance. Characteristic shrubs are many, including *Amelanchier utahensis*, *Arctostaphylos patula*, *Arctostaphylos pungens*, *Artemisia arbuscula*, *Artemisia nova*, *Artemisia tridentata* ssp. *tridentata*, *Artemisia tridentata* ssp. *vaseyana*, *Ceanothus greggii*, *Cercocarpus intricatus*, *Cercocarpus ledifolius*, *Coleogyne ramosissima*, *Ephedra* spp., *Ericameria* spp., *Glossopetalon spinescens*, *Gutierrezia sarothrae*, *Peraphyllum ramosissimum*, *Prunus virginiana*, *Purshia stansburiana*, *Quercus gambelii*, *Quercus turbinella*, *Ribes velutinum*, *Shepherdia rotundifolia*, and *Symphoricarpos oreophilus*. Along the eastern slopes of the Sierra Nevada or Transverse Ranges of southern California, *Arctostaphylos glauca*, *Ceanothus cuneatus*, *Eriogonum fasciculatum*, *Quercus chrysolepis*, and *Yucca schidigera* may also occur. The herbaceous layer is sparse to moderate and composed of grasses and often diverse forbs. Common species may include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Hesperostipa comata*, *Poa fendleriana*, *Poa secunda*, *Pleuraphis jamesii*, and *Pseudoroegneria spicata*. Although forb cover is generally sparse, it may be very diverse. Common forbs include *Astragalus* spp., *Cryptantha cinerea* var. *jamesii* (= *Cryptantha jamesii*), *Eriogonum caespitosum*, *Eriogonum umbellatum*, *Gayophytum ramosissimum*, *Gilia ochroleuca*, *Hymenoxys richardsonii*, *Lomatium foeniculaceum* ssp. *macdougallii* (= *Lomatium macdougallii*), *Machaeranthera canescens*, *Penstemon linarioides*, *Phlox* spp., and *Sphaeralcea coccinea*. Disturbed stands may have high cover of the introduced annual grass *Bromus tectorum* or *Halogeton glomeratus*, an introduced forb. This alliance also includes sparse understory stands often with scattered shrubs and grasses. The lack of understory can be caused by harsh substrate (rockland, shale badland) or dense tree canopy that shades out the understory.

ENVIRONMENT & DYNAMICS

Environmental Description: These woodlands occur on warm, dry sites on mountain slopes, foothills, plateaus and ridges in ranges of the Great Basin and southern California, usually on erosional terrain or upper alluvial slopes. Elevations range from 1000 to 2800 m. The climate of the region is characterized as semi-arid, with warm summers and cold winters. Average annual precipitation is 27 cm (20-45 cm), and shows a peak during April through June, when more than 30% of the annual total is received. Summers are typically dry and there is usually extreme variation in yearly totals. In the Great Basin, these woodlands occur on intermediate slopes above pools of cold-air drainage. Upper elevation limits are determined by local climate and/or the presence of competing tree species. Soils are variable, but generally coarse-textured and well-drained and derived from gneiss, schist, quartzite, and amphibolite. Soil pH is usually nearly neutral or alkaline.

Dynamics: *Pinus monophylla* is a slow-growing, long-lived tree and stands appear somewhat static over time compared to more productive forests. Regeneration occurs primarily under nurse shrubs or adult trees, where canopy shading minimizes drought stress for seedlings (Koniak 1985). These woodlands are expanding into adjacent steppe grasslands in many areas, reportedly in connection with livestock grazing and altered fire regimes. Many of these woodlands have been intensively altered to enhance livestock forage.

DISTRIBUTION

Geographic Range: The core distribution of this woodland alliance is the Great Basin, but it extends out into adjacent ecoregions primarily west into the foothills of the Sierra Nevada, south on scattered mountain ranges of the Mojave Desert and east into the

transition zone with the Colorado Plateau. A second substantial range occurs along interior slopes in the Transverse and Peninsular ranges of southern California.

Nations: US

States/Provinces: AZ, CA, ID, NV, UT

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Lake Mead, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- >< *Pinus monophylla* (Singleleaf pinyon woodlands) Alliance (Sawyer et al. 2009) [87.040.00]
- = *Pinus monophylla*-(*Juniperus osteosperma*) Woodland Alliance (Evens et al. 2014)
- >< Singleleaf Pinyon Series (Sawyer and Keeler-Wolf 1995)
- >< Singleleaf Pinyon-Utah Juniper Series (Sawyer and Keeler-Wolf 1995)
- >< Utah Juniper Series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS

Associations:

- CEGLO00838 *Pinus monophylla* - *Quercus gambelii* / *Artemisia tridentata* Woodland
- CEPP006732 *Pinus monophylla* / *Eriogonum fasciculatum* Woodland
- CEGLO00828 *Pinus monophylla* - *Juniperus osteosperma* / *Cercocarpus ledifolius* Woodland
- CEGLO02941 *Pinus monophylla* - *Juniperus osteosperma* / *Quercus turbinella* Woodland
- CEGLO00827 *Pinus monophylla* / *Artemisia tridentata* Woodland
- CEGLO00829 *Pinus monophylla* - *Juniperus osteosperma* / Sparse Understory Woodland
- CEGLO03153 *Pinus monophylla* / *Ribes velutinum* Woodland
- CEGLO00831 *Pinus monophylla* - *Juniperus osteosperma* / *Artemisia nova* Woodland
- CEGLO00837 *Pinus monophylla* - *Juniperus osteosperma* - *Quercus gambelii* / *Artemisia tridentata* Woodland
- CEGLO02968 *Pinus monophylla* - *Juniperus osteosperma* / *Quercus gambelii* Woodland
- CEGLO00832 *Pinus monophylla* - *Juniperus osteosperma* / *Artemisia tridentata* Woodland
- CEGLO00834 *Pinus monophylla* - *Juniperus osteosperma* / *Cercocarpus ledifolius* / *Pseudoroegneria spicata* Woodland
- CEGLO00825 *Pinus monophylla* Woodland
- CEGLO00826 *Pinus monophylla* / *Amelanchier alnifolia* / *Arctostaphylos patula* Woodland
- CEGLO02971 *Pinus monophylla* - *Juniperus osteosperma* / *Coleogyne ramosissima* Woodland
- CEGLO00839 *Pinus monophylla* / *Symphoricarpos oreophilus* - *Artemisia tridentata* Woodland
- CEGLO02970 *Pinus monophylla* - *Juniperus osteosperma* / *Gutierrezia sarothrae* / *Pleuraphis jamesii* Woodland
- CEGLO00836 *Pinus monophylla* - *Juniperus osteosperma* / *Prunus virginiana* Woodland
- CEGLO02942 *Pinus monophylla* - *Juniperus osteosperma* / (*Shepherdia rotundifolia*, *Amelanchier utahensis*) Woodland
- CEGLO05437 *Pinus monophylla* - (*Juniperus osteosperma*) / *Cercocarpus intricatus* Woodland
- CEGLO05300 *Juniperus osteosperma* - (*Pinus monophylla*) / *Ceanothus greggii* Woodland
- CEGLO05438 *Pinus monophylla* - *Juniperus osteosperma* / *Glossopetalon spinescens* - *Artemisia tridentata* - *Purshia stansburiana* Woodland
- CEGLO05397 *Pinus monophylla* - *Juniperus osteosperma* / *Purshia stansburiana* Woodland
- CEGLO05299 *Juniperus osteosperma* - (*Pinus monophylla*) / *Arctostaphylos pungens* Woodland
- CEGLO05436 *Pinus monophylla* - *Juniperus osteosperma* / *Artemisia tridentata* ssp. *vaseyana* - Mixed Shrub Woodland
- CEGLO05439 *Pinus monophylla* - *Juniperus osteosperma* / *Peraphyllum ramosissimum* Woodland
- CEPS009608 *Pinus monophylla* - *Juniperus osteosperma* / *Purshia tridentata* Woodland [Park Special]
- CEGLO00830 *Pinus monophylla* - *Juniperus osteosperma* / *Artemisia arbuscula* Woodland
- CEGLO00833 *Pinus monophylla* - *Juniperus osteosperma* / *Artemisia tridentata* ssp. *vaseyana* / *Pseudoroegneria spicata* Woodland
- CEGLO05772 *Pinus monophylla* / *Prunus fasciculata* - *Rhus trilobata* Woodland
- CEGLO05771 *Pinus monophylla* / *Garrya flavescens* Woodland
- CEGLO03152 *Pinus monophylla* / *Cercocarpus ledifolius* / *Artemisia tridentata* - *Purshia tridentata* Woodland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by M. Jennings and D. Sarr.

Version Date: 2014/03/14

REFERENCES

References: Armstrong 1969, Baker 1983b, Baker 1984a, Baker and Kennedy 1985, Beatley 1976, Blackburn 1967, Blackburn et al. 1968a, Blackburn et al. 1968c, Blackburn et al. 1969a, Blackburn et al. 1969c, Blackburn et al. 1969d, Blackburn et al. 1969e, Blackburn et al. 1971, Bradley 1964, Brotherson and Evenson 1983, Caicco and Wellner 1983a, Caicco and Wellner 1983b, Caicco and Wellner 1983c, Clary et al. 1974, Dalen and Snyder 1987, Dastrup 1963, Despain 1973a, Donart et al. 1978b, Eddleman and Jaindl 1994, Evens et al. 2014, Everett 1986, Faber-Langendoen et al. 2017b, Heinze et al. 1962, Isaacson 1967, Jameson et al. 1962, Johnsen 1962, Johnson and Pfister 1982, Johnston 1987, Jones 1989b, Kline 1973, Knight et al. 1987, Komarkova et al. 1988a, Komarkova et al. 1988b, Koniak 1985, Kurzius 1981, Larson and Moir 1986, Larson and Moir 1987, Lesica and DeVelice 1992, Marriott and Jones 1989, Milton and Purdy 1983, Moir and Carleton 1987, Peterson 1984a, Rust 1999, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shaw et al. 1995, USFS 1983a, USFS 1985c, USFS 1985e, Warren n.d., West et al. 1978, West et al. 1998, Wight 1965, Wight and Fisser 1968

1. Forest & Woodland

1.B.2.Nc. Western North American Pinyon - Juniper Woodland & Scrub

1.B.2.Nc.1.d. M026 Intermountain Singleleaf Pinyon - Juniper Woodland

G249. Intermountain Basins Curl-leaf Mountain-mahogany Woodland & Scrub

Type Concept Sentence: This *Cercocarpus ledifolius*-dominated woodland and shrubland group occurs in hills and mountain ranges of the intermountain western U.S. from the eastern foothills of the Sierra Nevada northeast to the foothills of the Bighorn Mountains and includes both tree and shrub forms of *Cercocarpus ledifolius* with *Artemisia tridentata ssp. vaseyana*, *Purshia tridentata*, and species of *Arctostaphylos*, *Ribes*, or *Symphoricarpos* often present to codominant in the shrub layer.

OVERVIEW

Scientific Name: *Cercocarpus ledifolius* Woodland & Scrub Group

Common Name (Translated Scientific Name): Curl-leaf Mountain-mahogany Woodland & Scrub Group

Colloquial Name: Curl-leaf Mountain-mahogany / Herb Woodland

Type Concept: This woodland and shrubland group includes stands dominated by either the tree or shrub form of *Cercocarpus ledifolius*. Scattered junipers or pines may also occur. *Artemisia tridentata ssp. vaseyana*, *Purshia tridentata*, along with species of *Arctostaphylos*, *Ribes*, or *Symphoricarpos* are often present to codominate in the shrub layer. Herbaceous undergrowth is often sparse and dominated by bunchgrasses, usually *Pseudoroegneria spicata* and *Festuca idahoensis*. Stands occur in hills and mountain ranges of the Intermountain West basins from the eastern foothills of the Sierra Nevada northeast to the foothills of the Bighorn Mountains. It typically occurs from 600 m to over 2650 m in elevation on rocky outcrops or escarpments and forms small- to large-patch stands in forested areas. Most stands occur as shrublands on ridges and steep rimrock slopes, but they may be composed of small trees in steppe areas. The tree form of *Cercocarpus ledifolius* is more common in the western range extent. *Cercocarpus ledifolius* is a slow-growing, drought-tolerant species that generally does not resprout after burning and needs the protection from fire that rocky sites provide.

Classification Comments: Within this group, the *Cercocarpus ledifolius* woodland and shrubland alliances are poorly distinguished in the literature, as most authors describe the species as having either a tall-shrub or small-tree growth form within a single association. Some associations may have shrub-dominated stands in one area and also have a woodland physiognomy in another. The woodland physiognomy appears to be more typical, based on available literature. Near the northern edge of its range in Montana and Idaho, *Cercocarpus ledifolius* is described as occurring primarily in the shrub form (Mueggler and Stewart 1980, Tisdale 1986). These northern variants are the only described stands which appear to be clearly distinct from the woodland alliance. The woodland alliance may have a different subspecies (or variety) as a dominant than the shrubland. Woodland stands tend to occur in the more western portion of the species range and are largely attributed to *Cercocarpus ledifolius var. intercedens* (= *Cercocarpus ledifolius var. intermontanus*), whereas *Cercocarpus ledifolius var. ledifolius* is found in the eastern and northern portions of the range and typically occurs as a shrubland.

Similar NVC Types:

Diagnostic Characteristics: *Cercocarpus ledifolius* is the diagnostic and dominant species of this woodland and shrubland group. Scattered pinyon or juniper trees may be present with low cover in woodland stands. If pinyon and juniper trees are codominant, then the stand is pinyon-juniper woodland. In shrubland stands, other shrubs, especially *Artemisia tridentata ssp. vaseyana*, *Purshia tridentata*, or *Symphoricarpos* spp., may be present to codominant.

VEGETATION

Physiognomy and Structure: Structure in this group is variable as *Cercocarpus ledifolius* stands may form an open to dense short-tree canopy (3-5 m tall), a tall-shrub layer (3-4 m tall), or a short-shrub layer (1-2 m tall). Herbaceous layers are variable depending on density of woody canopy and type of substrate.

Floristics: This group includes both woodlands and shrublands dominated by *Cercocarpus ledifolius*. *Artemisia tridentata* ssp. *vaseyana*, *Purshia tridentata*, along with *Arctostaphylos patula*, *Holodiscus dumosus*, *Mahonia repens*, and species of *Ribes* or *Symphoricarpos* are often present. Undergrowth is often sparse and dominated by bunchgrasses, usually *Pseudoroegneria spicata* with *Calamagrostis rubescens*, *Festuca idahoensis*, *Leymus salinus*, or *Poa secunda*. Scattered junipers or pines may also occur.

ENVIRONMENT & DYNAMICS

Environmental Description: This woodland and shrubland group occurs in hills and mountain ranges of the Intermountain West basins from the eastern foothills of the Sierra Nevada northeast to the foothills of the Bighorn Mountains. It typically occurs from 600 m to over 2650 m in elevation on rocky outcrops or escarpments and forms small- to large-patch stands in forested areas. Most stands occur as shrublands on ridges and steep rimrock slopes, but they may be composed of small trees in steppe areas.

Dynamics: *Cercocarpus ledifolius* is a slow-growing, drought-tolerant species that can inhabit very poor sites, such as cliffs and outcrops. Stands are often small and clumped near ridgetops. These sites may also afford the species some protection from fire. The species is highly susceptible to fire damage and generally does not resprout. *Cercocarpus ledifolius* is highly favored by native ungulates for winter range, and many individual shrubs show evidence of highlining by deer or elk.

DISTRIBUTION

Geographic Range: This woodland and shrubland group occurs in hills and mountain ranges of the Intermountain West basins from the eastern foothills of the Sierra Nevada northeast to the foothills of the Bighorn Mountains.

Spatial Scale & Pattern [optional]: Large patch

Nations: US

States/Provinces: CA, CO, ID, MT, NV, OR, UT, WY

TNC Ecoregions [optional]: 6:P, 9:C, 10:P, 11:C, 12:C

USFS Ecoregions (2007): 313A:CC, 331A:CC, 331G:CC, 341A:CC, 341B:CP, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CP, 342G:CC, 342H:CC, 342I:CP, 342J:CC, M242C:CC, M261E:CC, M261G:CC, M331A:C?, M331B:CC, M331D:CC, M331E:CC, M331J:C?, M332A:CC, M332B:C?, M332D:C?, M332E:CC, M332F:CC, M332G:CC, M333D:PP, M341A:CC, M341B:CC, M341C:CC, M341D:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > Curlleaf Mountain-Mahogany (415) (Shiflet 1994)
- > Curlleaf Mountain-Mahogany - Bluebunch Wheatgrass (322) (Shiflet 1994)

LOWER LEVEL UNITS

Alliances:

- A3570 *Cercocarpus ledifolius* / Herbaceous Understory Woodland Alliance
- A0586 *Cercocarpus ledifolius* / Shrub Understory Woodland Alliance
- A0828 *Cercocarpus ledifolius* Scrub Alliance

AUTHORSHIP

Primary Concept Source: T.N. Shiflet (1994)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 11/09/2015

Classif Resp Region: West

Internal Author: KAS 1-10, 11-15

REFERENCES

References: Dealy 1975, Dealy 1978, Eyre 1980, Faber-Langendoen et al. 2017a, Holland and Keil 1995, Knight 1994, Knight et al. 1987, Lewis 1975b, Mueggler and Stewart 1980, Sawyer et al. 2009, Shiflet 1994

1. Forest & Woodland

1.B.2.Nc. Western North American Pinyon - Juniper Woodland & Scrub

G249. Intermountain Basins Curl-leaf Mountain-mahogany Woodland & Scrub

A3570. *Cercocarpus ledifolius* / Herbaceous Understory Woodland Alliance

Type Concept Sentence: This woodland alliance is characterized by an open tree canopy of *Cercocarpus ledifolius* with the understory characterized by an open to moderate herbaceous layer typically dominated by bunchgrasses. It occurs in semi-arid steppe and temperate mountainous habitats of the interior western United States.

OVERVIEW

Scientific Name: *Cercocarpus ledifolius* / Herbaceous Understory Woodland Alliance

Common Name (Translated Scientific Name): Curl-leaf Mountain-mahogany / Herbaceous Understory Woodland Alliance

Colloquial Name: Curl-leaf Mountain-mahogany / Herb Woodland

Type Concept: The vegetation in this alliance is characterized by an open canopy of *Cercocarpus ledifolius*. Steppe woodlands typically have only *Cercocarpus ledifolius* in the overstory canopy, but *Juniperus occidentalis*, *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus edulis*, or *Pinus monophylla* occur in local areas. The understory is characterized by an open to moderate herbaceous layer typically dominated by bunchgrasses. Characteristic species include *Achnatherum* spp., *Calamagrostis rubescens*, *Elymus elymoides*, *Festuca idahoensis*, *Leymus ambiguus*, *Leymus salinus*, and *Pseudoroegneria spicata*. Diverse forbs may be present, usually with low cover. Scattered short shrubs may be present, but they do not form a layer (<10% cover) and have less total cover than the herbaceous layer. Plant associations in this alliance occur in semi-arid steppe and cool temperate mountainous habitats of the interior western United States. These woodlands often form small patchy stands in forested areas or may form the only tree cover in steppe regions. Elevation ranges from 1730-2745 m (5675-9000 feet). Lower elevation stands in steppe regions have rolling topography, whereas mountain stands occur on moderate to very steep slopes and ridges. Aspect is variable depending on elevation. Annual precipitation is variable in amount (18-56 cm) and season depending on location with mostly snow in mountains and spring convective showers in steppe region. Soils are moderately shallow, rocky, well-drained gravelly loams over cracked bedrock or colluvium.

Classification Comments: The *Cercocarpus ledifolius* woodland and shrubland alliances are poorly distinguished in the literature, as most authors describe the species as having either a tall-shrub or small-tree growth form within a single association. Some associations may have shrub-dominated stands in one area and also have a woodland physiognomy in another. The woodland physiognomy appears to be more typical, based on available literature. Near the northern edge of its range in Montana and Idaho, *Cercocarpus ledifolius* is described as occurring primarily in the shrub-form (Mueggler and Stewart 1980, Tisdale 1986). These northern variants are the only described stands which appear to be clearly distinct from the woodland alliance.

The woodland stands may have a different subspecies (or variety) as a dominant than the shrubland. In Wyoming, the heritage program is proposing to recognize two *Cercocarpus ledifolius* alliances, based upon varieties of *Cercocarpus ledifolius*. The most widespread proposed alliance there is dominated by *Cercocarpus ledifolius* var. *ledifolius*, which grows up to about 1.5 m tall. The other proposed alliance, dominated by *Cercocarpus ledifolius* var. *intercedens*, is found only along the western border of the state, and the growth form is as small trees 4-5 m tall. The two taxa are obviously different in Wyoming, in stature and leaf characteristics, and are easily separated. Further review of the two current *Cercocarpus ledifolius* alliances may warrant treatment as proposed for Wyoming.

Internal Comments:

Other Comments:

Similar NVC Types: This alliance has similarities to several montane conifer woodland alliances that have *Cercocarpus ledifolius* codominant in the subcanopy in several other groups, such as G209, G213, G215, G224, G226, G243, and G344.

- A0828 *Cercocarpus ledifolius* Scrub Alliance: is similar except overstory is composed of shrub-form rather than tree-form *Cercocarpus ledifolius*.
- A0586 *Cercocarpus ledifolius* / Shrub Understory Woodland Alliance: is similar but understory has a shrub layer (>10% cover) or, if less, shrub cover exceeds herbaceous cover.

Diagnostic Characteristics: The vegetation in this woodland alliance is characterized by an open tree canopy dominated by *Cercocarpus ledifolius*, sometimes with low cover of *Juniperus occidentalis*, *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus edulis*, or *Pinus monophylla*. The understory is characterized by an open to dense herbaceous layer. Diagnostic species include *Achnatherum* spp., *Calamagrostis rubescens*, *Elymus elymoides*, *Festuca idahoensis*, *Leymus ambiguus*, *Leymus salinus*, and *Pseudoroegneria spicata*. If shrubs are present, then cover is low (<10%) and the herbaceous layer significantly exceeds shrub cover forming a layer.

VEGETATION

Physiognomy and Structure: Plant associations in this alliance are woodlands dominated by a spreading broad-leaved evergreen small tree (5-15 m tall) of open cover (10-30%). Scattered evergreen or cold-deciduous shrubs may be present with low cover (<10%). A ground layer of caespitose or rhizomatous perennial graminoids is present and characterizes the understory.

Floristics: The vegetation in this alliance is characterized by an open canopy of *Cercocarpus ledifolius*. Steppe woodlands typically have only *Cercocarpus ledifolius* in the overstory canopy, but *Juniperus occidentalis*, *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus edulis*, or *Pinus monophylla* occur in local areas. The understory is characterized by an open to moderate herbaceous layer typically dominated by bunchgrasses. Characteristic species include *Achnatherum* spp., *Calamagrostis rubescens*, *Elymus elymoides*, *Festuca idahoensis*, *Leymus ambiguus*, *Leymus salinus*, and *Pseudoroegneria spicata*. Diverse forbs may be present, usually with low cover, and include such perennials as *Geum triflorum*, *Hieracium cynoglossoides*, *Senecio integerrimus*, and *Viola nuttallii*; the annual *Agoseris heterophylla* is often present. Other abundant and constant species include *Achnatherum lemmonii*, *Hesperostipa comata*, *Poa fendleriana*, and *Poa secunda*, and the perennial sedge *Carex rossii*. Scattered short shrubs may be present, including *Amelanchier alnifolia*, *Artemisia tridentata* ssp. *vaseyana*, *Ericameria nauseosa* (= *Chrysothamnus nauseosus*), *Holodiscus dumosus*, *Purshia tridentata*, *Prunus virginiana*, *Ribes* spp., and *Symphoricarpos* spp., but they do not form a layer (<10% cover) and have less total cover than the herbaceous layer.

ENVIRONMENT & DYNAMICS

Environmental Description: Plant associations in this woodland alliance occur in semi-arid steppe and foothills, and cool temperate mountainous habitats of the interior western United States. These woodlands often form small patchy stands in forested areas or may form the only tree cover in steppe regions. Elevations range from 1730 m to over 2745 m (5675-9000 feet). Climate ranges from semi-arid at lower elevations in southern Idaho to cool temperate in mountains of Montana. Precipitation is variable in amount and season depending on locations, with annual precipitation ranging from 18-56 cm with much of the precipitation falling during the winter months as snow in mountains or as convective showers in May and June in steppe and foothills. Lower elevation sites in steppe regions have rolling topography with low relief. Stands found in foothills and mountains occur on moderate to very steep slopes and ridges. Aspect is variable depending on elevation, with cooler east to north slopes more typical of lower elevation sites. Soils are moderately shallow (30-48 cm deep), rocky, well-drained gravelly loams over cracked bedrock or colluvium. Stones make up 30-60% of the soil volume. *Cercocarpus* roots extend into cracks within the bedrock. Parent materials include andesite, granite, rhyolite, tuffs and metamorphic (schist).

Dynamics: *Cercocarpus ledifolius* is a slow-growing, drought-tolerant species that can inhabit very poor sites, such as cliffs and outcrops. Stands are often small and clumped near ridgetops. These sites may also afford the species some protection from fire. The species is highly susceptible to fire damage and generally does not resprout. *Cercocarpus ledifolius* is highly favored by native ungulates for winter range, and many individual shrubs show evidence of highlining by deer or elk.

DISTRIBUTION

Geographic Range: This alliance occurs in the Great Basin extending west into the foothills of the Sierra Nevada and north into the Columbia Plateau, from northeastern California north across Nevada, into southeastern Oregon, southern Idaho, western Utah and western Montana.

Nations: US

States/Provinces: CA, ID, MT, NV, OR, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- >< *Cercocarpus ledifolius* (Curl leaf mountain mahogany scrub) Alliance (Sawyer et al. 2009) [76.200.00]

LOWER LEVEL UNITS

Associations:

- CEG000961 *Cercocarpus ledifolius* / *Calamagrostis rubescens* Woodland
- CEG000962 *Cercocarpus ledifolius* / *Festuca idahoensis* Woodland
- CEG000964 *Cercocarpus ledifolius* / *Leymus salinus* ssp. *salmonis* Woodland
- CEG000968 *Cercocarpus ledifolius* / *Pseudoroegneria spicata* - *Festuca idahoensis* Woodland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by M.S. Reid and D. Sarr.

Version Date: 2014/03/14

REFERENCES

References: Beatley 1976, Blackburn et al. 1969d, Cooper et al. 1995, DeVelice 1992, Dealy 1975, Faber-Langendoen et al. 2017b, Gruell et al. 1985, Hall 1973, Heinze et al. 1962, Moseley 1987b, Mozingo 1987, Mueggler and Stewart 1980, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Tisdale 1986

1. Forest & Woodland

1.B.2.Nc. Western North American Pinyon - Juniper Woodland & Scrub

G249. Intermountain Basins Curl-leaf Mountain-mahogany Woodland & Scrub

A0586. *Cercocarpus ledifolius* / Shrub Understory Woodland Alliance

Type Concept Sentence: This woodland is characterized by an open to moderately dense tree canopy of *Cercocarpus ledifolius* with the understory characterized by an open to moderate shrub layer (>10% cover) or, if less, then shrub cover exceeds herbaceous cover. It occurs in semi-arid steppe and temperate mountainous habitats of the interior western United States.

OVERVIEW

Scientific Name: *Cercocarpus ledifolius* / Shrub Understory Woodland Alliance

Common Name (Translated Scientific Name): Curl-leaf Mountain-mahogany / Shrub Understory Woodland Alliance

Colloquial Name: Curl-leaf Mountain-mahogany / Shrub Woodland

Type Concept: The vegetation in this alliance is characterized by an open to moderately dense canopy of *Cercocarpus ledifolius*. These woodlands may occur as scattered communities in arid steppe or on rocky outcrops or steep escarpments within forests. Steppe woodlands typically have only *Cercocarpus ledifolius* in the overstory canopy, but *Juniperus occidentalis*, *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus edulis*, or *Pinus monophylla* occur locally. The understory is characterized by an open to dense short-shrub layer. Shrub cover is over 10% or, if less, exceeds herbaceous cover. Characteristic shrub species include *Amelanchier alnifolia*, *Arctostaphylos patula*, *Artemisia tridentata*, *Ericameria nauseosa* (= *Chrysothamnus nauseosus*), *Holodiscus dumosus*, *Prunus virginiana*, *Purshia tridentata*, *Quercus gambelii*, *Ribes* spp., *Symphoricarpos oreophilus*, and *Symphoricarpos rotundifolius*. Stands with sparse understories are included in this alliance because these stands usually have similar scattered shrubs present. A sparse to moderately dense herbaceous layer may be present and is typically dominated by bunchgrasses, including *Achnatherum* spp., *Calamagrostis rubescens*, *Elymus elymoides*, *Festuca idahoensis*, *Leymus ambiguus*, and *Pseudoroegneria spicata*. Diverse forbs may be present but usually with low cover. Plant associations in this alliance occur in semi-arid steppe and cool temperate mountainous habitats of the interior western United States. These woodlands often form small patchy stands on rocky outcrops or escarpments in forested areas, or may form the only tree cover in steppe regions. Elevations range from 1600 to 2835 m (5250-9300 feet). Annual precipitation averages 25-45 cm, with a significant proportion falling as winter snow. Soils are typically rocky and immature, and of coarser texture than soils of adjacent coniferous woodlands or forests.

Classification Comments: The *Cercocarpus ledifolius* woodland and shrubland alliances are poorly distinguished in the literature, as most authors describe the species as having either a tall-shrub or small-tree growth form within a single association. Some associations may have shrub-dominated stands in one area and also have a woodland physiognomy in another. The woodland physiognomy appears to be more typical, based on available literature. Near the northern edge of its range in Montana and Idaho, *Cercocarpus ledifolius* is described as occurring primarily in the shrub-form (Mueggler and Stewart 1980, Tisdale 1986). These northern variants are the only described stands which appear to be clearly distinct from the woodland alliance.

The woodland stands may have a different subspecies (or variety) as a dominant than the shrubland. In Wyoming, the heritage program is proposing to recognize two *Cercocarpus ledifolius* alliances, based upon varieties of *Cercocarpus ledifolius*. The most widespread proposed alliance there is dominated by *Cercocarpus ledifolius* var. *ledifolius*, which grows up to about 1.5 m tall. The other proposed alliance, dominated by *Cercocarpus ledifolius* var. *intercedens*, is found only along the western border of the state, and the growth form is as small trees 4-5 m tall. The two taxa are obviously different in Wyoming, in stature and leaf characteristics, and are easily separated. Further review of the two current *Cercocarpus ledifolius* alliances may warrant treatment as proposed for Wyoming.

Internal Comments:

Other Comments:

Similar NVC Types: This alliance has similarities to several montane conifer woodland alliances have *Cercocarpus ledifolius* codominant in subcanopy in several other groups, such as G209, G213, G215, G224, G226, G243, and G344.

- A0828 *Cercocarpus ledifolius* Scrub Alliance: is similar except overstory is composed of shrub-form rather than tree-form *Cercocarpus ledifolius*.
- A3570 *Cercocarpus ledifolius* / Herbaceous Understory Woodland Alliance: is similar but understory lacks a shrub layer and is dominated by an herbaceous layer (>10% cover) or, if less, grass cover exceeds shrub cover.

Diagnostic Characteristics: The vegetation in this woodland alliance is characterized by a tree canopy dominated by *Cercocarpus ledifolius*, sometimes with low cover of *Juniperus occidentalis*, *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus edulis*, or *Pinus monophylla*. The understory is characterized by an open to dense shrub layer dominated by species such as *Amelanchier alnifolia*, *Arctostaphylos patula*, *Artemisia tridentata*, *Ericameria nauseosa*, *Holodiscus dumosus*, *Quercus gambelii*, *Prunus virginiana*, *Purshia tridentata*, *Ribes* spp., *Symphoricarpos oreophilus*, or *Symphoricarpos rotundifolius*. An herbaceous layer may be present and is typically dominated by bunchgrasses sometimes with low cover of diverse forbs. If shrub cover is low (<10%), then it exceeds herbaceous cover.

VEGETATION

Physiognomy and Structure: Plant associations in this alliance are woodlands dominated by a spreading broad-leaved evergreen small tree (5-15 m tall) with open to moderate cover (10-60%). Smaller evergreen or cold-deciduous shrubs may be present and are typically of low to medium cover. A ground layer of cespitose or rhizomatous graminoids is usually present, but cover is highly variable.

Floristics: The vegetation in this alliance is characterized by an open to moderately dense canopy of *Cercocarpus ledifolius*. Steppe woodlands typically have only *Cercocarpus ledifolius* in the overstory canopy, but *Juniperus occidentalis*, *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus edulis*, or *Pinus monophylla* occur locally. Montane stands may have scattered emergent conifer trees present, including *Pinus jeffreyi*, *Pinus ponderosa*, and *Pseudotsuga menziesii*. The understory is characterized by an open to dense short-shrub layer. Shrub cover is over 10% or, if less, exceeds herbaceous cover. Characteristic shrub species include *Amelanchier alnifolia*, *Arctostaphylos patula*, *Artemisia tridentata*, *Ericameria nauseosa* (= *Chrysothamnus nauseosus*), *Holodiscus dumosus*, *Prunus virginiana*, *Purshia tridentata*, *Quercus gambelii*, *Ribes* spp., *Symphoricarpos oreophilus*, *Symphoricarpos rotundifolius*, and *Tetradymia canescens*. Stands with sparse understories are included in this alliance because these stands usually have similar scattered shrubs present. A sparse to moderately dense herbaceous layer may be present and is typically dominated by bunchgrasses, including *Achnatherum* spp., *Calamagrostis rubescens*, *Elymus elymoides*, *Festuca idahoensis*, *Leymus ambiguus*, and *Pseudoroegneria spicata*. Diverse forbs may be present but usually with low cover. Common forbs include *Arenaria* spp., *Balsamorhiza sagittata*, *Chaetopappa ericoides*, *Comandra umbellata*, *Hackelia patens*, *Lappula occidentalis*, *Packera multilobata* (= *Senecio multilobatus*), and *Senecio integerrimus*.

ENVIRONMENT & DYNAMICS

Environmental Description: Plant associations in this woodland alliance occur in semi-arid steppe and foothills, and cool temperate mountainous habitats of the interior western United States. These woodlands often form small patchy stands in arid steppe or on rocky outcrops or steep escarpments in forested areas or may form the only tree cover in steppe regions. Elevations range from 1600 to 2835 m (5250-9300 feet). Climate ranges from semi-arid at lower elevations in the Colorado Plateau, Columbia Plateau, and Owyhee Uplands to cool temperate in foothills and mountains of the western Sierra Nevada, northern Great Basin, and western slope of the Rocky Mountains. Precipitation is variable in amount and season depending on locations, with annual precipitation ranging from 25-45 cm with much of the precipitation falling during the winter months as snow in mountains or as convective showers in May and June in steppe and foothills. Lower elevation sites in steppe regions have rolling topography with low relief. Stands found in foothills and mountains occur on moderate to very steep slopes and ridges. Aspect is variable depending on elevation with cooler east to north slopes more typical of lower elevation sites. Soils are mostly shallow, rocky, well-drained sandy or gravelly loams derived from colluvium, bedrock, or less frequently alluvium. Parent materials are variable and include andesite, basalt, granite, rhyolite, tuff and metamorphic (schist) rocks, and sandstones. Stones make up 30-60% of the soil volume. *Cercocarpus* roots extend into cracks within the bedrock.

Dynamics: *Cercocarpus ledifolius* is a slow-growing, drought-tolerant species that can inhabit very poor sites, such as cliffs and outcrops. Stands are often small and clumped near ridgetops. These sites may also afford the species some protection from fire. The species is highly susceptible to fire damage and generally does not resprout. *Cercocarpus ledifolius* is highly favored by native ungulates for winter range, and many individual shrubs show evidence of highlining by deer or elk.

DISTRIBUTION

Geographic Range: This alliance occurs in the Great Basin extending west into the foothills of the Sierra Nevada and north into the Columbia Plateau, from northeastern California north across Nevada, into southeastern Oregon, southern Idaho, western Utah and southwestern Montana.

Nations: US

States/Provinces: CA, CO?, ID, MT, NV, OR, UT, WY?

TNC Ecoregions [optional]: 4:C, 6:C, 8:C, 9:C, 11:C, 12:C, 17:C, 18:C, 19:C

USFS Ecoregions (2007): 341Fb:CCC, 341Ff:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Bryce Canyon, Capitol Reef, Cedar Breaks, Death Valley, Dinosaur, Grand Canyon, Great Basin, John Day Fossil Beds, Yosemite)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- >< *Cercocarpus ledifolius* (Curl leaf mountain mahogany scrub) Alliance (Sawyer et al. 2009) [76.200.00]
- = *Cercocarpus ledifolius* Shrubland Alliance (Evens et al. 2014)

LOWER LEVEL UNITS

Associations:

- CEG000960 *Cercocarpus ledifolius* / *Artemisia tridentata* Woodland
- CEG001022 *Cercocarpus ledifolius* / *Artemisia tridentata* ssp. *vaseyana* Woodland
- CEG000963 *Cercocarpus ledifolius* / *Holodiscus dumosus* Woodland
- CEG005359 *Cercocarpus ledifolius* / *Quercus gambelii* Woodland
- CEG008637 *Cercocarpus ledifolius* / *Symphoricarpos rotundifolius* Woodland
- CEG005355 *Cercocarpus ledifolius* / *Arctostaphylos patula* Woodland
- CEG000970 *Cercocarpus ledifolius* / *Symphoricarpos oreophilus* Woodland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by M.S. Reid and D. Sarr.

Version Date: 2014/03/14

REFERENCES

References: Blackburn et al. 1969d, Cooper et al. 1995, DeVelice 1992, Dealy 1975, Evens et al. 2014, Faber-Langendoen et al. 2017b, Gruell et al. 1985, Hall 1973, Keeler-Wolf and Thomas 2000, Moseley 1987b, Mozingo 1987, Mueggler and Stewart 1980, Reid et al. 1999, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Tisdale 1986, VegCAMP and AIS 2013

1. Forest & Woodland

1.B.2.Nc. Western North American Pinyon - Juniper Woodland & Scrub

G249. Intermountain Basins Curl-leaf Mountain-mahogany Woodland & Scrub

A0828. *Cercocarpus ledifolius* Scrub Alliance

Type Concept Sentence: This shrubland is characterized by an open to moderately dense shrub layer dominated or codominated by *Cercocarpus ledifolius* with a sparse to moderately dense herbaceous layer. It occurs in semi-arid, mountainous habitats of the interior western United States.

OVERVIEW

Scientific Name: *Cercocarpus ledifolius* Scrub Alliance

Common Name (Translated Scientific Name): Curl-leaf Mountain-mahogany Scrub Alliance

Colloquial Name: Curl-leaf Mountain-mahogany Scrub

Type Concept: The vegetation in this alliance is characterized by an open shrub canopy of *Cercocarpus ledifolius*. The vegetation may occur as scattered small- and large-patch communities in arid steppe or on rocky outcrops or steep escarpments within forests. Other shrubs often occur in the stands and include *Amelanchier alnifolia*, *Artemisia arbuscula*, *Artemisia frigida*, *Artemisia nova*, *Artemisia tridentata*, *Ericameria nauseosa* (= *Chrysothamnus nauseosus*), *Mahonia repens*, *Prunus virginiana*, *Ribes* spp., and *Symphoricarpos* spp. The herbaceous layer is usually composed of xeric graminoids, including *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Achnatherum occidentale* (= *Stipa occidentalis*), *Calamagrostis rubescens*, *Elymus glaucus*, *Festuca idahoensis*, *Hesperostipa comata*, *Koeleria macrantha*, *Poa fendleriana*, *Poa secunda*, and *Pseudoroegneria spicata*. Diverse forbs may be present, usually with low cover. Outcrop communities usually include many of the species above, but may also include occasional forest trees, such as *Juniperus occidentalis*, *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus flexilis*, *Pinus jeffreyi*, *Pinus ponderosa*, or *Pseudotsuga menziesii*. The plant associations in this alliance occur in semi-arid, mountainous habitats of the interior western United States. These shrublands are often located on rocky outcrops or escarpments in forested areas. Most stands occur on steep rimrock slopes, usually in areas of shallow soils or protected slopes. Soils are typically rocky and immature, and are always rockier than found in surrounding sites. In Wyoming, stands of this alliance primarily grow on carbonate sediments (limestone or dolomite) or on sandstones rich in calcium carbonate. Other rock types include quartz, gneiss, and basalt.

Classification Comments: The *Cercocarpus ledifolius* woodland and shrubland alliances are poorly distinguished in the literature, as most authors describe the species as having either a tall-shrub or small-tree growth form within a single association. Some associations may have shrub-dominated stands in one area and also have a woodland physiognomy in another. The woodland physiognomy appears to be more typical, based on available literature. Near the northern edge of its range in Montana and Idaho, *Cercocarpus ledifolius* is described as occurring primarily in the shrub-form (Mueggler and Stewart 1980, Tisdale 1986). These northern variants are the only described stands which appear to be clearly distinct from the woodland alliance. The woodland alliance may have a different subspecies (or variety) as a dominant than the shrubland. In Wyoming, the heritage program is proposing to recognize two *Cercocarpus ledifolius* alliances, based upon varieties of *Cercocarpus ledifolius*. The most widespread proposed alliance there is dominated by *Cercocarpus ledifolius* var. *ledifolius*, which grows up to ca. 1.5 m tall. The other proposed alliance, dominated by *Cercocarpus ledifolius* var. *intercedens*, is found only along the western border of the state, and the growth form is small trees 4-5 m tall. The two taxa are obviously different in Wyoming, in stature and leaf characteristics, and are easily separated. Further review of the two current *Cercocarpus ledifolius* alliances may warrant treatment as proposed for Wyoming.

Internal Comments:

Other Comments:

Similar NVC Types: This alliance has similarities to several montane conifer woodland alliances have *Cercocarpus ledifolius* codominant in subcanopy in several other groups, such as G209, G213, G215, G224, G226, G243, and G344.

- A0586 *Cercocarpus ledifolius* / Shrub Understory Woodland Alliance: is similar except overstory is composed of tree-form rather than shrub-form *Cercocarpus ledifolius* and has a short-shrub layer.
- A3570 *Cercocarpus ledifolius* / Herbaceous Understory Woodland Alliance: is similar except overstory is composed of tree-form rather than shrub-form *Cercocarpus ledifolius* and has an herbaceous layer.

Diagnostic Characteristics: This alliance is composed of shrub-form *Cercocarpus ledifolius* dominating or codominating the shrub layer with other shrubs and dwarf-shrubs such as *Amelanchier alnifolia*, *Artemisia arbuscula*, *Artemisia frigida*, *Artemisia nova*, *Artemisia tridentata*, *Ericameria nauseosa*, *Mahonia repens*, *Prunus virginiana*, *Ribes* spp., and *Symphoricarpos* spp. An open to moderately dense herbaceous layer is usually present and composed of xeric graminoids, including *Achnatherum hymenoides*, *Achnatherum occidentale*, *Calamagrostis rubescens*, *Elymus glaucus*, *Festuca idahoensis*, *Hesperostipa comata*, *Koeleria macrantha*, *Poa secunda*, and *Pseudoroegneria spicata*.

VEGETATION

Physiognomy and Structure: The vegetation in this alliance is dominated by a spreading broad-leaved evergreen shrub layer of open to moderate cover. If present, the herbaceous layer is composed of open to moderate cover of perennial bunch grasses.

Floristics: The vegetation in this alliance is characterized by an open shrub canopy of *Cercocarpus ledifolius*. The vegetation may occur as scattered small- and large-patch communities in arid steppe or on rocky outcrops or steep escarpments within forests. Other shrubs often occur in the stands and include *Amelanchier alnifolia*, *Artemisia arbuscula*, *Artemisia frigida*, *Artemisia nova*, *Artemisia tridentata*, *Ericameria nauseosa* (= *Chrysothamnus nauseosus*), *Mahonia repens*, *Prunus virginiana*, *Ribes* spp., and *Symphoricarpos* spp. The herbaceous layer is usually composed of xeric graminoids, including *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Achnatherum occidentale* (= *Stipa occidentalis*), *Calamagrostis rubescens*, *Elymus glaucus*, *Festuca idahoensis*, *Hesperostipa comata*, *Koeleria macrantha*, *Poa fendleriana*, *Poa secunda*, and *Pseudoroegneria spicata*. Diverse forbs may be present, usually with low cover. Outcrop communities usually include many of the species above, but may also include occasional forest trees, such as *Juniperus occidentalis*, *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus flexilis*, *Pinus jeffreyi*, *Pinus ponderosa*, or *Pseudotsuga menziesii*. These shrublands are often located on rocky outcrops or escarpments in forested areas.

ENVIRONMENT & DYNAMICS

Environmental Description: The plant associations in this alliance occur in semi-arid, mountainous habitats of the interior west. Annual precipitation averages 25-45 cm, with a significant proportion falling as winter snow. These shrublands are often located on rocky outcrops or escarpments in forested areas. Most stands occur on steep rimrock slopes, usually in areas of shallow soils or protected slopes. In Wyoming, stands of this alliance primarily grow on carbonate sediments (limestone or dolomite) or on sandstones rich in calcium carbonate. Other rock types include quartz, gneiss, and basalt. Soils are typically rocky and immature, and are always rockier than found in surrounding sites. Adjacent vegetation is usually *Pinus ponderosa* or *Pseudotsuga menziesii* forests or woodlands, pinyon and/or juniper woodlands, or *Artemisia* shrubland.

Dynamics: *Cercocarpus ledifolius* is a slow-growing, drought-tolerant species which can inhabit very poor sites, such as cliffs, stony slopes, and outcrops. Stands are often small and clumped near ridgetops. These sites may also afford the species some protection from fire. The species is highly susceptible to fire damage and generally does not resprout. *Cercocarpus ledifolius* is highly favored by native ungulates for winter range and many individual shrubs show evidence of highlining by deer and elk.

DISTRIBUTION

Geographic Range: This alliance occurs in mountain ranges throughout the Great Basin and into the northern Mojave Desert, from eastern California and Oregon to Colorado and north to Wyoming and western Montana.

Nations: US

States/Provinces: CA, CO, MT, NM, NV, OR, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- >< *Cercocarpus ledifolius* (Curl leaf mountain mahogany scrub) Alliance (Sawyer et al. 2009) [76.200.00]
- = *Cercocarpus ledifolius* Shrubland Alliance (Bourgeron and Engelking 1994)
- >< Curlleaf Mountain-Mahogany Series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS**Associations:**

- CEG000967 *Cercocarpus ledifolius* / *Pseudoroegneria spicata* Scrub
- CEG005589 *Cercocarpus ledifolius* - *Purshia tridentata* / *Poa secunda* Scrub
- CEG000965 *Cercocarpus ledifolius* / *Mahonia repens* Scrub
- CEG001487 *Artemisia arbuscula* - *Cercocarpus ledifolius* / *Pseudoroegneria spicata* - *Poa secunda* Scrub
- CEG000969 *Cercocarpus ledifolius* / *Symphoricarpos longiflorus* Scrub
- CEG000966 *Cercocarpus ledifolius* / *Prunus virginiana* Scrub

AUTHORSHIP

Primary Concept Source: P.S. Bourgeron and L.D. Engelking (1994)

Author of Description: K.A. Schulz and D. Sarr

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Baker 1983c, Baker and Kennedy 1985, Bourgeron and Engelking 1994, Cooper et al. 1995, Dealy 1975, Faber-Langendoen et al. 2017b, Heinze et al. 1962, Johnson and Simon 1985, Knight et al. 1987, Lewis 1975a, Miller 1964, Mueggler and Stewart 1980, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Schlatterer 1972, Tisdale 1986

M027. Southern Rocky Mountain-Colorado Plateau Two-needle Pinyon - Juniper Woodland

This southern Rocky Mountain and Colorado Plateau pinyon and juniper savanna and woodland macrogroup is characterized by an open to closed evergreen, conifer tree canopy composed of diagnostic species *Juniperus monosperma* and/or *Pinus edulis* with an understory dominated by shrubs or grasses that lacks Madrean understory species. It occurs in dry mountains and foothills in southern Colorado south into northern and central New Mexico, and extends west across the Colorado Plateau and east to the plains on breaks in the southwestern Great Plains.

1. Forest & Woodland

1.B.2.Nc. Western North American Pinyon - Juniper Woodland & Scrub

1.B.2.Nc.2.a. M027 Southern Rocky Mountain-Colorado Plateau Two-needle Pinyon - Juniper Woodland

G250. Colorado Plateau Pinyon - Juniper Woodland

Type Concept Sentence: This woodland group is centered in the Colorado Plateau region and is composed of *Pinus edulis* often with *Juniperus osteosperma* or *Juniperus scopulorum* codominant in the tree canopy and a variable understory.

OVERVIEW

Scientific Name: *Pinus edulis* - *Juniperus osteosperma* Woodland Group

Common Name (Translated Scientific Name): Two-needle Pinyon - Utah Juniper Woodland Group

Colloquial Name: Two-needle Pinyon - Utah Juniper / Herb Open Woodland

Type Concept: This woodland group occurs in dry mountains and foothills of the Colorado Plateau region, including the Western Slope of Colorado and the Wasatch Range, south to the Mogollon Rim, and east into the northwestern corner of New Mexico. These

woodlands are typically composed of a mix of *Pinus edulis* and *Juniperus osteosperma* in the tree canopy. Either tree may dominate as long as there is significant presence of *Pinus edulis* (not accidental) to characterize the stand as a pinyon-juniper stand and not the typically more xeric lower-elevation *Juniperus osteosperma* woodland and savanna. *Juniperus scopulorum* may replace *Juniperus osteosperma* and codominate at higher-elevation/less xeric sites.

In the southern portion of the Colorado Plateau in northern Arizona and northwestern New Mexico, hybrids of *Juniperus monosperma* and *Juniperus osteosperma* or both juniper species may dominate or codominate the tree canopy. Understory layers are variable and may be dominated by shrubs, graminoids, or be absent. Associated species include *Arctostaphylos patula*, *Artemisia tridentata*, *Cercocarpus intricatus*, *Cercocarpus montanus*, *Coleogyne ramosissima*, *Purshia stansburiana*, *Purshia tridentata*, *Quercus gambelii*, *Bouteloua gracilis*, *Pleuraphis jamesii*, *Pseudoroegneria spicata*, *Poa secunda*, or *Poa fendleriana*. This group occurs at higher elevations than Great Basin Pinyon - Juniper Woodland Group (G247) where sympatric on the Colorado Plateau.

Stands are typically found at lower elevations but ranges from 1500-2440 m. These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Soils supporting this group vary in texture, ranging from stony, cobbly, gravelly, or sandy loams to clay loam or clay.

Classification Comments: This group corresponds to the *Pinus edulis*-dominated portion of the *persistent pinyon-juniper woodland* type from Romme et al. (2009) that occurs in the Colorado Plateau on rocky uplands with shallow, coarse-textured, and often skeletal soils that support relatively sparse herbaceous cover and rarely burn. The similar Great Basin Pinyon - Juniper Woodland Group (G247) is dominated or codominated by *Pinus monophylla*, not *Pinus edulis*. Hybrid pinyon stands are evaluated by overall floristics and environment with *Juniperus monosperma* more prevalent on more xeric, lower-elevation sites. Another similar group, Southern Rocky Mountain Pinyon - Juniper Woodland Group (G253), that is defined by the range of *Juniperus monosperma* and *Pinus edulis* in the southern Rocky Mountains, transitions into this group in the northwestern corner of New Mexico.

Similar NVC Types:

- G253 Southern Rocky Mountain Pinyon - Juniper Woodland
- G247 Great Basin Pinyon - Juniper Woodland
- G246 Colorado Plateau-Great Basin Juniper Open Woodland

Diagnostic Characteristics: *Pinus edulis* and *Juniperus osteosperma* typically codominate the tree canopy in this group. However, either tree may dominate as long as there is significant presence of *Pinus edulis* (not accidental) to characterize the stand as a pinyon-juniper stand and not the typically more xeric lower-elevation *Juniperus osteosperma* woodland and savanna. This group is restricted to where the ranges of *Pinus edulis* and *Juniperus osteosperma* overlap and includes areas where hybrids between *Juniperus monosperma* and *Juniperus osteosperma* or mixed stands occur in northern Arizona and northwestern New Mexico. Understory diagnostic species are more characteristic of the Great Basin than Rocky Mountains, such as *Arctostaphylos patula*, *Artemisia nova*, *Artemisia tridentata*, *Cercocarpus intricatus*, *Coleogyne ramosissima*, *Purshia stansburiana*, *Purshia tridentata*, *Pleuraphis jamesii*, *Pseudoroegneria spicata*, *Poa secunda*, or *Poa fendleriana*.

VEGETATION

Physiognomy and Structure: These woodlands are characterized by diagnostic tree species *Pinus edulis* and *Juniperus osteosperma* that form an open to dense tree layer 3-10 m tall. Shrub and herbaceous layers are variable and may be sparse to dense or absent. On extremely xeric sites, diagnostic trees species may only attain 2 m in height and have more of shrub form.

Floristics: This woodland group is dominated by *Pinus edulis* and/or *Juniperus osteosperma* in the tree canopy. *Juniperus scopulorum* may codominate at higher elevations. In the southern portion of the Colorado Plateau in northern Arizona and northwestern New Mexico, hybrids between *Juniperus monosperma* and of *Juniperus osteosperma* or both may dominate or codominate the tree canopy. *Juniperus scopulorum* may codominate with *Juniperus osteosperma* at higher elevations. Understory layers are variable and may be dominated by shrubs, graminoids, or be absent. Associated species include *Arctostaphylos patula*, *Artemisia tridentata*, *Cercocarpus intricatus*, *Cercocarpus montanus*, *Coleogyne ramosissima*, *Purshia stansburiana*, *Purshia tridentata*, *Quercus gambelii*, *Bouteloua gracilis*, *Pleuraphis jamesii*, *Pseudoroegneria spicata*, *Poa secunda*, or *Poa fendleriana*.

ENVIRONMENT & DYNAMICS

Environmental Description: This woodland group occurs in dry mountains and foothills of the Colorado Plateau region and is typically found at lower elevations but ranges from 1500-2440 m. These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Soils supporting this group vary in texture, ranging from stony, cobbly, gravelly, or sandy loams to clay loam or clay.

Dynamics: Key ecological processes are drought, fire, herbivory, and insect/disease outbreaks. Both *Pinus edulis* and *Juniperus osteosperma* are relatively short (generally <15 m tall), shade-intolerant, drought-tolerant, slow-growing, long-lived trees (especially *Juniperus osteosperma* can reach 650 years old) (Meeuwig and Bassett 1983, Little 1987, Zlatnik 1999e, Romme et al. 2003). Both tree species are also non-sprouting and may be killed by fire (Wright et al. 1979). The effect of a fire on these stands is largely dependent on the tree height and density, fine fuel load on the ground, weather conditions and season (Wright et al. 1979). Large trees generally survive unless the fire gets into the crown due to heavy fuel loads in the understory. In this system fire acts to open stands, increase diversity and productivity in understory species, and create a mosaic of stands of different sizes and ages across the landscape while maintaining the boundary between woodlands and adjacent shrublands or grasslands (Bradley et al. 1992).

DISTRIBUTION

Geographic Range: This group occurs on dry mountains and foothills of the Colorado Plateau region from the Western Slope of Colorado to the Wasatch Range, south to the Mogollon Rim, and east into the northwestern corner of New Mexico.

Spatial Scale & Pattern [optional]: Matrix

Nations: US

States/Provinces: AZ, CO, NM, UT, WY?

TNC Ecoregions [optional]: 18:C, 19:C, 20:?

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313C:CC, 313D:CC, 315H:CC, 321A:CC, 322A:CC, 341A:CC, 341B:CC, 341C:CC, 341F:CP, 342E:CP, 342G:CC, M313A:CC, M313B:CC, M331D:CC, M331E:CC, M331G:CC, M331H:CC, M331I:CC, M341B:CC, M341C:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Arches)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = Colorado Pinyon-Utah Juniper Series (Dick-Peddie 1993)

LOWER LEVEL UNITS

Alliances:

- A3573 *Pinus edulis* - *Juniperus osteosperma* / Shrub Understory Colorado Plateau Woodland & Scrub Alliance
- A3571 *Pinus edulis* - *Juniperus osteosperma* / Shrub Understory Foothill & Lower Montane Dry-Mesic Woodland Alliance
- A3572 *Pinus edulis* - *Juniperus osteosperma* / Herbaceous Understory Open Woodland Alliance

AUTHORSHIP

Primary Concept Source: D.E. Brown, C.H. Lowe and C.P. Pase (1979)

Author of Description: K.A. Schulz

Acknowledgments: E. Muldavin

Version Date: 11/09/2015

Classif Resp Region: West

Internal Author: KAS 1-10, 5-13, 11-15

REFERENCES

References: AOU 1983, Baker and Kennedy 1985, Bradley et al. 1992, Brown 1982a, Brown et al. 1979, Degenhardt et al. 1996, Dick-Peddie 1993, Ernst and Ernst 2003, Eyre 1980, FNA Editorial Committee 2003, Faber-Langendoen et al. 2017a, Küchler 1964, Little 1987, Meeuwig and Bassett 1983, Peterson 1983, Romme et al. 2003, Romme et al. 2009, Shiflet 1994, Spackman et al. 1997, Stebbins 2003, Stuever and Hayden 1997a, Tanner 1983, Tuhy et al. 2002, Weber and Wittmann 1996b, Welsh et al. 1993, West et al. 1998, Wright et al. 1979, Zlatnik 1999e

1. Forest & Woodland

1.B.2.Nc. Western North American Pinyon - Juniper Woodland & Scrub

G250. Colorado Plateau Pinyon - Juniper Woodland

A3572. *Pinus edulis* - *Juniperus osteosperma* / Herbaceous Understory Open Woodland Alliance

Type Concept Sentence: This open woodland and savanna alliance is characterized by diagnostic tree species *Pinus edulis* that forms a very open to moderately dense tree layer often with *Juniperus osteosperma* and an understory dominated by an open to dense layer of perennial grasses, lacking significant cover of shrubs. It occurs on dry mountain slopes, foothills, plateaus in the Colorado Plateau extending east into the west slope of the southern Rocky Mountains.

OVERVIEW

Scientific Name: *Pinus edulis* - *Juniperus osteosperma* / Herbaceous Understory Open Woodland Alliance

Common Name (Translated Scientific Name): Two-needle Pinyon - Utah Juniper / Herbaceous Understory Open Woodland Alliance

Colloquial Name: Two-needle Pinyon - Utah Juniper / Herb Open Woodland

Type Concept: This woodland alliance is characterized by diagnostic tree species *Pinus edulis* that forms a very open to moderately dense tree layer often with *Juniperus osteosperma* or, less frequently, *Juniperus monosperma* within the range of *Juniperus osteosperma* in northern Arizona. *Juniperus osteosperma* may also dominate stands as long as there is significant presence of *Pinus edulis* (not accidental) to characterize the stand as a pinyon-juniper stand and not the more xeric, typically lower elevation *Juniperus osteosperma* woodland and savanna. At higher elevations and relatively mesic sites, such as along drainages, *Juniperus scopulorum* may be present and sometimes dominant. Other conifers are absent or accidental with very low cover. The understory is characterized by an open to dense herbaceous layer. Scattered shrubs may be present but do not form a layer and do not exceed cover of the herbaceous layer. Perennial grasses typically dominate the herbaceous layer, although diverse forbs species are often present, but with low cover. Characteristic species include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus elymoides*, *Hesperostipa comata*, *Hesperostipa neomexicana*, *Leymus salinus*, *Muhlenbergia pungens*, *Poa fendleriana*, *Poa secunda*, *Pleuraphis jamesii*, and *Pseudoroegneria spicata*. The non-native, invasive annual grass *Bromus tectorum* becomes abundant in disturbed stands and may dominate the understory of highly disturbed stands. Some stands included in this alliance have been seeded with non-native perennial grasses such as *Psathyrostachys juncea* or *Agropyron cristatum* to control soil erosion or increase forage production and now have a semi-natural understory. This alliance occurs on warm, dry sites on mountain slopes, foothills, and plateaus in the Colorado Plateau extending east into the west slope of the southern Rocky Mountains. The climate of the region is semi-arid with drought not uncommon. Stands typically occur on nearly level to moderately steep, rocky slopes on hillsides and mesatops. Aspect does not seem important except in elevational extremes for a given latitude where low-elevation stands are restricted to the more mesic north slopes; canyons and high-elevation stands occur on south aspects. Sites are typically dry with shallow, rocky, calcareous and alkaline soils. Other sites include eroded "badlands," lava flows, scree slopes, and deep sands.

Classification Comments: In northwestern New Mexico outside the distributional range of *Juniperus osteosperma*, this alliance transitions into the southern Rocky Mountain pinyon-juniper woodland alliances. The following associations in this alliance need further review and classification action and possibly rename *Juniperus* spp. to (*Juniperus osteosperma*) as they are not known outside the *Juniperus osteosperma* range or distribution: *Pinus edulis* - *Juniperus* spp. / *Leymus salinus* Woodland (CEGL002340); *Pinus edulis* - *Juniperus* spp. / *Poa fendleriana* Woodland (CEGL000787); and *Pinus edulis* - *Juniperus* spp. / *Pseudoroegneria spicata* Woodland (CEGL000788).

Internal Comments: KAS-1-14: More classification work is needed here. There are a variety of environments that exist within this alliance of grass understory Colorado Plateau P-J woodlands and savanna, such as sandy plains and mesas (sand deposits), shale badlands, rocky mesatops, and higher elevation less xeric, foothill and lower montane sites. These environments could be used to create additional alliances.

Other Comments:

Similar NVC Types: This alliance has similarities to other pinyon-juniper woodland and juniper woodland alliances in several other groups, such as G200, G246, G247, G248, G252, G253, and G487.

- A3571 *Pinus edulis* - *Juniperus osteosperma* / Shrub Understory Foothill & Lower Montane Dry-Mesic Woodland Alliance: is similar but understory is a shrub layer (>10% cover) or, if less, shrub cover exceeds grass cover.
- A3497 *Juniperus osteosperma* / Herbaceous Understory Open Woodland Alliance
- A3573 *Pinus edulis* - *Juniperus osteosperma* / Shrub Understory Colorado Plateau Woodland & Scrub Alliance: is similar but understory is a shrub layer (>10% cover) or, if less, shrub cover exceeds grass cover.

Diagnostic Characteristics: This woodland alliance occurs in the Colorado Plateau and extends east into the west slope of the southern Rocky Mountains within the distributional range of *Juniperus osteosperma*. The diagnostic tree species are *Pinus edulis* and *Juniperus osteosperma*, either of which may dominate woodland stands as long as there is significant presence of *Pinus edulis* (not accidental). The understory is characterized by an open to dense herbaceous layer. Characteristic species that may dominate include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus elymoides*, *Hesperostipa comata*, *Hesperostipa neomexicana*, *Leymus salinus*, *Muhlenbergia pungens*, *Poa fendleriana*, *Poa secunda*, *Pleuraphis jamesii*, and *Pseudoroegneria spicata*. The non-native, invasive annual grass *Bromus tectorum* and non-native perennial grasses such as *Psathyrostachys juncea* or *Agropyron cristatum* may become abundant in disturbed stands.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has an open to moderately dense tree canopy that is typically 3-10 m tall. Stands are either solely dominated by evergreen needle-leaved trees or may be codominated by scale-leaved evergreen trees. An open to moderate ground layer dominated by perennial graminoids is usually present. Perennial forbs and cacti are often scattered throughout the stands. Annual forbs and grasses may be seasonally present. Scattered shrubs may be present, but do not form a layer (<10% cover).

Floristics: This alliance is characterized by a very open to moderately dense tree canopy typically 3-12 m tall. The diagnostic tree species is *Pinus edulis* often with *Juniperus osteosperma* or, less frequently, *Juniperus monosperma* within the range of *Juniperus osteosperma* in northern Arizona. *Juniperus osteosperma* may also dominate stands as long as there is significant presence (>5% cover) of *Pinus edulis* to characterize the stand as a pinyon-juniper stand and not the more xeric, typically lower elevation *Juniperus osteosperma* woodland and savanna. At higher elevations and relatively mesic sites, such as along drainages, *Juniperus scopulorum* may be present and sometimes dominant. Other conifers are absent or accidental with very low cover. The understory is characterized by an open to dense herbaceous layer. Scattered shrubs may be present, such as *Artemisia* spp., *Cercocarpus montanus*, *Ephedra viridis*, *Ericameria nauseosa*, *Fraxinus anomala*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Rhus aromatica*, but do not form a layer and do not exceed cover of the herbaceous layer. Perennial grasses typically dominate the herbaceous layer, although diverse forbs species are often present, but with low cover. Characteristic species include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus elymoides*, *Hesperostipa comata*, *Hesperostipa neomexicana*, *Leymus salinus*, *Muhlenbergia pungens*, *Poa fendleriana*, *Poa secunda*, *Pleuraphis jamesii*, and *Pseudoroegneria spicata*. Commonly present forbs include species of *Arenaria*, *Artemisia*, *Eriogonum*, *Heterotheca*, *Hymenoxys*, *Mirabilis*, *Oxytropis*, *Penstemon*, *Phlox*, *Senecio*, *Stenotus*, and *Zinnia*. Annual grasses and forbs are seasonally present. The non-native, invasive annual grass *Bromus tectorum* becomes abundant in disturbed stands and may dominate the understory of highly disturbed stands. Some stands included in this alliance have been seeded with non-native perennial grasses such as *Psathyrostachys juncea* or *Agropyron cristatum* to control soil erosion or increase forage production and now have a semi-natural understory.

ENVIRONMENT & DYNAMICS

Environmental Description: This woodland alliance occurs on warm, dry sites on canyon and mountain slopes, mesatops, foothills, and plateaus in the Colorado Plateau extending east into the west slope of the southern Rocky Mountains. Climate is semi-arid and droughts are not uncommon. Summers are generally hot, and winters are cold with occasional snows and extended periods of freezing temperatures. The seasonality of precipitation varies from east to west with summer rain more common in the southern and eastern portion of the alliance's range and winter precipitation more common in the western portion of the range. Mean annual precipitation ranges from 30-46 cm. Elevations normally range from 1500-2465 m (4921-8087 feet). Stands occur on the lower and middle slopes of ridges, on benches, terraces and dunes. These sites range from moderately to steeply sloping (47% to more than 100% slopes), although a minority of stands occur on gentle slopes with gradients not exceeding 10%. Aspect does not seem important except in elevational extremes for a given latitude where low-elevation stands are restricted to the more mesic north slopes; canyons and high-elevation stands occur on south aspects. Soils are shallow to moderately deep, well-drained, often calcareous and alkaline with textures ranging from sand to clay depending on the underlying geology. Parent materials vary from shale, limestone and sandstone to metamorphic, and granitic rocks, eolian deposits, and basalt alluvium or colluvium overlying Moenkopi siltstone. Rocks and bare ground are often common and occupy most of the unvegetated surface, up to 90% in some stands and averaging 60%.

Dynamics: *Pinus edulis* is extremely drought-tolerant and slow-growing (Little 1987, Powell 1988b, Muldavin et al. 1998c). It is also non-sprouting and may be killed by fire (Wright et al. 1979). The effect of fire on a stand is largely dependent on the tree height and density, fine-fuel load on the ground, weather conditions, and season (Dwyer and Pieper 1967, Wright et al. 1979). Trees are more vulnerable in open stands where fires frequently occur in the spring, when the relative humidity is low, wind speeds are over 10-20 mph, and there are adequate fine fuels to carry fire (Wright et al. 1979). Under other conditions, burns tend to be spotty with low tree mortality. Large trees are generally not killed unless fine fuels, such as tumbleweeds, have accumulated beneath the tree to provide ladder fuels for the fire to reach the crown (Jameson 1962). Closed-canopy stands rarely burn because they typically do not have enough understory or wind to carry a fire (Wright et al. 1979).

Although *Pinus edulis* is drought-tolerant, prolonged droughts will weaken trees and promote mortality by secondary agents. Periodic die-offs of pinyon pine caused by insects, such as the pinyon Ips beetle (*Ips confusus*), or fungal agents, such as blackstain root-rot (*Leptographium wageneri*), tend to be correlated with droughts (Anhold 2005). These mortality events may be localized or widespread but can result in 50 to 90% mortality of *Pinus edulis* (Harrington and Cobb 1988).

Climatic and other factors have resulted in denser and expanded pinyon-juniper stands throughout the Colorado Plateau and Great Basin. Denser stands are more susceptible to attack by insects and disease (Anhold 2005). In addition, altered fire regimes, cutting trees for fencing or firewood, and improper grazing by livestock have significant impacts on the quality of sites. Grazing by livestock can modify the fire regime by removing the fine fuels that carry fire. Fire, livestock grazing, and trampling by recreationalists and vehicles disturb cryptogamic soil crusts that help maintain soil structure, reduce soil erosion, provide habitat for plants and preserve biological diversity (Ladyman and Muldavin 1996). More study is needed to understand and manage these woodlands ecologically.

DISTRIBUTION

Geographic Range: The core distribution of this woodland and savanna alliance is the Colorado Plateau extending east into the west slope of the southern Rocky Mountains.

Nations: US

States/Provinces: AZ, CO, NM, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > *Pinus edulis* Series (Francis 1986)
- > Colorado Pinyon-Utah Juniper Series (Dick-Peddie 1993)

LOWER LEVEL UNITS

Associations:

- CEGLO02819 *Pinus edulis* - *Juniperus osteosperma* / *Pseudoroegneria spicata* - Cushion Plant Woodland
- CEGLO00778 *Pinus edulis* - (*Juniperus osteosperma*) / *Bouteloua gracilis* Woodland
- CEGLO00788 *Pinus edulis* - *Juniperus* spp. / *Pseudoroegneria spicata* Woodland
- CEGLO00787 *Pinus edulis* - *Juniperus* spp. / *Poa fendleriana* Woodland
- CEGLO02364 *Pinus edulis* - *Juniperus osteosperma* / *Achnatherum hymenoides* Woodland
- CEGLO05652 *Pinus edulis* - *Juniperus osteosperma* / *Hesperostipa comata* Open Woodland
- CEGLO02373 *Pinus edulis* - *Juniperus osteosperma* / *Muhlenbergia pungens* Woodland
- CEGLO02379 *Pinus edulis* - *Juniperus osteosperma* / *Pleuraphis jamesii* Woodland
- CEGLO02368 *Pinus edulis* - *Juniperus osteosperma* / *Psathyrostachys juncea* Ruderal Woodland
- CEGLO02371 *Pinus edulis* - *Juniperus osteosperma* / *Hesperostipa neomexicana* Woodland
- CEGLO02367 *Pinus edulis* - *Juniperus osteosperma* / *Bromus tectorum* Ruderal Woodland
- CEGLO02340 *Pinus edulis* - *Juniperus* spp. / *Leymus salinus* Woodland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by J. Coles.

Version Date: 2014/03/14

REFERENCES

References: Anhold 2005, Baker 1982b, Baker 1983b, Baker 1983c, Baker 1984a, Baker and Kennedy 1985, Barnes 1987, Brown 1982a, Burns and Honkala 1990a, Dick-Peddie 1993, Donart et al. 1978a, Dwyer and Pieper 1967, Erdman 1962, Erdman 1969, Erdman 1970, Erdman et al. 1969, Everett 1986, Eyre 1980, Faber-Langendoen et al. 2017b, Francis 1986, Harrington and Cobb 1988, Hess and Wasser 1982, Isaacson 1967, Jameson 1962, Jameson and Reid 1965, Jameson et al. 1962, Johnston 1984, Johnston 1987, Kennedy 1983a, Ladyman and Muldavin 1996, Larson and Moir 1986, Larson and Moir 1987, Little 1987, Marr et al. 1973b, Marr et al. 1979, Mason et al. 1967, Moir 1963, Moir and Carleton 1987, Muldavin et al. 1998c, Northcutt 1978, Powell 1988b, Tiedemann 1978, USFS 1981a, Vories 1974, Warren et al. 1982, Wright et al. 1973, Wright et al. 1979

1. Forest & Woodland

1.B.2.Nc. Western North American Pinyon - Juniper Woodland & Scrub

G250. Colorado Plateau Pinyon - Juniper Woodland

A3573. *Pinus edulis* - *Juniperus osteosperma* / Shrub Understory Colorado Plateau Woodland & Scrub

Alliance

Type Concept Sentence: This open woodland and scrub alliance is characteristic of exposed rocky mesatops and canyon slopes and rims in the Colorado Plateau and is characterized by diagnostic tree species *Pinus edulis* that forms a very open to moderately dense, short tree layer often with *Juniperus osteosperma* and an understory lacking or dominated by an open to moderately dense layer of shrubs (>10% cover) or, if less, then exceeding cover of grasses.

OVERVIEW

Scientific Name: *Pinus edulis* - *Juniperus osteosperma* / Shrub Understory Colorado Plateau Woodland & Scrub Alliance

Common Name (Translated Scientific Name): Two-needle Pinyon - Utah Juniper / Shrub Understory Colorado Plateau Woodland & Scrub Alliance

Colloquial Name: Colorado Plateau Two-needle Pinyon - Utah Juniper Woodland & Scrub

Type Concept: This open woodland and scrub alliance is characteristic of exposed rocky mesatops and canyon slopes and rims on the Colorado Plateau, but extends upslope into foothills and on xeric sites. The vegetation is sparse to moderately dense (10-80% total vegetation cover) and is dominated by dwarfed (usually <3 m tall) *Pinus edulis* and/or *Juniperus osteosperma* trees that form extensive tall shrublands or scrublands in the canyon country of the Colorado Plateau region. Both tree species are present with 3-25% cover. The understory is lacking or characterized by an open to moderately dense layer of shrubs (>10% cover) or, if less, then exceeding cover of grasses. Shrubs, if present, often include *Artemisia bigelovii*, *Atriplex canescens*, *Cercocarpus intricatus*, *Cercocarpus montanus*, *Chrysothamnus viscidiflorus*, *Coleogyne ramosissima*, *Ephedra torreyana*, *Ephedra viridis*, *Fendlera rupicola*, *Glossopetalon spinescens* var. *aridum* (= *Glossopetalon nevadense*), *Petradoria pumila*, *Purshia stansburiana*, *Quercus havardii* var. *tuckeri*, or *Quercus turbinella*. Herbaceous layers are typically sparse and composed of xeric grasses and forbs. *Opuntia fragilis* or cushion plants such as *Arenaria eastwoodiae* and *Paronychia sessiliflora* may characterize the understory and exceed shrub cover. Sites are variable but generally xeric. Stands occur on dry canyon rims, ridges, hills, benches, hogbacks, mesas, elevated plains and occasionally in intermittent drainages. Elevations generally range from 1400 to 2165 m (4600-7100 feet), but may extend up to 2480 m (8135 feet). Stands typically occur on gentle to moderately steep slopes on all aspects, but range from flat to steep slopes (0-30%). The soils are variable but generally shallow, poorly developed and skeletal, ranging from well-drained clay loam or sandy clay to rapidly drain loamy sand. The unvegetated ground surface is typically composed of litter, bedrock, and bare soil. Because this is a relatively xeric woodland, bare soil and rocks may cover up to 70% of the unvegetated surface, although biological soil crusts provide up to 40% cover.

Classification Comments: This alliance is similar to *Pinus edulis* - *Juniperus osteosperma* / Shrub Understory Foothill & Lower Montane Dry-Mesic Woodland Alliance (A3571), but trees are sometime stunted by harsh, xeric environments and have a sparse to open woody canopy, and lack some of the upper foothill, lower montane floristic species such as *Quercus gambelii*, when compared to higher elevation foothill pinyon-juniper woodland stands. Additional review is needed to verify association placement in these alliances. Scattered shrubs frequently characterize sparse and rocky understory stands and so are included in this alliance.

Internal Comments: KAS-1-14: Many of the associations included in this alliance range from sparse scrub woodlands to woodlands and it is not possible to separate based on canopy stature or floristic composition of understory at the alliance level, e.g., a canyonlands P-J scrub. I have broadened the concept of this new alliance to include most Colorado Plateau P-J woodland or scrub associations with shrub or sparse understory into *Pinus edulis* - (*Juniperus osteosperma*) / Shrub Understory Woodland & Scrub Alliance (see name change). The less xeric associations, generally higher elevation stands with Gambel oak, mountain big sagebrush, etc., would be classified in the *Pinus edulis* - (*Juniperus osteosperma*) / Shrub Understory Foothill & Lower Montane Dry-Mesic Woodland Alliance (A3571), which I narrowed the concept to just include the relatively mesic P-J associations with shrubby understories.

Other Comments:

Similar NVC Types: This alliance has similarities to other pinyon-juniper woodland and juniper woodland alliances in several other groups, such as G200, G246, G247, G248, G252, G253, and G487.

- A3571 *Pinus edulis* - *Juniperus osteosperma* / Shrub Understory Foothill & Lower Montane Dry-Mesic Woodland Alliance: is similar but understory is dominated by an herbaceous layer (>10% cover) or, if less, grass cover exceeds shrub cover.
- A3572 *Pinus edulis* - *Juniperus osteosperma* / Herbaceous Understory Open Woodland Alliance: is similar but understory lacks a shrub layer and is dominated by an herbaceous layer (>10% cover) or, if less, grass cover exceeds shrub cover.

Diagnostic Characteristics: This is the common pinyon-juniper woodland and scrub found throughout much of the Colorado Plateau. The tree canopy is characterized by a sparse to open tree canopy that is relatively short (usually <3 m tall) but may extend up to 10 m. The diagnostic tree species are *Pinus edulis* and *Juniperus osteosperma*, either of which may dominate woodland stands as long as there is significant presence of *Pinus edulis* (not accidental) to characterize as a pinyon-juniper type. The sparse to moderately dense understory is an open shrub layer. The herbaceous layer is typically sparse and composed of grasses and often diverse forbs, especially cushion plants.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a sparse to moderately dense tree canopy that is typically <3 m tall, but may extent to 10 m on favorable sites. Stands are either solely dominated by evergreen needle-leaved trees or may be codominated by scale-leaved evergreen trees. A sparse to moderately dense shrub layer (0.5-3 m tall) may be present. If present, the shrub layer ranges from a single species to a diverse mix of broad-leaved and microphyllous deciduous or evergreen shrubs that are usually less than 3 m tall. A sparse to moderate ground layer dominated by perennial graminoids is usually present. Perennial forbs and cacti are often scattered throughout the stands. Annual forbs and grasses may be seasonally present.

Floristics: This vegetation of this open woodland and scrub alliance is sparse to moderately dense (10-80% total vegetation cover) and is dominated by dwarfed (usually <3 m tall) *Pinus edulis* and/or *Juniperus osteosperma* trees that form extensive tall shrublands or scrublands in the canyon country of the Colorado Plateau region. Both tree species are present with 3-25% cover. The understory

may be lacking or be characterized by an open to moderately dense layer of shrubs (>10% cover) or, if less, then exceeding cover of grasses. Shrubs, if present, often include *Artemisia bigelovii*, *Atriplex canescens*, *Cercocarpus intricatus*, *Cercocarpus montanus*, *Chrysothamnus viscidiflorus*, *Coleogyne ramosissima*, *Ephedra torreyana*, *Ephedra viridis*, *Fendlera rupicola*, *Glossopetalon spinescens* var. *aridum* (= *Glossopetalon nevadense*), *Petradoria pumila*, *Purshia stansburiana*, *Quercus havardii* var. *tuckeri*, or *Quercus turbinella*. Shrub mixes often occur on steeper talus slopes. Herbaceous layers are typically sparse and composed of xeric grasses and diverse forbs, especially cushion plants. *Opuntia fragilis* or cushion plants, such as *Arenaria eastwoodiae*, *Enceliopsis nudicaulis*, *Erigeron compactus*, *Erigeron pumilus*, *Eriogonum alatum*, *Frasera albomarginata*, *Heterotheca villosa*, *Hymenopappus filifolius*, *Paronychia sessiliflora*, *Polygala subspinoso*, *Stenotus armerioides*, *Tetraneuris acaulis*, *Tetraneuris torreyana* (= *Tetraneuris depressa*), *Townsendia aprica*, and *Townsendia incana*, may characterize the understory and exceed shrub cover. Common perennial grasses include *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua gracilis*, *Pleuraphis jamesii*, and *Poa fendleriana*. Other common forbs, such as *Arenaria fendleri*, *Artemisia ludoviciana*, *Descurainia pinnata*, *Eriogonum ovalifolium*, *Heterotheca villosa*, *Lappula occidentalis*, *Machaeranthera grindelioides*, *Oenothera pallida*, *Penstemon linarioides*, and *Streptanthus cordatus*, may be present with low cover. Stands of this community sampled at higher elevation have northern aspects and more dense vegetation cover. Biological soil crusts may have significant cover in sites derived from loess.

ENVIRONMENT & DYNAMICS

Environmental Description: This open woodland and scrub alliance is characteristic of exposed rocky mesotops and canyon slopes and rims on the Colorado Plateau, but extends upslope into foothills and on xeric sites. Climate is semi-arid. Summers are hot, and winters are cold with occasional snows and extended periods of freezing temperatures. The seasonality of precipitation varies from east to west with summer rain more common in the southern and eastern portion of the alliance's range and winter precipitation more common in the western portion of the range. Mean annual precipitation ranges from 20-35 cm. Sites are variable but generally xeric. Stands occur on dry canyon rims, ridges, hills, benches, Hogbacks, mesas, elevated plains and occasionally in intermittent drainages. Elevations generally range from 1400 to 2165 m (4600-7100 feet), but may extend up to 2480 m (8135 feet). Stands typically occur on gentle to moderately steep slopes on all aspects, but range from flat to steep slopes (0-30%). The soils are variable but generally shallow, poorly developed and skeletal, ranging from well-drained clay loam or sandy clay to rapidly drain loamy sand. Exposed sandstone or limestone bedrock and bare soil have high cover, and woody plants are generally rooted in cracks and joints in bedrock. Some stands may also occur on shale slopes covered by sandstone colluvium. Parent materials are variable and frequently include sandstones and shales of the Cedar Mesa, Chinle, and Dakota Formation sandstones, Kayenta Formation, Curtis Formation, Moenkopi Formation, Morrison Formation, Organ Rock shales and eolian silt deposits, and Wingate and Navajo sandstones eroded and redeposited as eolian sands. The unvegetated ground surface is typically composed of litter, bedrock, and bare soil. Because this is a relatively xeric woodland, bare soil and rocks may cover up to 70% of the unvegetated surface, although biological soil crusts provide up to 40% cover.

Dynamics: *Pinus edulis* is extremely drought-tolerant and slow-growing (Little 1987, Powell 1988b, Muldavin et al. 1998c). It is also non-sprouting and may be killed by fire (Wright et al. 1979). Many xeric stands in this alliance are too sparse to burn. However, the effect of fire on a stand is largely dependent on the tree height and density, fine-fuel load on the ground, weather conditions, and season (Dwyer and Pieper 1967, Wright et al. 1979). Trees are more vulnerable in open stands where fires frequently occur in the spring, when the relative humidity is low, wind speeds are over 10-20 mph, and there are adequate fine fuels to carry fire (Wright et al. 1979). Under other conditions, burns tend to be spotty with low tree mortality. Large trees are generally not killed unless fine fuels, such as tumbleweeds, have accumulated beneath the tree to provide ladder fuels for the fire to reach the crown (Jameson 1962). Closed-canopy stands rarely burn because they typically do not have enough understory or wind to carry a fire (Wright et al. 1979).

Although *Pinus edulis* is drought-tolerant, prolonged droughts will weaken trees and promote mortality by secondary agents. Periodic die-offs of pinyon pine caused by insects, such as the pinyon Ips beetle (*Ips confusus*), or fungal agents, such as blackstain root-rot (*Leptographium wageneri*), tend to be correlated with droughts (Anhold 2005). These mortality events may be localized or widespread but can result in 50 to 90% mortality of *Pinus edulis* (Harrington and Cobb 1988).

Climatic and other factors have resulted in denser and expanded pinyon-juniper stands throughout the Colorado Plateau and Great Basin. Denser stands are more susceptible to attack by insects and disease (Anhold 2005). In addition, altered fire regimes, cutting trees for fencing or firewood, and improper grazing by livestock have significant impacts on the quality of sites. Grazing by livestock can modify the fire regime by removing the fine fuels that carry fire. Fire, livestock grazing, and trampling by recreationalists and vehicles disturb cryptogamic soil crusts that help maintain soil structure, reduce soil erosion, provide habitat for plants and preserve biological diversity (Ladyman and Muldavin 1996). More study is needed to understand and manage these woodlands ecologically.

DISTRIBUTION

Geographic Range: The core distribution of this open woodland alliance is the canyon country of the Colorado Plateau.

Nations: US

States/Provinces: AZ, CO, NV?, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- < *Pinus edulis* Series (Francis 1986)
- < Colorado Pinyon-Utah Juniper Series (Dick-Peddie 1993)

LOWER LEVEL UNITS

Associations:

- CEG002365 *Pinus edulis* - *Juniperus osteosperma* / *Artemisia pygmaea* Woodland
- CEG005657 *Pinus edulis* - *Juniperus osteosperma* / *Cercocarpus montanus* - Mixed Shrubs Woodland
- CEG000782 *Pinus edulis* - *Juniperus osteosperma* / *Purshia stansburiana* Woodland
- CEG000781 *Pinus edulis* - *Juniperus osteosperma* / *Coleogyne ramosissima* Woodland
- CEG002328 *Pinus edulis* - *Juniperus osteosperma* / Mixed Shrubs Talus Woodland
- CEG002331 *Pinus edulis* - *Juniperus osteosperma* / *Artemisia nova* Woodland
- CEG002332 *Pinus edulis* - *Juniperus osteosperma* / *Petroragia pumila* Woodland
- CEG002334 *Pinus edulis* - *Juniperus osteosperma* / (*Shepherdia rotundifolia*, *Amelanchier utahensis*) Wooded Shrubland
- CEG002118 *Pinus edulis* - *Juniperus osteosperma* / *Artemisia bigelovii* Woodland
- CEG002148 *Pinus edulis* - *Juniperus osteosperma* / Sparse Understory Woodland
- CEG002335 *Pinus edulis* - *Juniperus osteosperma* / *Shepherdia rotundifolia* Woodland
- CEG002497 *Pinus edulis* - *Juniperus osteosperma* / *Quercus havardii* var. *tuckeri* Woodland
- CEG002366 *Pinus edulis* - *Juniperus osteosperma* / *Atriplex* spp. Woodland
- CEG002370 *Pinus edulis* - *Juniperus osteosperma* / *Ephedra viridis* - *Gutierrezia sarothrae* Woodland
- CEG004007 *Pinus edulis* - *Juniperus osteosperma* / *Quercus turbinella* Woodland
- CEG002375 *Pinus edulis* - *Juniperus osteosperma* / Cushion Plant Woodland
- CEG002374 *Pinus edulis* - *Juniperus osteosperma* / *Opuntia fragilis* Woodland
- CEG002369 *Pinus edulis* - *Juniperus osteosperma* / *Ephedra torreyana* - *Artemisia bigelovii* Woodland
- CEG004005 *Pinus edulis* - *Juniperus osteosperma* / *Fendlera rupicola* Woodland
- CEPP009635 *Pinus edulis* - *Juniperus osteosperma* / *Symphoricarpos longiflorus* Woodland
- CEG000779 *Pinus edulis* - *Juniperus osteosperma* / *Cercocarpus intricatus* Woodland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by J. Coles.

Version Date: 2014/03/14

REFERENCES

References: Anhold 2005, Baker 1982b, Baker 1983b, Baker 1983c, Baker 1984a, Baker and Kennedy 1985, Bassett et al. 1987, Brown 1982a, Burns and Honkala 1990a, Dick-Peddie 1993, Donart et al. 1978a, Dwyer and Pieper 1967, Erdman 1962, Erdman 1969, Erdman 1970, Erdman et al. 1969, Everett 1986, Faber-Langendoen et al. 2017b, Francis 1986, Harrington and Cobb 1988, Hess and Wasser 1982, Holm 1927, Isaacson 1967, Jameson 1962, Jameson and Reid 1965, Jameson et al. 1962, Johnston 1984, Johnston 1987, Kennedy 1983a, Ladyman and Muldavin 1996, Larson and Moir 1986, Larson and Moir 1987, Little 1987, Moir 1963, Moir and Carleton 1987, Muldavin et al. 1998c, Pieper 1968, Powell 1988b, Soil Conservation Service 1978, Tiedemann 1978, Vories 1974, Warren et al. 1982, Wright et al. 1973, Wright et al. 1979, Zimmerman 1978

1. Forest & Woodland

1.B.2.Nc. Western North American Pinyon - Juniper Woodland & Scrub

G250. Colorado Plateau Pinyon - Juniper Woodland

A3571. *Pinus edulis* - *Juniperus osteosperma* / Shrub Understory Foothill & Lower Montane Dry-Mesic Woodland Alliance

Type Concept Sentence: This woodland alliance is characterized by diagnostic tree species *Pinus edulis* that forms a very open to moderately dense tree layer often with *Juniperus osteosperma* (sometimes with *Juniperus monosperma* or *Juniperus scopulorum*) and an understory dominated by an open to dense layer of relatively mesic shrubs or shrubs exceed cover of grasses. It occurs on dry-mesic mountain slopes, foothills, and plateaus in the Colorado Plateau extending east into the west slope of the southern Rocky Mountains.

OVERVIEW

Scientific Name: *Pinus edulis* - *Juniperus osteosperma* / Shrub Understory Foothill & Lower Montane Dry-Mesic Woodland Alliance

Common Name (Translated Scientific Name): Two-needle Pinyon - Utah Juniper / Shrub Understory Foothill & Lower Montane Dry-Mesic Woodland Alliance

Colloquial Name: Foothill & Lower Montane Pinyon - Juniper / Shrub Dry-Mesic Woodland

Type Concept: This woodland alliance is characterized by diagnostic tree species *Pinus edulis* that forms an open to dense tree layer often with *Juniperus osteosperma* or, less frequently, *Juniperus monosperma* within the range of *Juniperus osteosperma* in northern Arizona. *Juniperus osteosperma* may also dominate stands as long as there is significant presence of *Pinus edulis* (not accidental) to characterize the stand as a pinyon-juniper stand and not the more xeric, typically lower elevation *Juniperus osteosperma* woodland. At higher elevations and relatively mesic sites, such as along drainages, *Juniperus scopulorum* may be present and sometimes dominant. Other conifers are absent or accidental with very low cover. The understory is characterized by relatively mesic shrubs that typically form an open to moderately dense layer. Diagnostic shrubs include *Amelanchier utahensis*, *Arctostaphylos patula*, *Arctostaphylos pungens*, *Artemisia tridentata ssp. tridentata*, *Artemisia tridentata ssp. vaseyana*, *Artemisia tridentata ssp. wyomingensis*, *Cercocarpus ledifolius*, *Quercus gambelii*, and *Symphoricarpos oreophilus*. The herbaceous layer is sparse to moderate and composed of grasses often with diverse, but low cover of forbs. Common species may include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Hesperostipa comata*, *Hesperostipa neomexicana*, *Poa fendleriana*, *Poa secunda*, *Pleuraphis jamesii*, and *Pseudoroegneria spicata*. The non-native, invasive annual grass *Bromus tectorum* may become abundant in disturbed stands and dominate the herbaceous layer of highly disturbed stands. These woodlands occur on warm, dry-mesic sites on mountain slopes and foothills and in the higher plateaus and mountains in the Colorado Plateau and the west slope of the southern Rocky Mountains. Stands occur on flat to moderate slopes along drainages, on mesatops, and on moderate to steep, sometimes rocky slopes of foothills, mountains and canyons, especially in draws where soil moisture is concentrated, or on northern aspects or where shaded by upper canyon walls. Aspects are variable and elevations range from 1500-2770 m (4920-9090 feet). The soils are variable but tend to be shallow, gravelly and rapidly drained, ranging from sandy loams to silt clay loams. Litter from shrubs may be extensive (over 50% cover). Parent materials include alluvial, colluvial or eolian deposits derived from sandstone, shale, limestone, granite quartzite and rhyolite.

Classification Comments: In northwestern New Mexico outside the distributional range of *Juniperus osteosperma*, this alliance transitions into the southern Rocky Mountain pinyon-juniper woodland alliances. Stands with sparse or rock understory are included in this alliance because scattered similar shrub species are frequently present and characterize the stand at lower cover. Additional review is needed to verify alliance placement between this alliance and *Pinus edulis* - *Juniperus osteosperma* / Shrub Understory Colorado Plateau Woodland & Scrub Alliance (A3573).

~*Pinus edulis* - *Juniperus* spp. / *Artemisia arbuscula* Woodland (CEGL004008) needs further review and classification action - possibly archive because of lack of information. Also review lower elevation stands dominated by *Artemisia tridentata ssp. wyomingensis* and possibly create a new association and place in *Pinus edulis* - *Juniperus osteosperma* / Shrub Understory Colorado Plateau Woodland & Scrub Alliance (A3573) to split from higher elevation stands dominated by *Artemisia tridentata ssp. vaseyana* placed in this alliance (A3571).

Internal Comments: mjr 12-14: CA added for MOJN.

Other Comments:

Similar NVC Types: This alliance has similarities to other pinyon-juniper woodland and juniper woodland alliances in several other groups, such as G200, G246, G247, G248, G252, G253, and G487.

- A3572 *Pinus edulis* - *Juniperus osteosperma* / Herbaceous Understory Open Woodland Alliance: is similar but understory lacks a shrub layer and is dominated by an herbaceous layer (>10% cover) or, if less, grass cover exceeds shrub cover.
- A3574 *Juniperus monosperma* / Shrub Understory Woodland Alliance
- A3496 *Juniperus osteosperma* / Shrub Understory Woodland Alliance
- A3573 *Pinus edulis* - *Juniperus osteosperma* / Shrub Understory Colorado Plateau Woodland & Scrub Alliance: is similar but overstory trees are often short and scrubby occurring on to rocky outcrops and canyonlands with understory composed of xeric shrub species and relatively mesic shrubs such as *Quercus gambelii* absent or at low cover.

Diagnostic Characteristics: This woodland alliance occurs in the Colorado Plateau and extends east into the west slope of the southern Rocky Mountains within the distributional range of *Juniperus osteosperma*. The diagnostic tree species are *Pinus edulis* and *Juniperus osteosperma*, either of which may dominate woodland stands as long as there is significant presence of *Pinus edulis* (not accidental) to characterize as a pinyon-juniper type. The understory is characterized by relatively mesic shrubs. Diagnostic shrubs include *Amelanchier utahensis*, *Arctostaphylos patula*, *Arctostaphylos pungens*, *Artemisia tridentata ssp. tridentata*, *Artemisia tridentata ssp. vaseyana*, *Artemisia tridentata ssp. wyomingensis*, *Cercocarpus ledifolius*, *Quercus gambelii*, and *Symphoricarpos oreophilus*. The herbaceous layer is sparse to moderate and composed of grasses often with diverse, but low cover of forbs.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a moderately sparse to moderately dense tree canopy that is typically 3-10 m tall. Stands are either solely dominated by evergreen needle-leaved trees or may be codominated by broad-leaved or scale-leaved evergreen trees. A sparse to moderately dense shrub layer (0.5-3 m tall) is present. If present, the shrub layer ranges from a single species to a diverse mixture of broad-leaved and microphyllous deciduous or evergreen shrubs that are usually less than 3 m tall. A sparse to moderate ground layer dominated by perennial graminoids may be present. Perennial forbs and cacti are often scattered throughout the stands. Annual forbs and grasses may be seasonally present.

Floristics: This woodland alliance is characterized by diagnostic tree species *Pinus edulis* that forms an open to dense tree layer often with *Juniperus osteosperma* or, less frequently, *Juniperus monosperma* within the range of *Juniperus osteosperma* in northern Arizona. *Juniperus osteosperma* may also dominate stands as long as there is significant presence of *Pinus edulis* (not accidental) to characterize the stand as a pinyon-juniper stand and not the more xeric, typically lower elevation *Juniperus osteosperma* woodland. At higher elevations and relatively mesic sites, such as along drainages, *Juniperus scopulorum* may be present and sometimes dominant. Other conifers are absent or accidental with very low cover. The understory is characterized by relatively mesic shrubs that typically form an open to moderately dense layer. Diagnostic shrubs include *Amelanchier utahensis*, *Arctostaphylos patula*, *Arctostaphylos pungens*, *Artemisia tridentata ssp. tridentata*, *Artemisia tridentata ssp. vaseyana*, *Artemisia tridentata ssp. wyomingensis*, *Cercocarpus ledifolius*, *Quercus gambelii*, and *Symphoricarpos oreophilus*. Many other shrubs may be present, including *Ericameria* spp., *Gutierrezia sarothrae*, *Holodiscus dumosus*, *Opuntia* spp., *Peraphyllum ramosissimum*, *Purshia stansburiana*, and *Shepherdia rotundifolia*. The herbaceous layer is sparse to moderate and composed of grasses often with diverse, but low cover of forbs. Common species may include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Hesperostipa comata*, *Hesperostipa neomexicana*, *Poa fendleriana*, *Poa secunda*, *Pleuraphis jamesii*, and *Pseudoroegneria spicata*. Commonly present forbs include species of *Arenaria*, *Artemisia*, *Balsamorhiza*, *Chenopodium*, *Cryptantha*, *Eriogonum*, *Heterotheca*, *Geranium*, *Machaeranthera*, *Mirabilis*, *Packera*, *Penstemon*, *Phlox*, *Senecio*, *Stenotus*, *Tetraneuris*, *Thalictrum*, *Vicia*, and *Zinnia*. Annual grasses and forbs are seasonally present. Seedling *Pinus edulis* and *Juniperus* spp. are often present. The non-native, invasive annual grass *Bromus tectorum* may become abundant in disturbed stands and dominate the herbaceous layer of highly disturbed stands.

ENVIRONMENT & DYNAMICS

Environmental Description: This woodland alliance occurs on warm, dry-mesic sites on mountain slopes and foothills and in the higher plateaus and mountains in the Colorado Plateau and the western slope of the southern Rocky Mountains. Climate is semi-arid. Summers are generally hot, and winters are cold with occasional snows and extended periods of freezing temperatures. The seasonality of precipitation varies from east to west with summer rain more common in the southern and eastern portion of the alliance's range and winter precipitation more common in the western portion of the range. Mean annual precipitation ranges from 30-46 cm. Sites are variable but generally are relatively mesic. Stands occur on flat to moderate slopes along drainages and on mesatops, and on moderate to steep, sometimes rocky slopes of foothills, mountains and canyons, especially in draws where soil moisture is concentrated, or on northern aspects or where shaded by upper canyon walls. Aspects are variable and elevations range from 1500-2770 m (4920-9090 feet). Stands in the northern part of the range and at higher elevations (>2400 m) tend to occupy southerly aspects; whereas in the southern part of the range and at lower elevations (<2000 m), stands on northerly aspects are common unless they are located in a moisture-concentrating gully. The soils are variable but tend to be shallow and rapidly drained, ranging from sandy loam, to sandy clay loam, silt loam, and silt clay loam soil textures. They are often gravelly or rocky. Litter from *Quercus gambelii* and other shrubs may be extensive (over 50% cover). Parent materials include alluvial, colluvial or eolian deposits derived from sandstone, shale, limestone, granite quartzite and rhyolite.

Dynamics: *Pinus edulis* is extremely drought-tolerant and slow-growing (Little 1987, Powell 1988b, Muldavin et al. 1998c). It is also non-sprouting and may be killed by fire (Wright et al. 1979). The effect of fire on a stand is largely dependent on the tree height and density, fine-fuel load on the ground, weather conditions, and season (Dwyer and Pieper 1967, Wright et al. 1979). Trees are more vulnerable in open stands where fires frequently occur in the spring, when the relative humidity is low, wind speeds are over 10-20 mph, and there are adequate fine fuels to carry fire (Wright et al. 1979). Under other conditions, burns tend to be spotty with low tree mortality. Large trees are generally not killed unless fine fuels, such as tumbleweeds, have accumulated beneath the tree to provide ladder fuels for the fire to reach the crown (Jameson 1962). Closed-canopy stands rarely burn because they typically do not have enough understory or wind to carry a fire (Wright et al. 1979).

Although *Pinus edulis* is drought-tolerant, prolonged droughts will weaken trees and promote mortality by secondary agents. Periodic die-offs of pinyon pine caused by insects, such as the pinyon Ips beetle (*Ips confusus*), or fungal agents, such as blackstain root-rot (*Leptographium wageneri*), tend to be correlated with droughts (Anhold 2005). These mortality events may be localized or widespread but can result in 50 to 90% mortality of *Pinus edulis* (Harrington and Cobb 1988).

Climatic and other factors have resulted in denser and expanded pinyon-juniper stands throughout the Colorado Plateau and Great Basin. Denser stands are more susceptible to attack by insects and disease (Anhold 2005). In addition, altered fire regimes, cutting trees for fencing or firewood, and improper grazing by livestock have significant impacts on the quality of sites. Grazing by livestock can modify the fire regime by removing the fine fuels that carry fire. Fire, livestock grazing, and trampling by recreationalists and vehicles disturb cryptogamic soil crusts that help maintain soil structure, reduce soil erosion, provide habitat for plants and preserve biological diversity (Ladyman and Muldavin 1996). More study is needed to understand and manage these woodlands ecologically.

DISTRIBUTION

Geographic Range: The core distribution of this woodland alliance is in high plateaus and mountains in the Colorado Plateau extending east into the western slope of the southern Rocky Mountains.

Nations: US

States/Provinces: AZ, CA, CO, NM, UT

TNC Ecoregions [optional]: 17:C

USFS Ecoregions (2007): 322A1:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Pinus edulis* (Two-needle pinyon stands) Special Stands (Sawyer et al. 2009) [87.050.00]
- < *Pinus edulis* Series (Francis 1986)
- >< *Pinus edulis* Woodland Alliance (Evens et al. 2014)
- < Colorado Pinyon-Utah Juniper Series (Dick-Peddie 1993)

LOWER LEVEL UNITS

Associations:

- CEG000775 *Pinus edulis* - *Juniperus osteosperma* / *Arctostaphylos pungens* Woodland
- CEG002939 *Pinus edulis* - *Juniperus osteosperma* / *Arctostaphylos patula* Woodland
- CEG002940 *Pinus edulis* - *Juniperus osteosperma* / *Cercocarpus ledifolius* Woodland
- CEG000789 *Pinus edulis* - *Juniperus osteosperma* / *Purshia tridentata* Woodland
- CEG005659 *Pinus edulis* - *Juniperus osteosperma* / *Quercus gambelii* Woodland
- CEG004008 *Pinus edulis* - *Juniperus* spp. / *Artemisia arbuscula* Woodland
- CEG005651 *Pinus edulis* - *Juniperus (monosperma, deppeana)* / *Quercus gambelii* Woodland
- CEG005658 *Pinus edulis* - *Juniperus osteosperma* / *Artemisia tridentata* (ssp. *wyomingensis*, ssp. *vaseyana*) Woodland
- CEG002329 *Pinus edulis* - *Juniperus osteosperma* / *Amelanchier utahensis* Woodland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by J.J. Coles.

Version Date: 2014/03/14

REFERENCES

References: Anhold 2005, Baker 1982b, Baker 1983b, Baker 1983c, Baker 1984a, Baker and Kennedy 1985, Bassett et al. 1987, Brown 1982a, DeLeuw, Cather & Company 1977, Dick-Peddie 1993, Donart et al. 1978a, Dwyer and Pieper 1967, Erdman 1962, Erdman 1969, Erdman 1970, Erdman et al. 1969, Evens 2000, Evens et al. 2014, Everett 1986, Faber-Langendoen et al. 2017b, Francis 1986, Harrington and Cobb 1988, Hess and Wasser 1982, Isaacson 1967, Jameson 1962, Jameson and Reid 1965, Jameson et al. 1962, Johnston 1984, Johnston 1987, Kennedy 1983a, Ladyman and Muldavin 1996, Larson and Moir 1986, Larson and Moir 1987, Little 1987, Marr et al. 1973b, Marr et al. 1979, Moir 1963, Moir and Carleton 1987, Muldavin et al. 1998c, Northcutt 1978, Pieper 1968, Powell 1988b, Sawyer et al. 2009, Soil Conservation Service 1978, Steinhoff 1978, Thomas et al. 2004, Tiedemann 1978, Vories 1974, Warren et al. 1982, Wright et al. 1973, Wright et al. 1979, Zimmerman 1978

1.B.3. Temperate Flooded & Swamp Forest

Temperate Flooded & Swamp Forest is a tree-dominated wetland influenced by minerotrophic groundwater, either on mineral or organic (peat) soil, found in mid-latitudes of the globe.

1.B.3.Nc. Rocky Mountain-Great Basin Montane Flooded & Swamp Forest

Forested riparian and depressional wetlands dominated by broad-leaved deciduous trees or conifers (or both) that occur at mid to high elevations of the Rocky Mountains, ranges of the Intermountain West and the Colorado Plateau, and in the Sierra Nevada and eastern Cascades.

M034. Rocky Mountain-Great Basin Montane Riparian & Swamp Forest

This macrogroup consists of montane riparian and swamp forests and woodlands dominated by cottonwood trees, conifer trees, or a mix with such species as *Acer negundo*, *Alnus rhombifolia*, *Picea engelmannii*, *Picea pungens*, *Pinus contorta*, *Pinus ponderosa*, *Populus angustifolia*, and *Populus balsamifera*. It occurs throughout the Great Basin and Rocky Mountains.

1. Forest & Woodland

1.B.3.Nc. Rocky Mountain-Great Basin Montane Flooded & Swamp Forest

1.B.3.Nc.1.a. M034 Rocky Mountain-Great Basin Montane Riparian & Swamp Forest

G506. Rocky Mountain-Great Basin Montane Riparian & Swamp Forest

Type Concept Sentence: This riparian forest group includes seasonally flooded conifer-dominated forests found at montane to subalpine elevations of the Rocky Mountain cordillera, from southern New Mexico north into Montana, and west into the Intermountain West region and the Colorado Plateau. *Picea engelmannii*, *Picea pungens*, and/or *Populus angustifolia* dominate, and the understory is often dominated by forbs or graminoids with only a few shrubs. Soils are mineral and very well-oxygenated.

OVERVIEW

Scientific Name: *Picea engelmannii* - *Picea pungens* - *Populus angustifolia* Riparian & Swamp Forest Group

Common Name (Translated Scientific Name): Engelmann Spruce - Blue Spruce - Narrowleaf Cottonwood Riparian & Swamp Forest Group

Colloquial Name: Rocky Mountain Grand Fir Riparian Forest

Type Concept: This group contains woodlands dominated by cottonwood, conifer and aspen that line montane streams. Dominant tree species usually include *Abies lasiocarpa*, *Picea engelmannii*, *Pinus ponderosa*, *Juniperus scopulorum*, and/or *Populus angustifolia*; other important species include *Pseudotsuga menziesii*, *Picea pungens*, *Picea engelmannii* x *glauca*, and *Populus tremuloides*. Other trees possibly present but not usually dominant include *Alnus incana*, *Abies concolor*, *Abies grandis*, *Pinus contorta*, and *Juniperus osteosperma*. Shrub cover tends to be limited but may include *Alnus incana*, *Betula occidentalis*, *Cornus sericea*, *Crataegus rivularis*, *Forestiera pubescens* var. *pubescens*, *Ribes* spp., *Rosa woodsii*, *Salix* spp., and others. The herbaceous undergrowth can be lush to depauperate. Herbaceous species include *Calamagrostis canadensis*, *Carex aquatilis* var. *aquatilis*, *Carex obnupta*, *Carex pellita*, *Equisetum arvense*, *Heracleum maximum*, *Ranunculus alismifolius*, *Senecio bigelovii* var. *bigelovii*, *Streptopus amplexifolius*, and *Veratrum californicum*. This riparian group includes seasonally flooded forests found at montane to subalpine elevations of the Rocky Mountain cordillera, from southern New Mexico north into Montana, and west into the Intermountain West region and the Colorado Plateau. It occurs throughout the interior of British Columbia and the eastern slopes of the Cascade Range. These are communities tolerant of periodic flooding and high water tables. Snowmelt moisture may create shallow water tables or seeps for a portion of the growing season. Stands typically occur at elevations between 1500 and 3300 m (4920-10,830 feet); farther north, elevation ranges between 900 and 2000 m. This is confined to specific riparian environments occurring on floodplains or terraces of rivers and streams, in V-shaped, narrow valleys and canyons (where there is cold-air drainage). Less frequently, occurrences are found in moderately wide valley bottoms on large floodplains along broad, meandering rivers, and on pond or lake margins.

Classification Comments: This group is restricted to montane riparian areas and avalanche chutes between lower and upper treeline.

Similar NVC Types:

- G505 Rocky Mountain-Great Basin Swamp Forest: occurs on saturated, extremely poorly drained soil.
- G507 North Pacific Montane Riparian Woodland

Diagnostic Characteristics: This group contains the conifer and aspen woodlands that line montane streams. These are communities tolerant of periodic flooding and high water tables.

VEGETATION

Physiognomy and Structure: Open to closed woodlands of tall conifer or deciduous trees with or without an understory of deciduous shrubs, generally forming linear bands following streams. These can blend into the surrounding upland forest, and often only the understory herbaceous species indicate the wet nature of the soils.

Floristics: Dominant tree species usually include *Abies lasiocarpa*, *Abies grandis*, *Picea engelmannii*, *Picea pungens*, *Populus angustifolia*, *Pinus ponderosa*, *Pinus contorta*, and/or *Juniperus scopulorum*; other important species include *Pseudotsuga menziesii*, *Picea engelmannii* x *glauca*, and *Populus tremuloides*. Other trees possibly present and dominant or codominant include *Abies concolor*, *Abies grandis*, *Pinus contorta*, and *Juniperus osteosperma*. Shrub cover tends to be limited but may include *Alnus incana*, *Betula occidentalis*, *Cornus sericea*, *Crataegus rivularis*, *Forestiera pubescens* var. *pubescens*, *Ribes* spp., *Rosa woodsii*, *Salix* spp., and others. The herbaceous undergrowth can be lush to depauperate. Herbaceous species include *Calamagrostis canadensis*, *Carex aquatilis* var. *aquatilis*, *Carex obnupta*, *Carex pellita*, *Equisetum arvense*, *Heracleum maximum*, *Ranunculus alismifolius*, *Senecio bigelovii* var. *bigelovii*, *Streptopus amplexifolius*, and *Veratrum californicum*. Floristic information is compiled from several sources for eastern Washington and Oregon (Kovalchik 1987, 1993, Crowe and Clausnitzer 1997), Nevada (Manning and Padgett 1995), Colorado (Kittel et al. 1999b), Montana (Butler 1979, 1985, Malanson and Butler 1984, Hansen et al. 1989), British Columbia (MacKenzie and Moran 2004), Utah (Padgett et al. 1989, Tuhy et al. 2002), New Mexico and Arizona (Szaro 1989, Muldavin et al. 2000a), and Wyoming (Walford 1996, Walford et al. 2001).

ENVIRONMENT & DYNAMICS

Environmental Description: *Climate:* Temperate cold. *Soil/substrate/hydrology:* Stands typically occur at elevations between 1500 and 3300 m (4920-10,830 feet); farther north, elevation ranges between 900 and 2000 m. This group is confined to specific riparian environments occurring on floodplains or terraces of rivers and streams, in V-shaped, narrow valleys and canyons (where there is cold-air drainage). Less frequently, occurrences are found in moderately wide valley bottoms on large floodplains along broad, meandering rivers, on pond or lake margins, and seeps on gentle slopes. Environmental information is compiled from several sources: for eastern Washington and Oregon (Kovalchik 1987, 1992, 2001, Crowe and Clausnitzer 1997); for Nevada (Manning and Padgett 1995); for Colorado (Baker 1988, 1989a, 1989b, 1990, Kittel et al. 1994, 1995, 1999a, 1999b); for Montana (Butler 1979, 1985, Malanson and Butler 1984, Hansen et al. 1989); for British Columbia (MacKenzie and Moran 2004); for Utah (Padgett et al. 1989, Tuhy et al. 2002); for New Mexico and Arizona (Szaro 1989, Muldavin et al. 2000a); and for Wyoming (Walford 1996, Walford et al. 2001).

Dynamics:

DISTRIBUTION

Geographic Range: This group is found at montane to subalpine elevations of the Rocky Mountain cordillera, from southern New Mexico north into Montana, Alberta and British Columbia, and west into the Intermountain West region and the Colorado Plateau.

Spatial Scale & Pattern [optional]: Linear

Nations: CA, US

States/Provinces: AB, AZ, BC, CA, CO, ID, MT, NM, NV, OR, SD, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = Blue Spruce: 216 (Eyre 1980) [Blue spruce commonly occurs in riparian zones]
- = ER Engelmann Spruce Riparian (Ecosystems Working Group 1998)
- < Engelmann Spruce - Subalpine Fir: 206 (Eyre 1980) [Engelmann spruce occurs as a dominant in riparian zones.]
- < Riparian (422) (Shiflet 1994)

LOWER LEVEL UNITS

Alliances:

- A3761 *Picea pungens* Riparian Forest Alliance
- A4154 *Acer negundo* - *Alnus incana* ssp. *tenuifolia* - *Cornus sericea* Riparian Woodland Alliance
- A3759 *Populus angustifolia* Riparian Forest Alliance
- A3797 *Pinus ponderosa* - *Juniperus scopulorum* - *Abies concolor* Riparian Woodland Alliance

- A3760 *Populus tremuloides* Riparian Forest Alliance
- A3762 *Abies grandis* Rocky Mountain Riparian Forest Alliance
- A3758 *Pinus contorta* var. *murrayana* - *Pinus contorta* var. *latifolia* Swamp Forest Alliance
- A3757 *Abies lasiocarpa* - *Picea engelmannii* Swamp Forest Alliance

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2011)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 05/11/2015

Classif Resp Region: West

Internal Author: GK 10-10, 9-13, 5-15, 12-15

REFERENCES

References: Baker 1988, Baker 1989a, Baker 1989b, Baker 1990, Butler 1979, Butler 1985, Crowe and Clausnitzer 1997, Ecosystems Working Group 1998, Eyre 1980, Faber-Langendoen et al. 2017a, Hansen et al. 1989, Kittel 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1999a, Kittel et al. 1999b, Kovalchik 1987, Kovalchik 1993, Kovalchik 2001, MacKenzie and Moran 2004, Malanson and Butler 1984, Manning and Padgett 1995, Muldavin et al. 2000a, Nachlinger et al. 2001, Padgett et al. 1988b, Padgett et al. 1989, Shiflet 1994, Szaro 1989, Tuhy et al. 2002, Walford 1996, Walford et al. 2001

1. Forest & Woodland

1.B.3.Nc. Rocky Mountain-Great Basin Montane Flooded & Swamp Forest

G506. Rocky Mountain-Great Basin Montane Riparian & Swamp Forest

A3762. *Abies grandis* Rocky Mountain Riparian Forest Alliance

Type Concept Sentence: This alliance consists of riparian areas dominated by *Abies grandis*, usually with other conifers. *Abies lasiocarpa*, *Larix occidentalis*, *Pinus monticola*, and *Pseudotsuga menziesii* may be present to codominant. *Betula papyrifera* or *Populus balsamifera* ssp. *trichocarpa* sometimes form a scattered subcanopy. It occupies sites on benches, toeslopes or valley bottoms along mountain streams. The alliance occurs in the Rocky Mountains of western Montana, Idaho and eastern Washington and eastern Oregon, possibly extending into British Columbia. Elevations range from 790-1410 m.

OVERVIEW

Scientific Name: *Abies grandis* Rocky Mountain Riparian Forest Alliance

Common Name (Translated Scientific Name): Grand Fir Rocky Mountain Riparian Forest Alliance

Colloquial Name: Rocky Mountain Grand Fir Riparian Forest

Type Concept: This is an alliance of riparian woodlands dominated by *Abies grandis*, usually with other conifers. *Abies lasiocarpa*, *Larix occidentalis*, *Pinus monticola*, and *Pseudotsuga menziesii* may be present to codominant. *Betula papyrifera* or *Populus balsamifera* ssp. *trichocarpa* sometimes forms a scattered subcanopy. There is usually a rich and well-developed shrub layer. Common shrubs include *Acer glabrum*, *Linnaea borealis*, *Rosa gymnocarpa*, *Rubus parviflorus*, and *Symphoricarpos albus*. The herbaceous layer is characterized by a diverse assemblage of moist-site forbs and ferns, including *Aralia nudicaulis*, *Athyrium filix-femina*, *Galium triflorum*, *Goodyera oblongifolia*, *Maianthemum stellatum*, *Orthilia secunda*, *Osmorhiza berteroi* (= *Osmorhiza chilensis*), *Senecio triangularis*, and *Tiarella trifoliata*. This alliance occurs in the Rocky Mountains of western Montana, Idaho and eastern Washington and eastern Oregon, possibly extending into British Columbia. It occupies sites on benches, toeslopes or valley bottoms along mountain streams. Elevations where the alliance occurs range from 790-1410 m. Soils are typically very cobbly silt loams or sandy loam. Water tables are generally within 1 m of the soil surface in the spring, but the soils are well-drained.

Classification Comments: This alliance does not include *Abies grandis* riparian and wetland locations west of the Cascade Crest. These sites are outside the range of *Thuja plicata*, which dominates similar sites throughout the wetter parts of the Pacific Northwest.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Stands on riparian seasonally wet soils dominated by *Abies grandis* or other conifer species.

VEGETATION

Physiognomy and Structure: Upper canopy of evergreen needle-leaved tall coniferous trees. A sparse subcanopy is occasionally present, composed of broad-leaved winter-deciduous trees. A shrub layer of broad-leaved cold-deciduous shrubs is usually present in moist sites. Herbaceous cover is a species-diverse layer of shade-tolerant forbs and ferns.

Floristics: Vegetation within this alliance is distributed on low- to mid-elevation mountain slopes and bottomlands of the northern Rocky Mountains. *Picea engelmannii* is often a codominant with *Abies grandis* in stands of this alliance. *Pseudotsuga menziesii* or *Larix occidentalis* may be present at the drier margins, and *Abies lasiocarpa* may occur in higher elevation or frost pocket locations. *Betula papyrifera* or *Populus balsamifera ssp. trichocarpa* sometimes form a scattered subcanopy. There is usually a rich and well-developed shrub layer. Common shrubs include *Acer glabrum*, *Linnaea borealis*, *Rosa gymnocarpa*, *Rubus parviflorus*, and *Symphoricarpos albus*. The herbaceous layer is characterized by a diverse assemblage of moist-site forbs and ferns, including *Aralia nudicaulis*, *Athyrium filix-femina*, *Galium triflorum*, *Goodyera oblongifolia*, *Maianthemum stellatum*, *Orthilia secunda*, *Osmorhiza berteroi* (= *Osmorhiza chilensis*), *Senecio triangularis*, and *Tiarella trifoliata*.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance generally occupies sites on benches, toeslopes or valley bottoms along mountain streams. Elevations where the alliance occurs range from 790-1410 m. Soils are typically very cobbly silt loams or sandy loam (Hansen et al. 1995). Water tables are generally within 1 m of the soil surface in the spring, but the soils are well-drained. Vegetation occurs within the maritime-influenced region of the northern Rocky Mountains.

Dynamics: The nominal species of this alliance is a long-lived, shade-tolerant conifer which can regenerate under a dense forest canopy. This type is often adjacent to drier *Pseudotsuga menziesii* or drier *Abies grandis* forests. Although *Abies grandis* is regarded as a climax species at such sites, repeated fire or disturbance can allow early-seral, but long-lived species, such as *Picea engelmannii* to codominate for many years. In mature, wet stands of this alliance, regeneration may be limited to rotting logs or stumps which allow germination above the wet forest floor.

DISTRIBUTION

Geographic Range: This alliance occurs in the Rocky Mountains of western Montana, Idaho and eastern Washington and eastern Oregon, possibly extending into British Columbia.

Nations: CA?, US

States/Provinces: BC?, ID, MT, OR, WA

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- >< *Abies grandis* Series (Cooper et al. 1987)

LOWER LEVEL UNITS

Associations:

- CEGLO00280 *Abies grandis* / *Senecio triangularis* Riparian Forest
- CEGLO00270 *Abies grandis* / *Athyrium filix-femina* Riparian Forest
- CEGLO03441 *Pinus monticola* / *Deschampsia cespitosa* Riparian Forest

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Burns and Honkala 1990a, Cooper et al. 1987, Faber-Langendoen et al. 2017b, Hansen et al. 1991, Hansen et al. 1995

1. Forest & Woodland

1.B.3.Nc. Rocky Mountain-Great Basin Montane Flooded & Swamp Forest

G506. Rocky Mountain-Great Basin Montane Riparian & Swamp Forest

A3757. *Abies lasiocarpa* - *Picea engelmannii* Swamp Forest Alliance

Type Concept Sentence: This alliance includes subalpine riparian or seep slope conifer forests characterized by the codominance of the conifers *Abies lasiocarpa* and *Picea engelmannii*. Other conifer species that may be present to codominant include *Picea engelmannii* x *glauca*, *Picea glauca*, *Pinus contorta*, and *Tsuga mertensiana* in the upper montane and subalpine areas of the Rocky Mountains. These forests occur in landscape positions where snowmelt moisture creates shallow water tables, seeps, or streamside flooding during much of the growing season.

OVERVIEW

Scientific Name: *Abies lasiocarpa* - *Picea engelmannii* Swamp Forest Alliance

Common Name (Translated Scientific Name): Subalpine Fir - Engelmann Spruce Swamp Forest Alliance

Colloquial Name: Subalpine Fir - Engelmann Spruce Swamp Forest

Type Concept: This alliance includes subalpine riparian or seep slope conifer forests characterized by the codominance of the conifers *Abies lasiocarpa* and *Picea engelmannii*. Other conifer species that may be present to codominant include *Picea engelmannii* x *glauca*, *Picea glauca*, *Pinus contorta*, and *Tsuga mertensiana*. Additional conifers may also be present in small amounts. The shrub layer is often well-developed, occurring as a dense ribbon along streams or where there is a break in the forest canopy. Important shrubs include *Alnus incana*, *Alnus viridis* ssp. *sinuata*, *Ledum glandulosum*, *Lonicera* spp., *Oplopanax horridus*, *Ribes lacustre*, *Salix* spp., *Vaccinium* spp., and *Xerophyllum tenax*. The herbaceous layer is typically lush and dominated by a mixture of mesophytic mostly forbs and some graminoids, including *Arnica cordifolia*, *Calamagrostis* spp., *Caltha leptosepala*, *Cardamine cordifolia*, *Carex* spp., *Deschampsia cespitosa*, *Dodecatheon jeffreyi*, *Equisetum* spp., *Ligusticum porteri*, *Ligusticum* spp., *Linnaea borealis*, *Mertensia ciliata*, *Mitella pentandra*, *Orthilia secunda*, *Oxypolis fendleri*, *Senecio triangularis*, *Senecio triangularis*, and *Streptopus amplexifolius*. These forests occur in the upper montane and subalpine areas of the Rocky Mountains in landscape positions where snowmelt moisture creates shallow water tables, seeps, or streamside flooding during much of the growing season. Sites include moist toeslopes, subirrigated stream terraces, alluvial benches, pond margins, wet meadows, or slopes and hillsides that are wet in spring and early summer. Soils often show evidence of podzolization processes and gleying due to seasonally saturated conditions, and tend to be acidic. They often have high organic matter content throughout the profile, but can vary from shallow to deep, and coarse to fine-textured.

Classification Comments: This alliance covers both closed-canopy and open-canopy woodlands and forests along riparian areas. One *Pinus flexilis* community type documented from Idaho and Wyoming is included in this alliance but there is no floristic or environmental information about it. We assume that it occurs at similar elevations as the other associations listed here.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Diagnostic characteristics of these forests are that the tree canopy is dominated by *Abies lasiocarpa* and/or *Picea engelmannii* as the predominant conifer in the tree regeneration layer, and they occur on sites saturated until late summer by snowmelt, occurring below seeps on lower hillslopes or in riparian habitats.

VEGETATION

Physiognomy and Structure: These are forests dominated by needle-leaved evergreen trees up to 30 m in height and of high cover (60-100%). A moderately dense shrub layer is usually present, dominated by ericaceous or, less commonly, cold-deciduous species. The herbaceous layer is dominated by perennial forbs, and herbaceous cover increases with increasing light availability and/or soil moisture.

Floristics: These forests are characterized by the codominance of *Abies lasiocarpa* and *Picea engelmannii* in the tree canopy, but *Pinus contorta* can be dominant on some sites. Other conifers can occur, typically as individuals of *Picea pungens*, *Larix occidentalis*, or *Pseudotsuga menziesii*. In the Northern Rockies, there is a well-developed shrub layer in these forests, although sometimes it can be patchy. *Alnus viridis* ssp. *sinuata* is the dominant shrub, averaging 35% cover, with lesser amounts of *Vaccinium membranaceum*, *Vaccinium scoparium*, or *Xerophyllum tenax*. The herbaceous layer in these Northern Rockies stands is not lush, and the most constant species are *Orthilia secunda* and *Arnica cordifolia*. In the Southern Rockies of Colorado and New Mexico, these forests do not have a significant layer of shrubs, but at high elevations *Vaccinium myrtillus* occasionally is present with 0-50% cover. *Salix drummondiana*, *Lonicera involucrata*, and *Ribes* species can be present, but with less than 10% cover. The herbaceous layer is a diverse mixture of mesophytic forbs and is often well over 80% in cover. Important species include *Cardamine cordifolia*, *Caltha leptosepala*, *Ligusticum porteri*, *Mertensia ciliata*, *Mitella pentandra*, *Oxypolis fendleri*, *Senecio triangularis*, and *Saxifraga odontoloma* (= *Micranthes odontoloma*).

ENVIRONMENT & DYNAMICS

Environmental Description: These are semi-riparian or seep slope forests in upper montane and subalpine areas of the northern and central Rocky Mountains. Annual precipitation generally exceeds 75 cm in these forests in the Northern Rockies, snowpacks are typically deep and late-lying, and summers are cool. Summer frosts are characteristic in these habitats, due to cold-air drainage. Elevations range from 1525-2290 m in the northern Rocky Mountains, and from 2500-3480 m in Colorado and New Mexico. These forests occur in landscape positions where snowmelt moisture creates shallow water tables or seeps for a portion of the growing season. Sites include lower and middle slopes, stream terraces, benches, narrow valleys, or seep slopes. Slope aspects vary, but are often northerly, and can be flat to moderately steep (up to 55%). When these forests occur along streams, they are usually within 5 m of the stream channel and within 2 m of channel bankfull height (Kittel et al. 1999a). Soils often show evidence of podzolization processes and gleying due to seasonally saturated conditions. They often have high organic matter content throughout the profile. These forests are a specialized type within the *Abies - Picea* matrix type in subalpine areas of the Rocky Mountains, but may extend into montane habitats due to cold-air drainage and cool, moist microhabitats. Adjacent upland forests include *Picea engelmannii* or *Abies lasiocarpa* forests at the upper elevation boundary and *Pseudotsuga menziesii*, *Abies grandis*, or *Tsuga heterophylla - Thuja plicata* forests at lower elevations. Wetter sites often support herbaceous, cold-deciduous, or ericaceous riparian plant communities, or *Abies lasiocarpa* seasonally flooded forest communities.

Dynamics: *Abies lasiocarpa* temporarily flooded forests develop at sites with cool summer temperatures and wet soils. Tree growth is very slow in these habitats, and forests are rapidly colonized by much more rapidly growing shade-intolerant species, such as *Pinus contorta*, *Populus tremuloides*, or *Alnus viridis ssp. sinuata*, following fire, clearcut logging, or windthrow disturbance. Extensive windthrow is not common due to the relatively sheltered topographic positions. Removal of the tree layer at these sites can lead to rising water tables and expansion of anaerobic wetland soils, precluding recolonization by trees.

DISTRIBUTION

Geographic Range: This alliance is found throughout the Rocky Mountains from eastern Oregon and Washington, southern British Columbia and Alberta, Montana, Wyoming, Colorado, Utah, New Mexico, the Sky Islands of Arizona, as well as mountain ranges in Nevada.

Nations: CA, US

States/Provinces: AB, AZ, BC, CO, ID, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- >< *Abies lasiocarpa - Picea engelmannii* Series (Johnston 1987)
- >< *Abies lasiocarpa-Picea engelmannii* Series (Johnston 1987)
- >< Engelmann Spruce - Subalpine Fir: 206 (Eyre 1980)
- >< Western Needleleaf Forests: 15: Western Spruce-Fir Forest (*Picea-Abies*) (Küchler 1964)
- >< Western Needleleaf Forests: 21: Southwestern Spruce-Fir Forest (*Picea-Abies*) (Küchler 1964)

LOWER LEVEL UNITS

Associations:

- CEGLO02677 *Picea engelmannii / Cornus sericea* Swamp Woodland
- CEGLO00327 *Abies lasiocarpa - Picea engelmannii / Salix drummondiana* Swamp Forest
- CEGLO00297 *Abies lasiocarpa - Picea engelmannii / Alnus viridis ssp. sinuata* Swamp Forest
- CEGLO00361 *Picea engelmannii / Eleocharis quinqueflora* Swamp Woodland
- CEGLO02663 *Abies lasiocarpa - Picea engelmannii / Mertensia ciliata* Swamp Forest
- CEGLO00376 *Picea engelmannii / Senecio triangularis* Swamp Forest
- CEGLO00357 *Picea engelmannii / Caltha leptosepala* Swamp Forest
- CEGLO00339 *Abies lasiocarpa / Trautvetteria caroliniensis* Swamp Forest
- CEGLO00359 *Picea engelmannii / Carex angustata* Swamp Forest
- CEGLO00302 *Abies lasiocarpa / Caltha leptosepala ssp. howellii* Swamp Forest
- CEGLO00336 *Abies lasiocarpa - Picea engelmannii / Streptopus amplexifolius* Swamp Forest
- CEGLO00511 *Tsuga mertensiana / Streptopus amplexifolius* Swamp Forest
- CEGLO00322 *Abies lasiocarpa - Picea engelmannii / Oplopanax horridus* Swamp Forest
- CEGLO02630 *Picea engelmannii / Carex scopulorum var. prionophylla* Swamp Woodland

CBR alliances

- CEGLO00314 *Abies lasiocarpa* / *Ledum glandulosum* Swamp Forest
- CEGLO02636 *Abies lasiocarpa* / *Carex aquatilis* Swamp Forest
- CEGLO00367 *Picea engelmannii* - *Populus angustifolia* / *Heracleum maximum* Swamp Forest
- CEGLO00296 *Abies lasiocarpa* - *Picea engelmannii* / *Alnus incana* Swamp Forest
- CEGLO00812 *Pinus flexilis* / *Dasiphora fruticosa* ssp. *floribunda* / *Distichlis spicata* Swamp Woodland
- CEGLO02678 *Picea engelmannii* / *Calamagrostis canadensis* Swamp Forest
- CEGLO05927 *Picea engelmannii* / *Equisetum arvense* Swamp Forest
- CEGLO05843 *Picea engelmannii* / *Salix drummondiana* Swamp Woodland
- CEGLO05446 *Picea engelmannii* / *Carex scopulorum* Swamp Woodland
- CEGLO00414 *Picea (engelmannii x glauca, engelmannii)* / *Packera streptanthifolia* Swamp Forest
- CEGLO00300 *Abies lasiocarpa* - *Picea engelmannii* / *Calamagrostis canadensis* Swamp Forest

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Alexander 1981, Baker 1986a, Baker 1989b, Clausnitzer and Zamora 1987, Cooper and Cottrell 1990, Cooper et al. 1987, DeVelice and Ludwig 1983a, DeVelice et al. 1986, Eyre 1980, Faber-Langendoen et al. 2017b, Hansen et al. 1991, Hansen et al. 1995, Hess 1981, Hess and Alexander 1986, Johnson and Clausnitzer 1992, Johnson and Simon 1987, Johnston 1987, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel et al. 1996, Kittel et al. 1999a, Komarkova et al. 1988a, Komarkova et al. 1988b, Kovalchik 1993, Küchler 1964, Mauk and Henderson 1984, Padgett et al. 1988b, Peet 1975, Peet 1981, Pfister et al. 1977, Richard et al. 1996, Steele et al. 1981, Steele et al. 1983, Steen and Dix 1974, Terwilliger et al. 1979a, Wasser and Hess 1982, Whipple 1975, Williams and Smith 1990, Williams et al. 1990b, Youngblood and Mauk 1985

1. Forest & Woodland

1.B.3.Nc. Rocky Mountain-Great Basin Montane Flooded & Swamp Forest

G506. Rocky Mountain-Great Basin Montane Riparian & Swamp Forest

A4154. *Acer negundo* - *Alnus incana* ssp. *tenuifolia* - *Cornus sericea* Riparian Woodland Alliance

Type Concept Sentence:

OVERVIEW

Scientific Name: *Acer negundo* - *Alnus incana* ssp. *tenuifolia* - *Cornus sericea* Riparian Woodland Alliance

Common Name (Translated Scientific Name): Box-elder - Thinleaf Alder - Red-osier Dogwood Riparian Woodland Alliance

Colloquial Name: Box-elder - Thinleaf Alder - Red-osier Dogwood Riparian Woodland

Type Concept:

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure:

Floristics:

ENVIRONMENT & DYNAMICS

Environmental Description:

Dynamics:

DISTRIBUTION

Geographic Range:

Nations: CA, US

States/Provinces: AB, AZ, CO, ID, MT, NM, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEGLO00627 *Acer negundo* - *Populus angustifolia* / *Cornus sericea* Riparian Forest
- CEGLO00936 *Acer negundo* / *Betula occidentalis* Riparian Woodland
- CEGLO02342 *Acer negundo* - *Ostrya knowltonii* Riparian Woodland
- CEGLO00626 *Acer negundo* / *Equisetum arvense* Riparian Forest
- CEGLO05383 *Acer negundo* - *Alnus oblongifolia* Riparian Forest
- CEGLO05940 *Acer negundo* - *Alnus incana ssp. tenuifolia* Riparian Forest
- CEGLO02750 *Acer negundo* / *Rhus trilobata* Riparian Woodland
- CEGLO02797 *Acer negundo* / *Quercus gambelii* Riparian Woodland
- CEGLO03971 *Ostrya knowltonii* Riparian Woodland
- CEGLO00625 *Acer negundo* / *Cornus sericea* Riparian Forest

AUTHORSHIP

Primary Concept Source: G. Kittel

Author of Description:

Acknowledgments:

REFERENCES

1. Forest & Woodland

1.B.3.Nc. Rocky Mountain-Great Basin Montane Flooded & Swamp Forest

G506. Rocky Mountain-Great Basin Montane Riparian & Swamp Forest

A3761. *Picea pungens* Riparian Forest Alliance

Type Concept Sentence: This alliance is characterized by the dominance of *Picea pungens* in the tree canopy. Common associates include *Abies concolor*, *Abies lasiocarpa*, *Picea engelmannii*, *Pinus contorta*, *Pinus ponderosa*, and *Pseudotsuga menziesii* (which may replace *Picea pungens*). *Populus angustifolia* is the most common deciduous tree species, although *Populus tremuloides* may persist as a seral species on well-drained sites. This riparian woodland alliance is found at middle elevations (from 1900-2900 m) of the central and southern Rocky Mountains and the Colorado Plateau. Stands typically occur in narrow or V-shaped valleys and canyons subject to cold-air drainage and limited sunlight. They occupy streambanks, terraces, narrow floodplains or benches, and subirrigated toeslopes; stream gradients are often steep. These sites can be subject to spring flooding, and usually water tables are within 1 m of the soil surface even late in the growing season.

OVERVIEW

Scientific Name: *Picea pungens* Riparian Forest Alliance

Common Name (Translated Scientific Name): Blue Spruce Riparian Forest Alliance

Colloquial Name: Blue Spruce Riparian Forest

Type Concept: This alliance is characterized by the dominance of *Picea pungens* in the tree canopy. Other conifers are usually present in these stands, depending upon geographic location, site moisture, and stand history. Common associates include *Abies concolor*, *Abies lasiocarpa*, *Picea engelmannii*, *Pinus contorta*, *Pinus ponderosa*, and *Pseudotsuga menziesii* (which may replace *Picea pungens*). *Populus angustifolia* is the most commonly present deciduous tree species, although *Populus tremuloides* may persist as a seral species on well-drained sites of this alliance. A shrub layer is often present but many stands lack a shrub layer. Common shrub species include *Alnus incana*, *Betula occidentalis*, *Cornus sericea*, *Rosa woodsii*, and several species of *Salix*. Other shrubs that may be present include *Dasiphora fruticosa ssp. floribunda* (= *Pentaphylloides floribunda*), *Lonicera involucrata*, and *Acer glabrum*. Because of favorable soil moisture, the herbaceous layer is usually a luxuriant mixture of forbs and graminoids, including *Calamagrostis canadensis*, *Carex siccata* (= *Carex foenea*), *Conioselinum scopulorum*, *Equisetum arvense*, *Fragaria virginiana*, *Heracleum sphondylium*, *Maianthemum stellatum*, *Mertensia ciliata*, and *Rudbeckia laciniata*. The herbaceous layer can have very

high cover in some stands, but also may be very sparse. This riparian woodland alliance is found at middle elevations (from 1900-2900 m) of the central and southern Rocky Mountains and the Colorado Plateau region. Stands typically occur in narrow, or V-shaped, valleys and canyons subject to cold-air drainage and limited sunlight. They occupy streambanks, terraces, narrow floodplains or benches, and subirrigated toeslopes; stream gradients are often steep. These sites can be subject to spring flooding, and usually water tables are within 1 m of the soil surface even late in the growing season. The soils are somewhat variable, often with signs of mottling.

Classification Comments: This alliance is for conifer-dominated stands that occur in riparian zones on seasonally, intermittently or temporarily flooded/saturated soils.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Diagnostic of this woodland alliance is the dominance of *Picea pungens* or *Pseudotsuga menziesii* with 50% relative cover occurring on sites that have surface water for brief periods during the growing season.

VEGETATION

Physiognomy and Structure: These woodlands are of low to medium stature (10-25 m) and dominated by needle-leaved evergreen trees. Cold-deciduous trees are sometimes mixed in these stands. These communities often have cold-deciduous shrub layers of moderate to dense cover (20-60%). The herbaceous layer is usually well-developed and dominated by mesophytic forbs and graminoids less than 1 m in height.

Floristics: These riparian woodlands are characterized by the dominance of *Picea pungens* and/or *Pseudotsuga menziesii* with occasional *Pinus ponderosa* or *Pinus contorta* trees in the canopy. Other conifers are usually present in these stands, depending upon geographic location, site moisture, and stand history. Common associates include *Abies concolor*, *Abies lasiocarpa*, *Picea engelmannii*, *Pinus contorta*, *Pinus ponderosa*, and *Pseudotsuga menziesii*. The presence of these conifers is usually associated with raised microsites created by root-crown hummocks and windthrow mounds. *Populus angustifolia* is the most commonly present deciduous tree species, although *Populus tremuloides* may persist as a seral species on well-drained sites of this alliance. There is often an abundant tall-shrub layer, with cover ranging from 20-60%, dominated by one or several cold-deciduous species. The most common species include *Alnus incana*, *Betula occidentalis*, *Cornus sericea*, *Rosa woodsii*, and willow species, including *Salix exigua*, *Salix drummondiana*, *Salix monticola*, and *Salix bebbiana*. Other shrubs that may be present include *Dasiphora fruticosa* ssp. *floribunda* (= *Pentaphylloides floribunda*), *Lonicera involucrata*, and *Acer glabrum*. Due to favorable soil moisture, the herbaceous layer is usually a luxuriant mixture of forbs and graminoids, including *Calamagrostis canadensis*, *Carex siccata* (= *Carex foenea*), *Conioselinum scopulorum*, *Equisetum arvense*, *Fragaria virginiana*, *Heracleum sphondylium*, *Maianthemum stellatum*, *Mertensia ciliata*, and *Rudbeckia laciniata*. The herbaceous layer can have very high cover in some stands.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance is found at middle elevations (from 1900-2900 m) of the central and southern Rocky Mountains and the Colorado Plateau region. Precipitation averages 46-60 cm annually, with the majority falling as growing-season rainfall. The temperature regime is continental and winters are moderately severe. Stands of this alliance typically occur in narrow, or V-shaped, valleys and canyons subject to cold-air drainage and limited sunlight. They occupy streambanks, terraces, narrow floodplains or benches, and subirrigated toeslopes; stream gradients are often steep. These sites can be subject to spring flooding, and usually water tables are within 1 m of the soil surface even late in the growing season. The soils are somewhat variable, but are primarily derived from glacial or alluvially deposited materials. They range from shallow silty loams over cobbles and gravel, to deep dark-colored clay loams with signs of mottling. The percentage of coarse fragments increases with soil depth, and most sites are well-drained. The pH is neutral to slightly alkaline.

Stands of these riparian woodlands are found within *Pinus ponderosa* or *Pseudotsuga menziesii* montane upland forests. Adjacent vegetation is usually *Pinus ponderosa* - *Pseudotsuga menziesii* forests at the upslope margin and herbaceous or other woody riparian communities where this vegetation grades into wetter streamside sites.

Dynamics: *Picea pungens* is a slow-growing, long-lived tree which regenerates from seed (Burns and Honkala 1990a). Seedlings are shallow-rooted and require perennially moist soils for establishment and optimal growth. *Picea pungens* is intermediate in shade tolerance, being somewhat more tolerant than *Pinus ponderosa* or *Pseudotsuga menziesii*, and less tolerant than *Abies lasiocarpa* or *Picea engelmannii*. It forms climax stands in the subhumid stands of the southern Rocky Mountains, but may occupy a seral position in more mesic northern stands (Burns and Honkala 1990a). In deep, narrow canyons with swift-moving streams and narrow floodplains and benches, *Picea pungens* appears to be a climax riparian species, and will remain on these sites until removed or

damaged by a catastrophic flood (Kittel et al. 1999a). It is common for these forests to be heavily disturbed by grazing or fire, as well as recreational uses, such as campgrounds, fishing access, home building, and other activities.

DISTRIBUTION

Geographic Range: This alliance is found in the Rocky Mountains in Colorado, Wyoming, Utah, Idaho, and New Mexico and the highlands of Arizona.

Nations: US

States/Provinces: AZ, CO, ID, NM, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- >< *Picea pungens* Series (Moir and Ludwig 1979)
- >< *Picea pungens* Series (Youngblood and Mauk 1985)
- >< *Picea pungens* Series (DeVelice et al. 1986)
- >< *Picea pungens* Series (Alexander et al. 1987)
- >< *Picea pungens* Series (Fitzhugh et al. 1987)
- >< *Picea pungens* Series (Larson and Moir 1987)
- >< *Pseudotsuga menziesii*/*Cornus sericea* Habitat Type (Hansen et al. 1995)
- >< Blue Spruce: 216 (Eyre 1980)

LOWER LEVEL UNITS

Associations:

- CEGLO00396 *Picea pungens* / *Dasiphora fruticosa* ssp. *floribunda* Riparian Woodland
- CEGLO00894 *Picea pungens* / *Alnus incana* Riparian Woodland
- CEGLO00389 *Picea pungens* / *Equisetum arvense* Riparian Woodland
- CEGLO02637 *Picea pungens* / *Betula occidentalis* Riparian Woodland
- CEGLO00899 *Pseudotsuga menziesii* / *Cornus sericea* Riparian Woodland
- CEGLO02639 *Pseudotsuga menziesii* / *Betula occidentalis* Riparian Woodland
- CEGLO00388 *Picea pungens* / *Cornus sericea* Riparian Woodland

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Alexander et al. 1987, Baker 1986a, Baker 1989b, Burns and Honkala 1990a, Cooper and Cottrell 1990, DeVelice and Ludwig 1983a, DeVelice et al. 1986, Eyre 1980, Faber-Langendoen et al. 2017b, Fitzhugh et al. 1987, Hansen et al. 1990, Hansen et al. 1991, Hansen et al. 1995, Hess and Wasser 1982, Johnston 1984, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996, Kittel et al. 1997a, Kittel et al. 1999a, Komarkova et al. 1988a, Larson and Moir 1987, Moir and Ludwig 1979, Padgett et al. 1988b, Padgett et al. 1989, Richard et al. 1996, Youngblood and Mauk 1985

1. Forest & Woodland

1.B.3.Nc. Rocky Mountain-Great Basin Montane Flooded & Swamp Forest

G506. Rocky Mountain-Great Basin Montane Riparian & Swamp Forest

A3758. *Pinus contorta* var. *murrayana* - *Pinus contorta* var. *latifolia* Swamp Forest Alliance

Type Concept Sentence: This riparian woodland alliance is characterized by *Pinus contorta*. Other conifers sometimes present may include *Abies grandis*, *Abies lasiocarpa*, *Abies magnifica* var. *shastensis*, *Picea engelmannii*, *Pinus flexilis*, or *Tsuga mertensiana*. This forest alliance occurs in upper montane riparian or wetland areas in the Rocky Mountains and Sierra Nevada. Sites are flat, wet, relatively cold floodplain and basin landforms. Stands occur in forested margins of meadows, lake or forest basins, and along valley bottoms. In all cases, the sites are flat to gently sloping.

OVERVIEW

Scientific Name: *Pinus contorta* var. *murrayana* - *Pinus contorta* var. *latifolia* Swamp Forest Alliance

Common Name (Translated Scientific Name): Sierra Lodgepole Pine - Tall Lodgepole Pine Swamp Forest Alliance

Colloquial Name: Sierra Lodgepole Pine - Tall Lodgepole Pine Swamp Forest

Type Concept: This riparian woodland alliance is characterized by *Pinus contorta*. Other conifers sometimes present may include *Abies grandis*, *Abies lasiocarpa*, *Abies magnifica* var. *shastensis*, *Picea engelmannii*, *Pinus flexilis*, or *Tsuga mertensiana*. The short-shrub layer may be present with *Dasiphora fruticosa* ssp. *floribunda* (= *Pentaphylloides floribunda*), *Ledum glandulosum*, *Lonicera caerulea*, *Spiraea douglasii*, *Vaccinium cespitosum*, and/or *Vaccinium uliginosum*. Herbaceous species are not abundant in shrubby stands. Associate species often present can include *Carex angustata*, *Fragaria* spp., *Geum macrophyllum*, *Ligusticum grayi*, *Maianthemum stellatum*, *Thalictrum occidentale*, and *Trifolium longipes*. Some stands have a lush herbaceous layer is dominated by tall graminoids such as *Calamagrostis canadensis*. This forest alliance occurs in upper montane riparian or wetland areas in the Rocky Mountains and Sierra Nevada. Sites are flat, wet, relatively cold floodplain and basin landforms. Stands occur in forested margins of meadows, lake or forest basins, and along valley bottoms. In all cases, the sites are flat to gently sloping.

Classification Comments: *Pinus contorta* is a poor competitor and occupies both extremes on the moisture gradient. This alliance covers the non-bog, swamp forests types dominated by *Pinus contorta*.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: The dominance of *Pinus contorta* in the moderately dense to dense tree canopy without significant regeneration of other tree species, and the extended flooding and high water tables during the growing season.

VEGETATION

Physiognomy and Structure: The overstory tree canopy is dominated by evergreen needle-leaved trees. A short-shrub layer or an herbaceous layer may be present.

Floristics: *Pinus contorta* is the only tree present in the reported stands, and is the only species represented in the regeneration layer. Other conifers sometimes present may include *Abies grandis*, *Abies lasiocarpa*, *Abies magnifica* var. *shastensis*, *Picea engelmannii*, *Pinus flexilis*, or *Tsuga mertensiana*. The shrub layer may include *Arctostaphylos uva-ursi*, *Ribes* spp., *Rosa woodsii*, *Spiraea douglasii*, *Vaccinium boreale*, and several species of *Salix*, including *Salix boothii*, *Salix geyeriana*, and *Salix lemmonii*. The herbaceous layer can be forb- or graminoid-dominated. Graminoids include *Calamagrostis canadensis*, *Carex angustata*, *Carex angustata*, *Carex aquatilis*, *Danthonia californica*, *Deschampsia cespitosa*, *Elymus glaucus*, *Juncus balticus*, and *Koeleria macrantha*. Forb species include *Achillea millefolium*, *Antennaria* spp., *Dodecatheon jeffreyi*, *Fragaria virginiana*, *Galium boreale*, *Geum macrophyllum*, *Maianthemum stellatum*, *Mimulus primuloides*, *Packera pseud aurea* (= *Senecio pseud aureus*), *Potentilla* spp., *Symphotrichum spathulatum* (= *Aster occidentalis*), *Thalictrum occidentale*, and *Trifolium longipes*.

ENVIRONMENT & DYNAMICS

Environmental Description: Sites include edges of meadows, streamside terraces, lakeshores, and flat to slightly concave drainages and basins. Valleys where it occurs are broad, low-gradient, and usually flat-bottomed. Soils are silts, sandy loams and silty clay loams. Wetter stands will have a significant organic component, sometime with a peat layer (Kovalchik 1987). The soil surface will often be slightly flooded at snowmelt, but by late summer the water table will drop to >1 m depth (Kovalchik 1987).

Dynamics:

DISTRIBUTION

Geographic Range: This alliance occurs in the Sierra Nevada of California and Nevada, and the Rocky Mountains of eastern Oregon, Idaho, Alberta, Montana, Wyoming, Colorado, and Utah.

Nations: CA, US

States/Provinces: AB, CA, CO, ID, MT, NV, OR, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL**USNVC Confidence Level with Comments:** Low.**SYNONYMY**

- >< *Picea engelmannii* Forested Wetlands (Chappell et al. 1997)
- >< Aspen: 217 (Eyre 1980)
- >< Lodgepole Pine: 218 (Eyre 1980)

LOWER LEVEL UNITS**Associations:**

- C EGL000157 *Pinus contorta* var. *murrayana* - *Populus tremuloides* / *Spiraea douglasii* Swamp Forest
- C EGL000147 *Pinus contorta* / *Deschampsia cespitosa* Swamp Forest
- C EGL005929 *Pinus contorta* / *Cornus sericea* Swamp Woodland
- C EGL000138 *Pinus contorta* / *Calamagrostis canadensis* Swamp Forest
- C EGL000140 *Pinus contorta* / *Carex (aquatilis, angustata)* Swamp Woodland

AUTHORSHIP**Primary Concept Source:** G. Kittel, in Faber-Langendoen et al. (2013)**Author of Description:** G. Kittel**Acknowledgments:****Version Date:** 2014/09/26**REFERENCES****References:** Chappell et al. 1997, Crowe and Clausnitzer 1997, Eyre 1980, Faber-Langendoen et al. 2017b, Hopkins 1979a, Kovalchik 1987, Volland 1976

1. Forest & Woodland

1.B.3.Nc. Rocky Mountain-Great Basin Montane Flooded & Swamp Forest

G506. Rocky Mountain-Great Basin Montane Riparian & Swamp Forest

A3797. *Pinus ponderosa* - *Juniperus scopulorum* - *Abies concolor* Riparian Woodland Alliance**Type Concept Sentence:** This alliance consists of conifer-dominated canopies of low-elevation riparian areas characterized by an open canopy of the conifers *Pinus ponderosa*, *Juniperus scopulorum*, and/or *Abies concolor*. These woodlands can occur as broad, extensive stands on wider floodplain terraces or as narrow, long ribbons. They are found throughout the Rocky Mountains, south into Arizona and New Mexico, and west into eastern mountain valleys of Washington and Oregon.**OVERVIEW****Scientific Name:** *Pinus ponderosa* - *Juniperus scopulorum* - *Abies concolor* Riparian Woodland Alliance**Common Name (Translated Scientific Name):** Ponderosa Pine - Rocky Mountain Juniper - White Fir Riparian Woodland Alliance**Colloquial Name:** Ponderosa Pine - Rocky Mountain Juniper - White Fir Riparian Woodland**Type Concept:** Vegetation included in this riparian alliance is characterized by an open canopy of conifers. Dominant species include *Pinus ponderosa*, *Juniperus scopulorum*, and/or *Abies concolor*. Other conifer or deciduous trees may be present but the stand remains characterized by conifer dominance. Typically a tall-shrub layer is present, with species such as *Alnus* spp., *Betula occidentalis*, *Cornus sericea*, *Crataegus douglasii*, *Juglans major*, *Prunus virginiana*, *Quercus garryana*, or *Salix* spp. The herbaceous layer can be dominated by either graminoids or forbs. This alliance occurs on low-elevation streams in valleys that vary from V-shaped to trough-shaped or broad and flat, and stream gradients are typically moderate. These woodlands can occur as broad, extensive stands on wider floodplain terraces or as narrow, long ribbons. Sites include mountain valleys, foothill ravines, terraces and alluvial benches of major streams and rivers. In southern Arizona, stands occur along smaller perennial streams and washes. Soils are cobbly, coarse-textured and derived from alluvium. This alliance is found throughout the Rocky Mountains, south into Arizona and New Mexico, and west into the Columbia Basin of Washington and Oregon.**Classification Comments:** Conifer-dominated riparian woodlands tend to be in areas of lower elevation than is typical for the conifer species, or in wide valley bottoms.**Internal Comments:** GMK 8-14: This alliance may be too broad geographically and floristically. It may make sense to split north and south along floristic lines. However, there are few conifer only-dominated riparian areas at low elevations, so it may simply be a convenience to have them in one alliance, especially if many of the associations share broader distributed species such as *Pinus ponderosa*.**Other Comments:**

Similar NVC Types:

Diagnostic Characteristics: Diagnostic of this semi-riparian alliance are woodland stands dominated by *Pinus ponderosa*, *Juniperus scopulorum*, or *Abies concolor* with brief seasonal flooding during the growing season.

VEGETATION

Physiognomy and Structure: The tree canopy is dominated by a 5- to 10-m tall coniferous layer. The canopy is relatively open with an understory of widely scattered to dense shrubs. The tall-shrub stratum is moderately dense with 10-25% cover.

Floristics: These are riparian woodlands dominated by conifer trees. Dominant tree species include *Pinus ponderosa*, *Juniperus scopulorum*, and/or *Abies concolor*. Other trees present may include *Acer negundo*, *Juniperus deppeana*, *Pinus discolor*, *Pinus edulis*, *Populus angustifolia*, *Populus balsamifera ssp. trichocarpa*, *Pseudotsuga menziesii*, and *Quercus* spp. Some stands contain no shrub layers, others have luxurious growth of shrubs including *Alnus incana*, *Alnus rhombifolia*, *Amelanchier alnifolia*, *Betula occidentalis*, *Cornus sericea*, *Crataegus douglasii*, *Frangula betulifolia* (= *Rhamnus betulifolia*), *Holodiscus discolor*, *Juglans major*, *Physocarpus malvaceus*, *Prunus virginiana*, *Quercus garryana*, *Rhus aromatica*, *Ribes* spp., *Rosa woodsii*, *Salix* spp., *Solanum dulcamara*, *Symphoricarpos albus*, *Symphoricarpos occidentalis*, *Toxicodendron rydbergii* and/or *Vitis arizonica*. Herbaceous undergrowth can be absent or, if present, may occur both beneath the tree canopy or on exposed point bars. Native graminoids include *Bromus ciliatus* var. *richardsonii* (= *Bromus richardsonii*), *Panicum bulbosum*, *Panicum virgatum*, *Pascopyrum smithii*, and *Piptatheropsis micrantha* (= *Oryzopsis micrantha*). Forbs can include *Achillea millefolium*, *Apocynum androsaemifolium*, *Galium boreale*, *Galium mexicanum ssp. asperrimum* (= *Galium asperrimum*), *Geranium caespitosum*, *Glycyrrhiza lepidota*, *Maianthemum stellatum*, *Potentilla* spp., *Pteridium aquilinum*, *Thalictrum fendleri*, and the fern ally *Equisetum arvense*.

ENVIRONMENT & DYNAMICS

Environmental Description: These are riparian streamside stands that occur on both wide floodplains and narrow valleys with little floodplain development. It can form extensive stands on older alluvial terraces of floodplains of major streams or rivers and others are narrow bands in V-shaped canyons. These woodlands are intolerant of frequent and prolonged flooding; however, they are tolerant of periodic flooding and high water tables. Typically, the soils are shallow, derived from coarse alluvial substrates. Soil textures are sandy clay loams to sandy loams with a high percentage of coarse fragments.

Dynamics: Flooding events that create bare mineral seedbeds on newly created alluvial terraces may be necessary for reproduction of conifers in these riparian sites (Muldavin et al. 1996), as grasses and forbs may compete with conifer seedlings for space and water. Conifer species grow within the flood zone of desert stream reaches, where they are able to germinate and grow on fresh, moist alluvium in the absence of competing grasses (Muldavin et al. 1996).

DISTRIBUTION

Geographic Range: This alliance is found on lower foothills and canyon bottoms of Arizona, New Mexico, Utah, Colorado, Idaho, eastern Washington, eastern Oregon, Wyoming and Montana.

Nations: US

States/Provinces: AZ, CO, ID, MT, NM, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- >< *Pinus ponderosa* Series (Muldavin et al. 1996)
- >< Ponderosa Pine Series (Crowe and Clausnitzer 1997)

LOWER LEVEL UNITS**Associations:**

- CEGLO00853 *Pinus ponderosa* / *Cornus sericea* Riparian Woodland
- CEGLO02766 *Pinus ponderosa* Riparian Woodland
- CEGLO02638 *Pinus ponderosa* / *Alnus incana* Riparian Woodland
- CEGLO02777 *Juniperus scopulorum* Riparian Woodland [Placeholder]
- CEGLO02754 *Pseudotsuga menziesii* / *Acer negundo* Riparian Woodland
- CEGLO05367 *Abies concolor* - *Acer negundo* / *Alnus incana ssp. tenuifolia* Riparian Forest
- CEGLO05384 *Pinus ponderosa* / *Forestiera pubescens* Riparian Woodland

- C EGL000866 *Pinus ponderosa* / *Symphoricarpos albus* Riparian Woodland
- C EGL000855 *Pinus ponderosa* / *Crataegus douglasii* Riparian Woodland
- C EGL000746 *Juniperus scopulorum* / *Cornus sericea* Riparian Woodland

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Bassett et al. 1987, Billings 1954, Cronquist et al. 1972, Crowe and Clausnitzer 1997, Evans 1989a, Faber-Langendoen et al. 2017b, Hansen et al. 1991, Hansen et al. 1995, Kauffman et al. 1985, Kittel et al. 1994, Kittel et al. 1996, Kittel et al. 1997a, Kittel et al. 1999a, Mack 1988, Maxey and Eakin 1949, Muldavin et al. 1996, ORNHP unpubl. data, Reid et al. 1994, Simpson 1876, Welsh et al. 1987

1. Forest & Woodland

1.B.3.Nc. Rocky Mountain-Great Basin Montane Flooded & Swamp Forest

G506. Rocky Mountain-Great Basin Montane Riparian & Swamp Forest

A3759. *Populus angustifolia* Riparian Forest Alliance

Type Concept Sentence: This alliance consists of riparian woodlands dominated by *Populus angustifolia* alone or codominated with other deciduous or coniferous trees. It occurs on narrow stream terraces and large floodplains in the Rocky Mountains of Montana, Idaho, Wyoming, Utah, Colorado and New Mexico. It is also found in the mountains of eastern Oregon, Nevada, California's Sierra Nevada, and the highlands of Arizona. Elevations range from 1200-2750 m (4000-9000 feet).

OVERVIEW

Scientific Name: *Populus angustifolia* Riparian Forest Alliance

Common Name (Translated Scientific Name): Narrowleaf Cottonwood Riparian Forest Alliance

Colloquial Name: Narrowleaf Cottonwood Riparian Forest

Type Concept: This alliance consists of riparian forests and woodlands dominated by *Populus angustifolia* alone or codominated with other deciduous or coniferous trees. Due to the broad north to south geographic scope of this alliance, as well as its elevational range from foothill to subalpine, many other tree species may be present within stands. These include *Abies lasiocarpa*, *Acer grandidentatum*, *Acer negundo*, *Juniperus scopulorum*, *Picea engelmannii*, *Picea pungens*, *Pinus ponderosa*, *Populus balsamifera*, *Populus deltoides*, *Pseudotsuga menziesii*, and *Salix amygdaloides*. The shrub layer is dominated by *Acer glabrum*, *Alnus incana*, *Alnus oblongifolia*, *Amelanchier alnifolia*, *Amelanchier utahensis*, *Artemisia tridentata*, *Brickellia californica*, *Cornus sericea*, *Crataegus rivularis*, *Juniperus deppeana*, *Lonicera involucrata*, *Quercus gambelii*, *Rosa woodsii*, *Salix* spp., and/or *Symphoricarpos occidentalis*. Woody vines may be present, such as *Clematis ligusticifolia*, *Humulus lupulus* var. *lupuloides* (= *Humulus americanus*), *Parthenocissus quinquefolia* (= *Parthenocissus inserta*), and *Vitis arizonica*. The herbaceous undergrowth is often dominated by non-native hay grasses and little forb cover. Common forbs that can be abundant include *Achillea millefolium*, *Heracleum maximum* (= *Heracleum lanatum*), *Maianthemum stellatum*, *Osmorhiza depauperata*, and/or *Thalictrum fendleri*. This alliance occurs in the Rocky Mountains of Montana, Idaho, Wyoming, Utah, Colorado and New Mexico. It is also found in the mountains of eastern Oregon, Nevada, California's Sierra Nevada, and the highlands of Arizona. Stands occur on narrow stream terraces and large floodplains. Elevations range from 1200-2750 m (4000-9000 feet). Microtopography is often smooth to gently undulating with slopes between 2 and 5%. Stands generally occur within 1 m vertical distance of flooding high water mark, but can also occur on higher terraces, up to 3 m above the channel. Water tables fluctuate seasonally, subirrigating soils in spring, but often dropping and drying soils by late August. Soils are typically well-drained with large amounts of coarse fragments in the subsurface horizons. The soil textures are fine sandy loams, clay loams, silty clay loams, and silty clay, sometimes with buried thin organic layers. Stands have also been documented on pure sand, where streams bisected sand dunes.

Classification Comments: While the geographic scope is large for this alliance, the constancy of canopy *Populus angustifolia* and the riparian/ streamside/ alluvial environment maintain a surprisingly consistent set of species composition throughout, even though there are regional expressions, these are variations on a theme. One reviewer suggested geographic separation for these regional expressions. Gwen Kittel developed these 4 alliance groupings, attempting geographic separation: Suballiance 1. *Populus angustifolia* - *Pinus pungens* - *Salix irrorata* Woodland Suballiance (Central - NV, UT, CO, OR); Suballiance 2. *Populus angustifolia* - *Alnus oblongifolia* - *Acer grandidentatum* Woodland Suballiance (Northern - Canada, MT, WY, ID); Suballiance 3. *Populus angustifolia* - *Juniperus deppeana* - *Forestiera pubescens* Woodland Suballiance (Southern - NM, AZ, CA, TX); and Suballiance 4. *Populus angustifolia* - *Pinus ponderosa* - *Cornus sericea* Woodland Suballiance (Throughout).

Internal Comments:**Other Comments:****Similar NVC Types:**

Diagnostic Characteristics: Diagnostic of this alliance is the dominance of *Populus angustifolia* in the tree canopy.

VEGETATION

Physiognomy and Structure: The tree canopy is dominated by broad-leaved deciduous (10-15 m tall) trees. The canopy consists of overlapping crowns generally forming 25-100% cover. The tree subcanopy is minor, dominated by 5- to 10-m tall trees with 10-25% cover. The tall- and short-shrub layers range from sparse to moderate cover (10-70%). The herbaceous layer typically is dominated by perennial forbs.

Floristics: Associations within this alliance are defined as cold-deciduous, temporarily flooded woodlands. The tree canopy is typically open and dominated by *Populus angustifolia* with 20-70% cover. Other trees can include *Acer negundo*, *Juniperus scopulorum*, *Picea pungens*, *Pinus ponderosa*, *Picea engelmannii*, and *Salix amygdaloides* at lower elevation sites within the Rocky Mountains and *Populus balsamifera*, *Populus deltoides*, or *Acer grandidentatum* in the northern areas. The shrub layer is can be very dense and diverse with 10-80% cover of *Acer glabrum*, *Alnus incana*, *Amelanchier utahensis*, *Cornus sericea*, *Crataegus rivularis*, *Lonicera involucrata*, *Quercus gambelii*, *Rosa woodsii*, *Salix* spp., or *Symphoricarpos occidentalis*. The shrub layer in Arizona and New Mexico stands also consists of *Juniperus deppeana*, *Brickellia californica*, and *Alnus oblongifolia*. The forb layer includes 0-50% cover of *Achillea millefolium*, *Heracleum maximum* (= *Heracleum lanatum*), *Maianthemum stellatum*, and *Osmorhiza depauperata*. Graminoid cover is insignificant. In New Mexico and Arizona, a significant vine component is present, with cover of 25-60%, consisting mainly of *Clematis ligusticifolia*, *Humulus lupulus* var. *lupuloides* (= *Humulus americanus*), *Parthenocissus quinquefolia* (= *Parthenocissus inserta*), and *Vitis arizonica*.

ENVIRONMENT & DYNAMICS

Environmental Description: Vegetation types in this alliance occur on terraces and floodplains immediately adjacent to streams. Elevations range from 1350 m in the southwest to 2400 m in Colorado. Microtopography is often smooth to gently undulating with slopes between 2 and 5%. Stands generally occur within 1 m of the high water mark, but can also occur on higher terraces, up to 3 m above the channel. Water tables are rarely within 50 cm of the soil surface, and stands are as much as 3-4 m above the stream level (Hansen et al. 1995). Soil pH levels range from slightly acidic to moderately alkaline (pH 6.2-8.4). Soils are typically well-drained with large amounts of coarse fragments in the subsurface horizons. The soil textures are fine sandy loams, clay loams, silty clay loams, and silty clay. Soils are frequently reworked by floods and beavers. Peat deposits, if present, are thin.

Dynamics: Cottonwood forests grow within an alluvial environment that is continually changing due to the ebb and flow of the river. Riparian vegetation is constantly being "re-set" by flooding disturbance. Cottonwood communities are early-, mid- or late-seral, depending on the age class of the trees and the associated species of the stand. Mature cottonwood stands do not regenerate in place, but regenerate by "moving" up and down a river reach. Over time, a healthy riparian area supports all stages of cottonwood communities. The process of cottonwood regeneration is well-documented. Periodic flooding events can leave sandbars of bare, mineral substrate. Cottonwood seedlings germinate and become established on newly-deposited, moist sandbars. In the absence of large floods in subsequent years, seedlings begin to trap sediment. In time, the sediment accumulates and the sandbar rises. The young forest community is then above the annual flood zone of the river channel.

In this newly elevated position, with an absence of excessive browsing, fire, and agricultural conversion, this cottonwood community can grow into a mature riparian forest. At the same time, the river channel continually erodes streambanks and creates fresh, new surfaces for cottonwood establishment. This results in a dynamic patchwork of different age classes, plant associations and habitats.

As cottonwoods mature, other tree species may become established. If the land surface is subject to reworking by the river, successional processes will start over with erosion and subsequent flooding deposition. If the land surface is not subject to alluvial processes, on for example a high terrace, the cottonwoods will be replaced by upland shrub or tree species from adjacent areas.

DISTRIBUTION

Geographic Range: This alliance occurs in the Rocky Mountains and broad river plains of mountain valleys of Alberta, Montana, Idaho, Wyoming, Utah, Colorado and New Mexico. It is also found in the mountains of eastern Oregon, Nevada, California's Sierra Nevada, and the highlands of Arizona.

Nations: CA, US

States/Provinces: AB, AZ, CA, CO, ID, MT, NM, NV, OR, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: NPS (Great Basin); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- >< Cottonwood - Willow: 235 (Eyre 1980)
- >< Deciduous Forest Series (Johnston 1987)
- >< Montane Riparian Wetlands (Brown 1982a)

LOWER LEVEL UNITS

Associations:

- CEGLO00646 *Populus angustifolia* / *Acer grandidentatum* Riparian Forest
- CEGLO05962 *Populus angustifolia* / *Forestiera pubescens* var. *pubescens* Riparian Woodland
- CEGLO02646 *Populus angustifolia* / *Salix drummondiana* - *Acer glabrum* Riparian Woodland
- CEGLO00933 *Populus angustifolia* - *Juniperus deppeana* / *Brickellia californica* Riparian Woodland
- CEGLO02643 *Populus angustifolia* Sand Dune Riparian Forest
- CEGLO00656 *Populus angustifolia* - *Populus deltoides* - *Salix amygdaloides* Riparian Forest
- CEGLO00653 *Populus angustifolia* / *Rosa woodsii* Riparian Forest
- CEGLO00934 *Populus angustifolia* - *Picea pungens* / *Alnus incana* Riparian Woodland
- CEGLO02644 *Populus angustifolia* / *Crataegus rivularis* Riparian Woodland
- CEGLO02664 *Populus angustifolia* / *Cornus sericea* Riparian Woodland
- CEGLO00650 *Populus angustifolia* / *Lonicera involucrata* Riparian Forest
- CEGLO02648 *Populus angustifolia* / *Symphoricarpos* (*albus*, *occidentalis*, *oreophilus*) Riparian Woodland
- CEGLO02645 *Populus angustifolia* / *Salix* (*monticola*, *drummondiana*, *lucida*) Riparian Woodland
- CEGLO00648 *Populus angustifolia* / *Betula occidentalis* Riparian Woodland
- CEGLO00935 *Populus angustifolia* - *Pinus ponderosa* Riparian Woodland
- CEGLO02641 *Populus angustifolia* - *Pseudotsuga menziesii* Riparian Woodland
- CEGLO00938 *Populus angustifolia* / *Alnus oblongifolia* Riparian Woodland
- CEGLO02647 *Populus angustifolia* / *Salix irrorata* Riparian Woodland
- CEGLO00652 *Populus angustifolia* / *Rhus trilobata* Riparian Woodland
- CEGLO02642 *Populus angustifolia* / *Alnus incana* Riparian Woodland
- CEGLO02640 *Populus angustifolia* - *Juniperus scopulorum* Riparian Woodland
- CEGLO00651 *Populus angustifolia* / *Prunus virginiana* Riparian Woodland
- CEGLO00654 *Populus angustifolia* / *Salix exigua* Riparian Woodland
- CEGLO05992 *Populus angustifolia* - *Acer negundo* Riparian Woodland
- CEGLO02537 *Populus angustifolia* / *Artemisia tridentata* ssp. *vaseyana* / *Eriogonum umbellatum* Dry Outwash Riparian Woodland
- CEGLO02804 *Populus angustifolia* / *Quercus gambelii* Riparian Woodland
- CEGLO00655 *Populus angustifolia* / *Salix ligulifolia* - *Shepherdia argentea* Riparian Woodland

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2016/09/29

REFERENCES

References: Baker 1984a, Baker 1986a, Baker 1989b, Bassett et al. 1987, Beidleman 1954, Boles and Dick-Peddie 1983, Brown 1982a, Cancalossi 1979, Cooper and Cottrell 1990, DeLeuw, Cather & Company 1977, Dick-Peddie 1993, Durkin et al. 1994b, Durkin et al. 1995a, Eyre 1980, Faber-Langendoen et al. 2017b, Freeman and Dick-Peddie 1970, Girard et al. 1997, Gom and Rood 1999, Hansen et al. 1991, Hansen et al. 1995, Hess 1981, Hess and Alexander 1986, Hess and Wasser 1982, Johnston 1987, Keammerer 1974a, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996, Kittel et al. 1997a, Kittel et al. 1999a, Klish 1977, Komarkova 1986, Laurenzi et al. 1983, Marriott and Jones 1989, Muldavin et al. 1993a, Muldavin et al. 1993b, Olson and Gerhart 1982, Padgett and Manning 1988, Padgett et al. 1988b, Padgett et al. 1989, Ramaley 1942, Richard et al. 1996, Smith 1994b, Thompson and Hansen 2002, Trammell and Trammell 1977, Woodbury et al. 1961, Youngblood et al. 1985a, Youngblood et al. 1985b

1. Forest & Woodland

1.B.3.Nc. Rocky Mountain-Great Basin Montane Flooded & Swamp Forest

G506. Rocky Mountain-Great Basin Montane Riparian & Swamp Forest

A3760. *Populus tremuloides* Riparian Forest Alliance

Type Concept Sentence: This alliance includes only those stands of *Populus tremuloides* that are truly wetlands and riparian in their setting. Most stands of this alliance are found in riparian zones. Some may be near lakes where the ground is flooded or saturated for a short time in the spring. The moderate to closed tree canopy is dominated by *Populus tremuloides*; sometimes other trees are codominant, such as *Populus angustifolia*, *Abies concolor*, *Pinus ponderosa*, and *Picea pungens*. More open stands have a prominent shrub layer containing species such as *Alnus incana*, *Cornus sericea*, and *Salix* spp. This alliance is found in the Rocky Mountains of Alberta, Montana, Idaho, Wyoming, Colorado, Utah, eastern Oregon and Washington, and Great Basin mountain ranges of Nevada, possibly extending into the Sierra Nevada of California. In addition it occurs on high plateaus and canyons of New Mexico.

OVERVIEW

Scientific Name: *Populus tremuloides* Riparian Forest Alliance

Common Name (Translated Scientific Name): Quaking Aspen Riparian Forest Alliance

Colloquial Name: Quaking Aspen Riparian Forest

Type Concept: This alliance includes only those stands of *Populus tremuloides* that are truly wetlands and riparian in their setting. Most stands of this alliance are found in riparian zones. Some may be near lakes where the ground is flooded or saturated for a short time in the spring. The moderate to closed tree canopy is dominated by *Populus tremuloides*; sometimes other trees are codominant, such as *Populus angustifolia*, *Abies concolor*, *Pinus ponderosa*, and *Picea pungens*. More open stands have a prominent shrub layer containing species such as *Alnus incana*, *Cornus sericea*, and *Salix* spp. This alliance is found in the Rocky Mountains of Alberta, Montana, Idaho, Wyoming, Colorado, Utah, eastern Oregon and Washington, and Great Basin mountain ranges of Nevada, possibly extending into the Sierra Nevada of California. In addition it occurs on high plateaus and canyons of New Mexico.

Classification Comments: *Populus tremuloides* is a widespread species that occurs in generally mesic slopes. This alliance is limited to those stands on wetland soils and riparian alluvial areas and draws where water collects.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Riparian and other wetland areas dominated in the upper canopy by *Populus tremuloides*.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a moderately dense to dense tree canopy dominated by cold-deciduous broad-leaved trees (5-20 m tall). Evergreen needle-leaved trees may be present to codominant in the tree canopy. The understory is variable. Sparse to dense, tall- and short-shrub layers may be present and are typically dominated by deciduous broad-leaved species; however, a scale-leaved short shrub dominates the understory of some stands. Sparse to dense, tall or short herbaceous layers may also be present and may be dominated by perennial forbs or graminoids.

Floristics: This alliance is dominated by *Populus tremuloides*. Common tree associates include *Abies concolor*, *Abies lasiocarpa*, *Betula papyrifera*, *Picea engelmannii*, *Picea glauca*, *Pinus contorta*, *Populus balsamifera* ssp. *trichocarpa*, and *Pseudotsuga menziesii*, depending on the elevation. A shrub layer may be dominated by *Alnus incana*, *Amelanchier alnifolia*, *Arctostaphylos uva-ursi*, *Betula nana*, *Betula occidentalis*, *Cornus sericea*, *Prunus americana*, *Prunus pensylvanica*, *Prunus virginiana*, *Quercus gambelii*, *Ribes montigenum*, *Rosa woodsii*, *Rubus idaeus*, *Salix bebbiana*, *Salix drummondiana*, *Salix monticola*, other *Salix* spp., *Sorbus scopulina*, *Symphoricarpos albus*, *Symphoricarpos oreophilus*, and/or *Vaccinium scoparium*. The dwarf-shrubs *Mahonia repens* and *Vaccinium myrtillus* are common. The herbaceous layer may be lush and diverse, dominated by graminoids or tall forbs. Common graminoids may include *Bromus ciliatus*, *Bromus carinatus*, *Calamagrostis canadensis*, *Carex siccata* (= *Carex foenea*), *Carex hoodii*, *Elymus glaucus*, *Elymus trachycaulus*, and *Festuca thurberi*. Forbs may include *Achillea millefolium*, *Delphinium x occidentale*, *Equisetum arvense*, *Eucephalus engelmannii* (= *Aster engelmannii*), *Fragaria virginiana*, *Geranium richardsonii*, *Ligusticum porteri*, *Maianthemum stellatum*, *Mertensia arizonica*, *Osmorhiza occidentalis*, *Senecio bigelovii* var. *bigelovii*, *Thalictrum occidentale*, *Veratrum californicum*, and many others. Exotic grasses such as the perennial *Poa pratensis* and the annual *Bromus tectorum* are often common in stands disturbed by grazing.

ENVIRONMENT & DYNAMICS

Environmental Description: Forests included in this alliance occur in seasonally flooded areas in the Rocky Mountain region. Elevations range from 850-3170 m. Climate is temperate with a relatively long growing season, typically cold winters and often deep snow. Mean annual precipitation is greater than 38 cm and typically greater than 50 cm. The distribution of *Populus tremuloides* forests is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand (Mueggler 1988). Secondarily, its range is limited by the length of the growing season or low temperatures (Mueggler 1988). Habitats vary in aspect

according to elevation and latitude in respect to the most limiting factor. Stands in this alliance are restricted to sites saturated by seepage from springs and streams from snowmelt. They occur below seeps on gentle slopes, wet draws and flats, and in depressions along streambank terraces. Aspects are variable. In Colorado they are typically on cool, moist north and northeast aspects, whereas in northwestern Wyoming, aspects often are on warmer eastern or western slopes. Soils are often fine-textured, poorly drained, consisting of silts and clays, often forming an organic muck (Youngblood and Mueggler 1981). However, some the alluvial soils are coarse-textured and permit rapid groundwater movement (Hansen et al. 1995). The water table is typically at or near the soil surface in the spring but may drop more than 1 m by midsummer (Hansen et al. 1995). Parent materials are variable and may include sedimentary, metamorphic or igneous rocks, but it appears to grow best on limestone, basalt, and calcareous or neutral shales (Mueggler 1988).

Dynamics: Stands in this alliance often originate, and likely are maintained by, stand-replacing disturbances such as crown fire, disease and windthrow, or clearcutting by man and beaver. The stems of these thin-barked, clonal trees are easily killed by surface fires. They can quickly and vigorously resprout in densities of up to 30,000 stems per hectare (Knight 1994). Stands are favored by fire in the conifer zone (Mueggler 1988). The stems are relatively short-lived (100-150 years) and individual stands will succeed to longer-lived conifer forest if undisturbed. With adequate disturbance, a clone may live many centuries. Although *Populus tremuloides* produces abundant seeds, seedling survival is rare because the long warm, moist conditions required to establish are rare in the habitats where it occurs.

DISTRIBUTION

Geographic Range: This alliance is found in the Rocky Mountains of Alberta, Montana, Idaho, Wyoming, Colorado, Utah, eastern Oregon and Washington, and Great Basin mountain ranges of Nevada, possibly extending into the Sierra Nevada of California. In addition it occurs on high plateaus and canyons of New Mexico.

Nations: CA, US

States/Provinces: AB, CA?, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: NPS (Great Basin)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- ? *Pinus ponderosa* Riparian Woodlands (Chappell et al. 1997) [includes Oregon's *Pinus ponderosa* - *Populus tremuloides* / *Carex* spp. - (*Poa* spp.) Forest. This type may have a flood regime.]
- >< *Populus tremuloides* (Aspen groves) Alliance (Sawyer et al. 2009) [61.111.00]
- ? *Populus tremuloides* Riparian/Wetland Forests and Woodlands (Chappell et al. 1997)
- >< Aspen Forest (#81B00) (Holland 1986b)
- >< Aspen Series (Sawyer and Keeler-Wolf 1995)
- >< Aspen: 217 (Eyre 1980)

LOWER LEVEL UNITS

Associations:

- CEG000621 *Populus tremuloides* / *Veratrum californicum* Riparian Forest
- CEG001082 *Populus tremuloides* / *Alnus incana* - *Salix* spp. Riparian Forest
- CEG000576 *Populus tremuloides* Canyon Formation Riparian Forest
- CEG000599 *Populus tremuloides* / *Ranunculus alismifolius* Riparian Forest
- CEG000574 *Populus tremuloides* / *Calamagrostis canadensis* Riparian Forest
- CEG000577 *Populus tremuloides* / *Carex pellita* Riparian Forest
- CEG001149 *Populus tremuloides* / *Alnus incana* / *Betula nana* - *Ribes* spp. Riparian Forest
- CEG001150 *Populus tremuloides* / *Alnus incana* Riparian Forest
- CEG003149 *Populus tremuloides* / *Rosa woodsii* Riparian Forest
- CEG002902 *Populus tremuloides* / *Salix drummondiana* Riparian Forest
- CEG000590 *Populus tremuloides* / *Senecio bigelovii* var. *bigelovii* Riparian Forest
- CEG000600 *Populus tremuloides* / *Ribes montigenum* Riparian Forest
- CEG002650 *Populus tremuloides* / *Betula occidentalis* Riparian Forest
- CEG003442 *Populus tremuloides* / *Carex aquatilis* var. *aquatilis* Riparian Forest
- CEG003147 *Populus tremuloides* - *Pinus jeffreyi* Riparian Forest
- CEG000584 *Populus tremuloides* / *Equisetum arvense* Riparian Forest

- CEGLO00191 *Pinus ponderosa* - *Populus tremuloides* / *Carex* spp. - (*Poa* spp.) Riparian Forest
- CEGLO05418 *Abies concolor* - (*Populus tremuloides*) / *Salix boothii* / *Carex scopulorum* Riparian Forest
- CEGLO05419 *Abies concolor* - *Populus tremuloides* / *Carex scopulorum* Riparian Forest
- CEGLO00582 *Populus tremuloides* / *Cornus sericea* Riparian Forest
- CEGLO03371 *Populus tremuloides* / *Carex obnupta* Riparian Forest

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Bock and Bock 1984, Boggs et al. 1990, Chappell et al. 1997, Cooper and Heidel 1997, Cooper and Pfister 1981, DeByle 1985, Evans 1989a, Evenden 1990, Eyre 1980, Faber-Langendoen et al. 1996, Faber-Langendoen et al. 2017b, Freeman and Dick-Peddie 1970, Hall 1967, Hansen et al. 1990, Hansen et al. 1991, Hansen et al. 1995, Hayward 1928, Hoffman and Alexander 1980, Holland 1986b, Hopkins 1979a, Johnston and Hendzel 1985, Kagan 1985, Kettler and McMullen 1996, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1997a, Kittel et al. 1999b, Klimas 1988a, Knight 1994, Kovalchik 1987, Manning and Padgett 1991, Manning and Padgett 1995, Mueggler 1988, Mueggler and Campbell 1986, Mutel 1973, Padgett 1982, Padgett et al. 1988b, Padgett et al. 1989, Powell 1988a, Richard et al. 1996, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Smith 1994b, Van Auken and Bush 1988, WNHP unpubl. data, Watson 1912, Youngblood and Mueggler 1981

1. Forest & Woodland

1.B.3.Nc. Rocky Mountain-Great Basin Montane Flooded & Swamp Forest

1.B.3.Nc.1.b. M034 Rocky Mountain-Great Basin Montane Riparian & Swamp Forest

G505. Rocky Mountain-Great Basin Swamp Forest

Type Concept Sentence: This group is dominated by conifers such as *Thuja plicata* and/or *Picea engelmannii* with an obligate wetland herbaceous understory such as *Lysichiton americanus*, that generally occurs only on very poorly drained soils that are saturated year-round or may have seasonal flooding in the spring. It occurs in the northern Rocky Mountains from northwestern Wyoming north into the Canadian Rockies and west into eastern Oregon and Washington.

OVERVIEW

Scientific Name: *Thuja plicata* - *Picea engelmannii* / *Lysichiton americanus* Swamp Forest Group

Common Name (Translated Scientific Name): Western Red-cedar - Engelmann Spruce / American Skunk-cabbage Swamp Forest Group

Colloquial Name: Engelmann Spruce Swamp Forest

Type Concept: This forested wetland/swamp group occurs in the northern Rocky Mountains from northwestern Wyoming north into the Canadian Rockies and west into eastern Oregon and Washington. It is dominated by conifers with diagnostic hydric undergrowth vegetation. Dominant conifers include *Abies grandis*, *Abies lasiocarpa*, *Picea engelmannii*, *Picea glauca* (and their hybrid), *Pinus contorta*, *Pseudotsuga menziesii*, *Thuja plicata*, and/or *Tsuga heterophylla*. Aquatic obligate herbs include *Alopecurus aequalis*, *Calamagrostis canadensis*, *Carex disperma*, *Carex vesicaria*, *Dryopteris* spp., *Eleocharis palustris*, *Lysichiton americanus*, *Mitella breweri*, *Mitella pentandra*, *Phalaris arundinacea*, *Senecio triangularis*, and/or *Streptopus amplexifolius*. Typical wetland shrubs such as *Alnus incana*, *Cornus sericea* (= *Cornus stolonifera*), *Rhamnus alnifolia*, and *Salix* spp. may also be present. These occur on poorly drained soils that are saturated year-round or may have seasonal flooding in the spring. These are primarily on flat to gently sloping lowlands, but also occur up to near the lower limits of continuous forest (below the subalpine parkland), and can occur on steeper slopes where soils are shallow over unfractured bedrock (aka on seeps). This group is indicative of poorly drained, mucky areas, and areas are often bathed in a mosaic of moving and stagnant water. It can also occur around vernal ponds (usually <1 m but can be as much as 2 m deep) that usually fill with water over the fall, winter and early spring, but then at least partially dry up towards the end of the growing season. Trees that ring these ponds shade the water and influence the hydrology of the ponds themselves. Soils can be woody peat, muck or mineral but tend toward mineral. Stands generally occupy sites on benches, toeslopes or valley bottoms along mountain streams. Stands are usually dominated by conifers, but can have hardwoods mixed or dominant. These wetland types are generally distinguishable from other upland forests and woodlands by shallow water tables.

Classification Comments: This is named and described as a conifer-dominated wetland, but it is noted that deciduous trees can be present and may solely dominate some stands. However, to date, there is no documentation or verification of deciduous-dominated swamps.

Similar NVC Types:

- G506 Rocky Mountain–Great Basin Montane Riparian & Swamp Forest: is found in aerated, better drained areas.
- G256 North Pacific Maritime Swamp Forest: is very similar but limited to the coastal maritime climates and lacks *Picea engelmannii*.
- G610 North Pacific Maritime Wooded Bog & Poor Fen: is a very similar group that occurs farther west and has Pacific Northwest Coastal indicator species.

Diagnostic Characteristics: This group is dominated by conifers with obligate wetland herbaceous understory on poorly drained soils that are saturated year-round or may have seasonal flooding in the spring.

VEGETATION

Physiognomy and Structure: Wetlands dominated by tall conifer trees, tall deciduous hardwood trees or both, often surrounding a perennial or ephemeral water body. Herbaceous undergrowth is often very dense and ranges from 0.1-1.5 m in height.

Floristics: Abundant conifer tree species include *Abies grandis*, *Abies lasiocarpa*, *Picea engelmannii*, *Picea glauca*, *Pinus contorta*, *Pseudotsuga menziesii*, *Thuja plicata*, and or *Tsuga heterophylla*. Deciduous broadleaf trees may also be present or dominant (but swamps dominated by deciduous trees have not yet been documented) such as *Betula papyrifera*, *Fraxinus latifolia*, *Larix occidentalis*, *Populus balsamifera ssp. trichocarpa* (= *Populus trichocarpa*), and/or *Populus tremuloides*. These wetland types are generally distinguishable from other upland forests and woodlands by shallow water table indicator, mesic or hydric undergrowth vegetation; some of the most typical herbaceous species include *Alopecurus aequalis*, *Athyrium filix-femina*, *Calamagrostis canadensis*, *Callitriche heterophylla*, *Carex disperma*, *Carex vesicaria*, *Dryopteris* spp., *Eleocharis palustris*, *Equisetum arvense*, *Lysichiton americanus*, *Mitella breweri*, *Mitella pentandra*, *Phalaris arundinacea*, *Senecio triangularis*, and *Streptopus amplexifolius*. Common shrubs include *Alnus incana*, *Cornus sericea* (= *Cornus stolonifera*), *Rhamnus alnifolia*, and *Salix* spp. Floristic descriptions are compiled from Crowe and Clausnitzer (1997), Canadian Rockies Ecoregional Plan (2002), MacKenzie and Moran (2004), and Mincemoyer (2005).

ENVIRONMENT & DYNAMICS

Environmental Description: *Climate:* Temperate cool. *Soil/substrate/hydrology:* This group is dominated by conifers on poorly drained soils that are saturated year-round or may have seasonal flooding in the spring. These are primarily on flat to gently sloping lowlands, but also occur up to near the lower limits of continuous forest (below the subalpine parkland). It can occur on steeper slopes where soils are shallow over unfractured bedrock. This group is indicative of poorly drained, mucky areas, and areas are often a mosaic of moving and stagnant water. These wetland types are generally distinguishable from other upland forests and woodlands by shallow water tables and mesic or hydric undergrowth vegetation. It can also occur around vernal ponds (usually <1 m but can be as much as 2 m deep) that usually fill with water over the fall, winter and early spring, but then at least partially dry up towards the end of the growing season. Trees that ring these ponds shade the water and influence the hydrology of the ponds themselves. Soils can be woody peat, muck or mineral but tend toward mineral. Stands generally occupy sites on benches, toeslopes or valley bottoms along mountain streams. Environmental descriptions are compiled from Crowe and Clausnitzer (1997), NCC (2002), MacKenzie and Moran (2004), and Mincemoyer (2005).

Dynamics: These forests have permanently saturated soils that rarely dry out.

DISTRIBUTION

Geographic Range: This group occurs in the northern Rocky Mountains from northwestern Wyoming and central Montana, north into the Canadian Rockies of Alberta and British Columbia and west into Idaho, eastern Oregon and Washington.

Spatial Scale & Pattern [optional]: Large patch, Small patch

Nations: CA, US

States/Provinces: AB, BC, ID, MT, OR, WA, WY

TNC Ecoregions [optional]: 7:C, 8:C, 9:P, 26:C, 68:C

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Alliances:

CBR alliances

- A3775 *Picea engelmannii* Swamp Forest Alliance
- A3776 *Thuja plicata* - *Tsuga heterophylla* Rocky Mountain Swamp Forest Alliance

AUTHORSHIP

Primary Concept Source: S. Shaw and C.G. Fredine (1971)

Author of Description: G. Kittel and M.S. Reid

Acknowledgments:

Version Date: 12/02/2015

Classif Resp Region: West

Internal Author: GK 10-10, 9-13, 12-15

REFERENCES

References: Crowe and Clausnitzer 1997, Eyre 1980, Faber-Langendoen et al. 2017a, MacKenzie and Moran 2004, Mincemoyer 2005, NCC 2002, National Wetlands Working Group 1988, Shaw and Fredine 1971, Warner and Rubec 1997

1. Forest & Woodland

1.B.3.Nc. Rocky Mountain-Great Basin Montane Flooded & Swamp Forest

G505. Rocky Mountain-Great Basin Swamp Forest

A3775. *Picea engelmannii* Swamp Forest Alliance

Type Concept Sentence: This alliance consists of riparian wetlands dominated by *Picea engelmannii*, *Picea glauca*, and their hybrids. *Betula papyrifera* is occasionally present. It can be found in riparian areas of Montana, Wyoming and Idaho where the climate has a maritime influence with moist air masses from the Pacific Ocean that release large amounts of snow and rain.

OVERVIEW

Scientific Name: *Picea engelmannii* Swamp Forest Alliance

Common Name (Translated Scientific Name): Engelmann Spruce Swamp Forest Alliance

Colloquial Name: Engelmann Spruce Swamp Forest

Type Concept: This alliance contains coniferous-dominated swampy riparian areas with *Picea engelmannii*, *Picea glauca*, and their hybrids. *Betula papyrifera* is occasionally present. Shrub layer includes *Alnus incana*, *Betula occidentalis*, and/or *Cornus sericea*. The herbaceous layer is dominated by the forb *Lysichiton americanus* or *Carex disperma*, *Cinna latifolia*, and/or *Athyrium filix-femina*. This alliance can be found on level sites that have a high water table such as adjacent to meandering streams and ponds; the water table is usually within 50 cm of the soil surface throughout the year. Standing water may be present in depressions. Soils are poorly drained and have a high organic matter content in the upper horizon. Stands are located in low-elevation (880-900 m) valleys. The vegetation in this alliance occurs in riparian areas in Montana, Wyoming and Idaho.

Classification Comments: This alliance covers stands with saturated soils throughout the growing season.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Wooded wetlands dominated by *Picea engelmannii*, *Picea glauca*, and their hybrids.

VEGETATION

Physiognomy and Structure: This alliance is characterized by a moderately open canopy of needle-leaved evergreen trees. The shrub layer has a moderately open canopy of deciduous species. Forbs dominate the herbaceous canopy.

Floristics: This alliance contains coniferous-dominated swampy riparian areas with *Picea engelmannii* and hybrid swarms of *Picea* (a result of its hybridization with *Picea glauca*, a common lower elevation condition). A moderately open canopy of *Picea* spp. dominates the tree canopy. *Betula papyrifera* is occasionally present. A number of shrub species occur in the understory; the most common species are *Alnus incana*, *Betula occidentalis*, and *Cornus sericea*. The herbaceous layer is dominated by the forb *Lysichiton americanus*. *Cinna latifolia* and *Athyrium filix-femina* are common associates, but occur in low abundances.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands are located in low-elevation (880-900 m) valleys adjacent to meandering streams and ponds. They are found on level sites that have a high water table; the water table is usually within 50 cm of the soil surface throughout the year. Standing water may be present in depressions. Soils are poorly drained and have a high organic matter content in the upper horizon.

Dynamics: The driving variable of greatest importance is permanent soil saturation (spring flooding common).

DISTRIBUTION

Geographic Range: This alliance is found in Idaho, Wyoming, Montana, and may occur in Colorado.

Nations: US

States/Provinces: CO?, ID, MT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEGL000412 *Picea (engelmannii x glauca, engelmannii)* / *Lysichiton americanus* Swamp Forest
- CEGL000405 *Picea (engelmannii x glauca, engelmannii)* / *Carex disperma* Swamp Forest

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Cooper 1975, Cooper 1986a, Cooper and Cottrell 1990, Faber-Langendoen et al. 2017b, Hansen et al. 1991, Hansen et al. 1995, Jensen 1990, Johnston 1987, Kettler and McMullen 1996, Kittel et al. 1999a, Moseley et al. 1991, Padgett et al. 1989, Peet 1975, Pfister et al. 1977, Steele et al. 1981, Steele et al. 1983, Williams and Smith 1990, Youngblood and Mueggler 1981

1. Forest & Woodland

1.B.3.Nc. Rocky Mountain-Great Basin Montane Flooded & Swamp Forest

G505. Rocky Mountain-Great Basin Swamp Forest

A3776. *Thuja plicata* - *Tsuga heterophylla* Rocky Mountain Swamp Forest Alliance

Type Concept Sentence: These are seasonally flooded forests are dominated by conifer species such as *Thuja plicata* and/or *Tsuga heterophylla*. Other tree species that may be present include *Pseudotsuga menziesii*, *Abies grandis*, and *Abies lasiocarpa*. They occur in riparian areas and toeslopes that remain saturated throughout the growing season. These stands occur in the marine-influenced interior mountains of northeastern Washington, northern Idaho, southeastern British Columbia and northwestern Montana east of the Continental Divide.

OVERVIEW

Scientific Name: *Thuja plicata* - *Tsuga heterophylla* Rocky Mountain Swamp Forest Alliance

Common Name (Translated Scientific Name): Western Red-cedar - Western Hemlock Rocky Mountain Swamp Forest Alliance

Colloquial Name: Rocky Mountain Western Red-cedar - Western Hemlock Swamp Forest

Type Concept: These seasonally flooded forests are characterized by a dense to somewhat open coniferous canopy dominated by *Thuja plicata*. *Tsuga heterophylla* is a typical associate in these stands. *Pseudotsuga menziesii*, *Abies grandis*, and *Abies lasiocarpa* may also share the upper tree canopy. The herbaceous layer is diverse and dominated by wetland and moist forest species, including *Lysichiton americanus*, *Athyrium filix-femina*, *Achlys triphylla*, and *Senecio triangularis*. Mosses and lichens are common on trees, downed logs, and the forest floor. The alliance occurs in the marine-influenced coastal and interior mountains of northeastern Washington, northern Idaho, southeastern British Columbia and northwestern Montana east of the Continental Divide. This alliance is found from sea level in coastal areas to over 1800 m in the northern Rocky Mountains of Idaho and western Montana. Annual precipitation ranges from less than 100 cm in the Northern Rockies to 300 cm or more in the coastal ranges of Oregon and Washington. These forests occur on riparian, toeslope, or valley bottom sites that are flooded for a substantial portion of the growing season. The seasonal flooding originates mostly from precipitation and snowmelt collecting in basins, with a small amount of streamside flooding. The soils are organic and saturated for part of the growing season. These forests are often transitional to non-forested wetlands.

Classification Comments: Maritime influence of interior Rocky Mountains creates pockets where *Thuja plicata* and *Tsuga heterophylla* thrive.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Saturated soil wetlands dominated by *Thuja plicata* and/or *Tsuga heterophylla*.

VEGETATION

Physiognomy and Structure: Stands of this alliance typically contain a dense canopy of tall conifers approaching 50 m or more in height. There is often a sparse to dense layer of cold-deciduous or evergreen shrubs. The herbaceous layer is usually a dense layer of shade-tolerant forbs and ferns, but in some cases can be sparse.

Floristics: Stands are dominated or codominated by *Thuja plicata*. *Tsuga heterophylla* is a typical associate that may be confined to higher microsites such as buttress roots, stumps and nurse logs. Other important and occasionally codominant conifers may include *Abies grandis*, *Abies lasiocarpa*, *Larix occidentalis*, *Pseudotsuga menziesii*, or *Taxus brevifolia*. Broad-leaved cold-deciduous trees, including *Alnus rubra*, *Acer macrophyllum*, *Betula papyrifera*, and *Populus balsamifera* ssp. *trichocarpa*, may form a subcanopy. Understory shrubs include *Acer glabrum*, *Alnus incana*, *Linnaea borealis*, *Paxistima myrsinites*, *Rubus parviflorus*, and/or *Vaccinium membranaceum*. The herbaceous layer may have *Adiantum pedatum*, *Aralia nudicaulis*, *Asarum caudatum*, *Athyrium filix-femina*, *Clintonia uniflora*, *Coptis occidentalis*, *Cornus canadensis*, *Geum macrophyllum*, *Gymnocarpium dryopteris*, *Lysichiton americanus*, *Tiarella trifoliata*, and/or *Trillium ovatum*. Mosses and lichens are common on trees, downed logs, and the forest floor.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands of the alliance generally occur on all slopes and aspects, but grow best on sites with high soil moisture, such as toeslopes and bottomlands (Cooper et al. 1987). These forests generally occur at moist, non-flooded or upland sites that are not saturated yearlong, such as riparian, toeslope, or valley bottom sites that are flooded for a substantial portion of the growing season. The seasonal flooding originates mostly from precipitation and snowmelt collecting in basins, with a small amount of streamside flooding. The soils are organic and saturated for part of the growing season.

Dynamics: Following disturbance, a variety of other conifer species can become established and dominate sites previously supporting stands of this forest alliance. *Pseudotsuga menziesii*, in particular, can become established and dominate sites for many years following disturbance. In the northern Rocky Mountains, stand-replacing disturbance can result in conversion to communities dominated by either *Larix occidentalis* or *Pinus monticola*. Typically, stand-replacement fire-return intervals are 150-500 years with moderate-severity fire intervals of 50-100 years. Specific fire influences vary with site characteristics. Generally, wetter sites burn less frequently and support older stands with more *Tsuga heterophylla* and *Thuja plicata*.

DISTRIBUTION

Geographic Range: This alliance occurs in the marine-influenced coastal and interior mountains of northeastern Washington, northern Idaho, southeastern British Columbia and northwestern Montana east of the Continental Divide.

Nations: CA?, US

States/Provinces: BC?, ID, MT, OR, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- >< Eastside *Tsuga heterophylla*-*Thuja plicata* Forests (Chappell et al. 1997)
- >< *Tsuga heterophylla*-*Thuja plicata* Coniferous Wetlands (Chappell et al. 1997)
- >< Western Needleleaf Forests: 2: Cedar-Hemlock-Douglas Fir Forest (*Thuja-Tsuga-Pseudotsuga*) (Küchler 1964)
- >< Western Redcedar - Western Hemlock: 227 (Eyre 1980)
- >< Western Redcedar: 228 (Eyre 1980)
- >< Westside *Pseudotsuga menziesii*-*Tsuga heterophylla* Forests (Chappell et al. 1997)

LOWER LEVEL UNITS

Associations:

- C EGL000479 *Thuja plicata* - *Tsuga heterophylla* / *Oplopanax horridus* Rocky Mountain Swamp Forest
- C EGL005931 *Thuja plicata* / *Carex disperma* Swamp Forest

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Atzet and McCrimmon 1990, Atzet et al. 1996, Burns and Honkala 1990a, Chappell et al. 1997, Clausnitzer and Zamora 1987, Cooper et al. 1987, Daubenmire 1952, Daubenmire and Daubenmire 1968, Douglas 1971, Eyre 1980, Faber-Langendoen et al. 2017b, Franklin 1966, Franklin and Dyrness 1973, Glad et al. 1987, Green and Klinka 1994, Hansen et al. 1991, Hansen et al. 1995, Henderson et al. 1986, Kojima and Krajina 1975, Kovalchik 1993, Kunze 1994, K uchler 1964, Lillybridge et al. 1995, Pfister et al. 1977, Scow et al. 1987, Topik et al. 1986, WNHP unpubl. data, Williams and Lillybridge 1985, Williams et al. 1990b, Zamora 1983

1.B.3.Nd. Western North American Interior Flooded Forest

This lowland riparian forest and woodland type is dominated by broad-leaved deciduous trees (cottonwoods, sycamores, and hackberries) and palms that occur along perennial and intermittent rivers, springs and oases of the California Central Valley, Southwest U.S. deserts, and the Tamaulipan region of south Texas and adjacent Mexico.

M036. Interior Warm & Cool Desert Riparian Forest

This macrogroup covers warm and cold climate riparian and wetland forested vegetation of the southwestern deserts and western interior U.S., including the Tamaulipan area of southern Texas. Some of the dominant trees species of this highly diverse macrogroup include *Vachellia farnesiana*, *Celtis laevigata*, *Ebenopsis ebano*, *Juglans major*, *Platanus racemosa*, *Platanus wrightii*, *Populus deltoides* ssp. *wislizeni*, *Populus deltoides* ssp. *monilifera*, *Populus fremontii*, *Prosopis glandulosa*, *Salix laevigata*, and *Salix gooddingii*. This macrogroup also includes oases dominated by evergreen palms *Washingtonia filifera* or *Sabal mexicana*.

1. Forest & Woodland

1.B.3.Nd. Western North American Interior Flooded Forest

1.B.3.Nd.2.b. M036 Interior Warm & Cool Desert Riparian Forest

G797. Western Interior Riparian Forest & Woodland

Type Concept Sentence: This group consists of riparian woodlands dominated by trees and tall arborescent shrubs, with species such as *Acer negundo*, *Celtis laevigata* var. *reticulata*, *Cephalanthus occidentalis*, *Fraxinus velutina*, *Juglans major*, *Platanus wrightii*, *Populus deltoides*, *Populus fremontii*, *Platanus racemosa*, *Quercus lobata*, *Salix gooddingii*, *Salix laevigata*, *Sapindus saponaria*, and *Washingtonia filifera*. It is found throughout lowlands of the Interior West, including southwestern warm and cool deserts and Mediterranean California.

OVERVIEW

Scientific Name: Western Interior Riparian Forest & Woodland Group

Common Name (Translated Scientific Name): Western Interior Riparian Forest & Woodland Group

Colloquial Name: Box-elder - Singleleaf Ash - Netleaf Hackberry Riparian Woodland

Type Concept: This group consists of riparian woody vegetation. Dominant trees may include *Acer negundo*, *Celtis laevigata* var. *reticulata*, *Cephalanthus occidentalis*, *Fraxinus velutina*, *Juglans major*, *Platanus wrightii*, *Populus deltoides* ssp. *wislizeni*, *Populus deltoides* ssp. *monilifera*, *Populus fremontii*, *Platanus racemosa*, *Quercus lobata*, *Salix amygdaloides*, *Salix gooddingii*, *Salix laevigata*, *Sapindus saponaria*, and *Washingtonia filifera*. Dominant shrubs include *Alnus oblongifolia*, *Baccharis salicifolia*, *Prunus* spp., *Salix exigua*, *Salix lasiolepis*, *Shepherdia argentea*, and *Vitis californica*. Other dominants on serpentine substrates include *Aquilegia eximia*, *Carex serratodens*, *Cirsium fontinale*, *Hesperocyparis sargentii* (= *Cupressus sargentii*), *Frangula californica* ssp. *tomentella* (= *Rhamnus tomentella*), *Mimulus glaucescens*, *Mimulus guttatus*, *Packera clevelandii* (= *Senecio clevelandii*), *Salix breweri*, *Solidago* spp., *Stachys albens*, and *Umbellularia californica*. The variety of plant associations within this group reflects elevation, stream gradient, floodplain width, and flooding events. It also includes springs, seeps, and perennial and intermittent streams and riparian areas found on serpentine substrates. These are disturbance-driven systems that require flooding, scour and deposition for germination and maintenance. Periodic flooding and associated sediment scour are necessary to maintain growth and reproduction of vegetation. Flooding regimes have been significantly altered in all but a few tributaries that support this group. This group occurs

throughout lowlands of the interior west, including southwest warm and cool deserts and Mediterranean California, generally below about 1800 m (6000 feet) elevation. Known occurrences include the following rivers and their tributaries: Colorado, Gila, Pecos, Rio Grande, Sacramento, San Joaquin, Santa Cruz, Salt, San Pedro, Truckee, Snake and others.

Classification Comments: This group combines warm southwestern deserts with cool interior lower elevation rivers, and occurs from sea level, but does not include montane elevations.

Similar NVC Types:

- G510 Interior West Ruderal Riparian Forest & Scrub
- G533 North American Warm Desert Riparian Low Bosque & Shrubland
- G541 Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope

Diagnostic Characteristics: This group is wide-ranging in the western U.S. and occurs in the warm desert regions (Sonoran and Mojave) of the southwestern U.S. and adjacent Mexico, Mediterranean California, and the cool desert interior in riparian corridors along perennial and seasonally intermittent streams and spring-fed depressions. Diagnostic tree species trees include *Juglans major*, *Platanus racemosa*, *Platanus wrightii*, *Populus deltoides* ssp. *monilifera*, *Populus deltoides* ssp. *wislizeni*, *Populus fremontii*, *Salix amygdaloides*, *Salix laevigata*, and *Washingtonia filifera*. Shrubs are rich and varied. Stands are always adjacent to streams or their floodplains and have been observed to follow narrow tributaries. Seasonal flooding and soil saturation by a rising water table are necessary to maintain growth and reproduction of vegetation.

VEGETATION

Physiognomy and Structure: Open to closed woodlands of tall cold-deciduous trees and shrubs, forming linear bands following stream and river courses and alluvial floodplains. Herbaceous undergrowth is variable depending on the amount of shading in the overstory.

Floristics: The vegetation is a mix of riparian woodlands dominated by trees and tall arborescent shrubs. Dominant trees include *Acer macrophyllum*, *Acer negundo*, *Alnus rhombifolia*, *Alnus rubra*, *Celtis laevigata* var. *reticulata*, *Cephalanthus occidentalis*, *Fraxinus velutina*, *Juglans major*, *Platanus racemosa*, *Platanus wrightii*, *Populus deltoides* ssp. *wislizeni*, *Populus deltoides* ssp. *monilifera*, *Populus fremontii*, *Pseudotsuga menziesii*, *Quercus agrifolia*, *Quercus lobata*, *Salix amygdaloides*, *Salix gooddingii*, *Salix laevigata*, *Salix lasiolepis*, *Sapindus saponaria*, and *Washingtonia filifera*. Shrub dominants include *Alnus oblongifolia*, *Baccharis salicifolia*, *Prunus* spp., *Salix exigua*, *Salix geyeriana*, *Salix lasiolepis*, and *Vitis californica*. Other dominants on serpentine substrates include *Aquilegia eximia*, *Carex serratodens*, *Cirsium fontinale*, *Hesperocyparis sargentii* (= *Cupressus sargentii*), *Frangula californica* ssp. *tomentella* (= *Rhamnus tomentella*), *Mimulus glaucescens*, *Mimulus guttatus*, *Packera clevelandii* (= *Senecio clevelandii*), *Salix breweri*, *Solidago* spp., *Stachys albens*, and *Umbellularia californica*. These are disturbance-driven systems that require flooding, scour and deposition for germination and maintenance. Exotic species that may be present include *Ailanthus altissima*, *Eucalyptus* spp., and *Tamarix* spp., and herbs such as *Arundo donax*.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands occur on streambanks and floodplains. The variety of plant associations within this group reflects elevation, stream gradient, floodplain width, and flooding events. It also includes springs, seeps, and perennial and intermittent streams on serpentine substrates.

Dynamics: Vegetation is dependent upon annual or periodic flooding and associated sediment scour and/or annual rise in the water table for growth and reproduction. Permanent subsurface water is required to maintain *Washingtonia filifera*. Salinity is low in the root zone, but increases near the surface where evaporation leaves salt accumulations. Reproduction of *Washingtonia filifera* is limited by water supply, surface salinity, rainfall, and fire. Fan palms are fire-tolerant, while the understory species are not, and fires open up the understory allowing palm seedlings to establish. Removal of the understory also decreases competition for water. There are currently 24 known occurrences of *Washingtonia filifera* in Arizona, Nevada, and California (Sawyer et al. 2009).

DISTRIBUTION

Geographic Range: The group occurs throughout Mediterranean California, California's Central Valley, the southern Coast Ranges of Oregon, the lower valleys of Nevada and southern Idaho and the Colorado Plateau south into the canyons and desert valleys of the Sonoran and Mojave deserts of southwestern United States and adjacent Mexico. Specifically, it is known in California, southern Oregon, Nevada, Utah, Colorado, southern Arizona, New Mexico, adjacent Mexico (Baja California, Baja California del Sur, Chihuahua), and western Texas. Elevation ranges from sea level up to 1800 m.

Spatial Scale & Pattern [optional]:

Nations: MX, US

States/Provinces: AZ, CA, CO, ID, MXBC?, MXBS, MXCH, MXSO, NM, NV, OR, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- >< *Quercus lobata* (Valley oak woodland) Alliance (Sawyer et al. 2009) [71.040.00]
- >< Arizona Cypress: 240 (Eyre 1980)
- >< Cottonwood - Willow: 235 (Eyre 1980)
- >< Port Orford-Cedar: 231 (Eyre 1980)
- < Riparian Woodland (203) (Shiflet 1994) [Serpentine substrates are not specifically mentioned in Shiflet (1994).]

LOWER LEVEL UNITS

Alliances:

- A0953 *Alnus oblongifolia* Riparian Forest Alliance
- A3801 *Platanus wrightii* Riparian Forest Alliance
- A0957 *Juglans major* - *Juglans microcarpa* Riparian Forest Alliance
- A3796 *Acer negundo* - *Fraxinus anomala* - *Celtis laevigata* var. *reticulata* Riparian Woodland Alliance
- A0485 *Washingtonia filifera* Wet Woodland Alliance
- A3750 *Platanus racemosa* - *Quercus agrifolia* - *Juglans californica* Riparian Woodland Alliance
- A3803 *Populus fremontii* - *Fraxinus velutina* - *Salix gooddingii* Riparian Forest & Woodland Alliance
- A3752 *Salix gooddingii* - *Salix laevigata* Riparian Forest Alliance
- A0644 *Populus fremontii* Great Basin Riparian Forest Alliance
- A0945 *Juglans microcarpa* Riparian Scrub Alliance
- A3798 *Populus deltoides* ssp. *wislizeni* - *Populus deltoides* ssp. *monilifera* - *Salix amygdaloides* Riparian Woodland Alliance
- A3802 *Populus deltoides* ssp. *wislizeni* - *Populus deltoides* ssp. *monilifera* Riparian Forest Alliance
- A0618 *Quercus lobata* Riparian Forest Alliance

AUTHORSHIP

Primary Concept Source: G. Kittel, P. Comer and T. Keeler-Wolf in Faber-Langendoen et al. (2015)

Author of Description: G. Kittel

Acknowledgments: Julie Evens, Todd Keeler-Wolf

Version Date: 09/29/2016

Classif Resp Region: West

Internal Author: MSR 11-14; GK 5-15, 12-15, 9-16

REFERENCES

References: Barbour and Major 1988, Brown 1982a, Dick-Peddie 1993, Eyre 1980, Faber-Langendoen et al. 2017a, Holland and Keil 1995, MacMahon 1988, Muldavin et al. 2000a, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994, Stout et al. 2013, Szaro 1989, Thomas et al. 2004, Vogl and McHargue 1966

1. Forest & Woodland

1.B.3.Nd. Western North American Interior Flooded Forest

G797. Western Interior Riparian Forest & Woodland

A3796. *Acer negundo* - *Fraxinus anomala* - *Celtis laevigata* var. *reticulata* Riparian Woodland Alliance

Type Concept Sentence: This alliance consists of riparian woodlands dominated by *Acer negundo*, *Fraxinus anomala*, and/or *Celtis laevigata* var. *reticulata*. Common associates include *Alnus incana*, *Betula occidentalis*, *Brickellia grandiflora*, *Brickellia longifolia*, *Cornus sericea*, *Quercus gambelii*, *Rhus trilobata*, and others. It is found on intermittently dry streams and/or in slickrock canyons, and occurs on the Colorado Plateau and south into Arizona and New Mexico.

OVERVIEW

Scientific Name: *Acer negundo* - *Fraxinus anomala* - *Celtis laevigata* var. *reticulata* Riparian Woodland Alliance

Common Name (Translated Scientific Name): Box-elder - Singleleaf Ash - Netleaf Hackberry Riparian Woodland Alliance

Colloquial Name: Box-elder - Singleleaf Ash - Netleaf Hackberry Riparian Woodland

Type Concept: This alliance consists of riparian woodlands dominated by *Acer negundo*, *Fraxinus anomala*, and/or *Celtis laevigata* var. *reticulata*. Common associates include *Alnus incana*, *Betula occidentalis*, *Brickellia grandiflora*, *Brickellia longifolia*, *Cornus sericea*, *Quercus gambelii*, *Rhus trilobata*, and others. Cottonwoods and willows are usually not present and, if present, are in very

CBR alliances

low abundance. It is found adjacent to streams and rivers, seeps and springs, near the base of colluvial slopes, and on alluvial terraces or in slickrock canyons, and occurs on the Colorado Plateau and south into Arizona and New Mexico.

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure: These are broad-leaved deciduous woodlands typically with the canopy 10-20 m tall, with a sparse shrub layer and dense to sparse herbaceous layer.

Floristics: Stands are dominated by *Fraxinus anomala*, *Acer negundo*, and/or *Celtis laevigata* var. *reticulata*, usually in monotypic stands but occasionally can be seen together. Other trees present may include *Juniperus osteosperma*, *Pinus edulis*, or *Pseudotsuga menziesii*. Associated tall shrubs include *Amelanchier alnifolia*, *Betula occidentalis*, *Forestiera pubescens*, *Quercus gambelii*, *Rhus trilobata*, and *Salix exigua*. Short shrubs contribute low cover and include *Ephedra viridis*, *Ericameria nauseosa*, *Holodiscus dumosus*, *Rhus trilobata*, *Symphoricarpos rotundifolius*, and the vines *Clematis ligusticifolia* and *Vitis arizonica*. The herbaceous layer may have *Elymus glaucus*, *Equisetum arvense*, *Equisetum hyemale*, *Maianthemum stellatum*, *Mentha arvensis*, and *Phalaris arundinacea*. Exotic graminoids such as *Poa pratensis* or *Agrostis stolonifera* can be abundant.

ENVIRONMENT & DYNAMICS

Environmental Description: This vegetation is restricted to mesic sites, such as near seeps, springs and ephemeral stream channels, on immediate riverbanks, within 2 m of the active channel, or streambanks immediately below perennial or seasonal springs or on lower colluvial slopes where additional soil moisture is available. Sites are flat to gently sloping and may have any aspect. Substrates are nearly always derived from colluvium but often have been transported or redistributed by water to form alluvial deposits. Soils are shallow to deep and well-drained to rapidly drained. Soil texture varies widely and can be coarse-loamy to fine-loamy and generally has large amounts of gravel and cobble. The water table is seasonally within 1 m of the surface.

Dynamics: With scouring floods, *Acer negundo* may survive only if it grows on upper colluvial slopes. This may provide a seed source for regeneration after flooding and deposition. Female trees of the dioecious *Acer negundo* are better adapted to growing along the channel edge and are recommended over male trees for restoration of disturbed streambanks. *Acer negundo* is not rhizomatous, but has strong roots that provide streambank stability.

DISTRIBUTION

Geographic Range: This alliance ranges from Idaho to Montana south through Nevada, Utah, Colorado, Arizona and New Mexico.

Nations: CA, US

States/Provinces: AZ, CO, ID, MT, NM, NV, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEG002692 *Acer negundo* / *Brickellia (grandiflora, longifolia)* Riparian Woodland
- CEG002752 *Fraxinus anomala* Riparian Woodland
- CEG005953 *Celtis laevigata* var. *reticulata* / *Brickellia californica* Riparian Woodland
- CEP009676 *Acer negundo* / *Quercus turbinella* Woodland [Park Special]
- CEG005941 *Acer negundo* - *Fraxinus velutina* Riparian Woodland
- CEG002599 *Acer negundo* - *Celtis laevigata* var. *reticulata* Riparian Woodland
- CEG005942 *Acer negundo* / *Salix exigua* Riparian Woodland

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Faber-Langendoen et al. 2017b, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999a, Padgett et al. 1989, Welsh et al. 1987

1. Forest & Woodland

1.B.3.Nd. Western North American Interior Flooded Forest

G797. Western Interior Riparian Forest & Woodland

A0957. *Juglans major* - *Juglans microcarpa* Riparian Forest Alliance

Type Concept Sentence: This is a riparian wooded alliance where *Juglans major* or *Juglans microcarpa* dominates the upper canopy. Several other woody species, such as *Acer negundo*, *Brickellia laciniata*, *Celtis laevigata* var. *reticulata*, *Chilopsis linearis*, and *Fallugia paradoxa*, may be present. It occurs on perennial and intermittent streambanks and beds in the Southwest, typically gentle gradient but none-the-less very rocky reaches found in southern Arizona and New Mexico and it may also occur in adjacent areas in Mexico and southwestern Texas.

OVERVIEW

Scientific Name: *Juglans major* - *Juglans microcarpa* Riparian Forest Alliance

Common Name (Translated Scientific Name): Arizona Walnut - Little Walnut Riparian Forest Alliance

Colloquial Name: Arizona Walnut - Little Walnut Riparian Forest

Type Concept: This is a riparian wooded alliance where *Juglans major* or *Juglans microcarpa* dominates the upper canopy. Any of the following codominant trees or tall shrubs may also occur: *Acer negundo*, *Brickellia laciniata*, *Pinus edulis*, *Platanus occidentalis*, *Platanus wrightii*, *Quercus* spp., *Salix gooddingii*, or *Sapindus saponaria*. Other important shrubs and vines include *Celtis laevigata* var. *reticulata*, *Fallugia paradoxa*, *Frangula californica* (= *Rhamnus californica*), *Rhus glabra*, *Rhus trilobata*, *Ungnadia speciosa*, and *Vitis arizonica*. Common graminoid species are *Bouteloua curtipendula*, *Bouteloua gracilis*, and *Carex* spp. Forb cover has been reported to be sparse and typically weedy. This alliance occurs in and adjacent to streambeds in Arizona and New Mexico. It is typically found along rubble-bottomed perennial, intermittent and temporary streams, dry rocky ravines, arroyos, and streambeds from approximately 700-2300 m elevation.

Classification Comments: This alliance contains both short scrubby trees and taller forest-forming trees. *Juglans major* can have growth forms of tall shrubs or short trees.

Internal Comments: GK 9-14: Might this occur in SW Texas as well?

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure: The woody canopy is dominated by broad-leaved deciduous tall shrubs or short trees, with an understory of shorter shrubs (1-2 m) and vines. A graminoid stratum is often present.

Floristics: This alliance is composed of structurally and compositionally variable riparian shrublands, with *Juglans major* or *Juglans microcarpa* being the most abundant and characteristic woody species. Other woody shrubs and small trees that can be present can include *Acer negundo*, *Brickellia laciniata*, *Celtis laevigata* var. *reticulata*, *Chilopsis linearis*, *Fallugia paradoxa*, *Frangula californica* (= *Rhamnus californica*), *Fraxinus velutina*, *Ostrya knowltonii*, *Pinus edulis*, *Platanus occidentalis*, *Platanus wrightii*, *Quercus* spp., *Rhus glabra*, *Rhus trilobata*, *Salix gooddingii*, *Salix nigra*, *Sapindus saponaria*, *Ungnadia speciosa*, and/or *Vitis arizonica*. The understory is composed primarily of perennial grasses such as *Andropogon gerardii*, *Bouteloua curtipendula*, *Bouteloua gracilis*, *Carex* spp., and *Schizachyrium scoparium* var. *scoparium* (= *Schizachyrium scoparium* ssp. *neomexicanum*). Forb cover was reported by Szaro (1989) to be sparse and typically weedy.

ENVIRONMENT & DYNAMICS

Environmental Description: It is found along perennial, intermittently and temporarily flooded streams. Sites include dry rocky ravines, arroyos, and streambeds from approximately 700 to 2300 m elevation. Stream gradients are to be 8-9 m per kilometer,

fairly low gradients (Szaró 1989). The headwaters of these streams are in montane areas, and even when the streambed is dry, it is usually subirrigated by a shallow water table. Following monsoonal rains, the streambed can be shallowly inundated for several weeks at a time. Soils are fairly coarse and have been described as limestone cobbles, flat-bedded limestone streambeds, boulder, gravelly and "rubble-bottomed."

Dynamics: *Juglans microcarpa* is shade-intolerant. Young individuals direct much of their energy into developing a large, deep taproot, which permits saplings to survive the periods of extreme drought that are common.

Brown (1982a) states that the mixed broad-leaved types, of which *Juglans major* is included, are relictual communities. The present distribution reflects a contraction of the formerly widespread, Early Tertiary mixed mesophytic forest. These riparian forests are vernal adapted to Early Tertiary climates and have retreated to pockets where the warm temperate climate persists.

DISTRIBUTION

Geographic Range: Communities within this alliance occur throughout southern Arizona and the southwestern "boot heel" of New Mexico. Given the range of the nominal species, it is likely the alliance also occurs in Mexico (Elias 1987).

Nations: MX?, US

States/Provinces: AZ, MXSO?, NM

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- ? *Juglans microcarpa* Community Type (Szaró 1989)
- ? Interior and Californian Riparian Deciduous Forests and Woodlands (Brown 1982a) [within Warm-Temperate Wetlands.]
- ? Little Walnut Series (Dick-Peddie 1993)
- ? Temperate Riparian Deciduous Forest Biome; Mixed Broadleaf Series (Pase and Layser 1977)

LOWER LEVEL UNITS

Associations:

- CEGLO01102 *Juglans major* Flooded Forest
- CEGLO04594 *Juglans microcarpa* / *Sorghastrum nutans* Flooded Scrub Woodland
- CEGLO00858 *Pinus ponderosa* / *Juglans major* Flooded Woodland
- CEGLO04593 *Juglans microcarpa* / *Cladium mariscus* ssp. *jamaicense* Flooded Scrub Woodland
- CEGLO05326 *Juglans major* - *Prosopis velutina* Flooded Forest
- CEGLO05954 *Juglans major* - *Acer negundo* / *Rhus trilobata* var. *trilobata* Flooded Forest
- CEGLO05955 *Juglans major* - *Celtis laevigata* var. *reticulata* / *Brickellia californica* Flooded Forest
- CEGLO05957 *Juglans major* / *Forestiera pubescens* var. *pubescens* Flooded Forest
- CEGLO05956 *Juglans major* / *Bouteloua curtipendula* Flooded Forest
- CEGLO01103 *Juglans microcarpa* Scrub
- CEGLO01101 *Juglans major* - *Pinus edulis* / *Bromus carinatus* Flooded Forest

AUTHORSHIP

Primary Concept Source: D. Culver, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Brown 1982a, Diamond 1993, Dick-Peddie 1993, Elias 1987, Faber-Langendoen et al. 2017b, Freeman and Dick-Peddie 1970, Henry 1981, Kearney et al. 1969, Pase and Layser 1977, Szaró 1989

1. Forest & Woodland

1.B.3.Nd. Western North American Interior Flooded Forest

G797. Western Interior Riparian Forest & Woodland

A0945. *Juglans microcarpa* Riparian Scrub Alliance

Type Concept Sentence: This alliance is found primarily along intermittently to temporarily flooded low-elevation (below 1500 m) streambeds and stream margins in desert canyons and valleys. Stream gradients are gentle. The headwaters of these streams are often in montane areas, and even when the streambed is dry, it is usually subirrigated. Following monsoonal rains, the streambed can be shallowly inundated for several weeks at a time. These are riparian scrublands with *Juglans microcarpa* as a dominant.

OVERVIEW

Scientific Name: *Juglans microcarpa* Riparian Scrub Alliance

Common Name (Translated Scientific Name): Little Walnut Riparian Scrub Alliance

Colloquial Name: Little Walnut Riparian Scrub

Type Concept: This alliance is found primarily along intermittently to temporarily flooded low-elevation (below 1500 m) streambeds and stream margins in desert canyons and valleys. Stream gradients are gentle. The headwaters of these streams are often in montane areas, and even when the streambed is dry, it is usually subirrigated. Following monsoonal rains, the streambed can be shallowly inundated for several weeks at a time. These are riparian scrublands with *Juglans microcarpa* as a dominant. Other woody species can include *Celtis laevigata* var. *reticulata*, *Fallugia paradoxa*, *Brickellia laciniata*, *Salix gooddingii*, *Salix nigra*, *Platanus occidentalis*, *Ungnadia speciosa*, and *Quercus* spp.

Classification Comments: The old alliance A.945 has been split, with two associations (CEGL004593 and CEGL004594) moving to A0957 in M508. These two associations are likely to be closely related to other riparian vegetation of New Mexico, Arizona, and Mexico. There may also be undescribed associations representing this alliance. In addition, the group placement of this alliance needs review and more information is needed to fully document the range and floristics of this alliance.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: *Juglans microcarpa*; open, scrubby riparian vegetation.

VEGETATION

Physiognomy and Structure: This alliance consists of structurally variable broad-leaved deciduous shrublands. The woody vegetation varies in both height and density, and from shrubby growth to well-developed small trees. The canopy of the woody plants may be dense to somewhat open or consist of widely scattered individuals. Woody vines are common in some stands, and most have an herbaceous layer, usually dominated by graminoids.

Floristics: This alliance is composed of structurally and compositionally variable riparian shrublands, with *Juglans microcarpa* being the most abundant and characteristic woody species. Other woody shrubs and small trees that can be present can include *Celtis laevigata* var. *reticulata*, *Fallugia paradoxa*, *Fraxinus velutina*, *Ostrya knowltonii*, *Chilopsis linearis*, *Brickellia laciniata*, *Salix gooddingii*, *Salix nigra*, *Platanus occidentalis*, *Ungnadia speciosa*, and *Quercus* spp. The understory, particularly in the Texas examples, is composed primarily of perennial grasses typical of adjacent upland vegetation, such as *Leptochloa dubia*, *Bothriochloa barbinodis* (= var. *barbinodis*), *Bouteloua curtipendula*, *Schizachyrium scoparium* var. *scoparium* (= *Schizachyrium scoparium* ssp. *neomexicanum*), and *Andropogon gerardii*. *Cladium mariscus* ssp. *jamaicense* is the graminoid dominant in one association in Texas. Woody vines, such as *Vitis arizonica* can be important in stands in New Mexico.

ENVIRONMENT & DYNAMICS

Environmental Description: Little information is available about the environmental factors related to this alliance. It is found primarily along intermittently to temporarily flooded low-elevation (below 1500 m) streambeds and stream margins in desert canyons and valleys. Stream gradients were reported by Szaro (1989) to be 8 to 9 m per kilometer, fairly low gradients. The headwaters of these streams are in montane areas, and even when the streambed is dry, it is usually subirrigated. Following monsoonal rains, the streambed can be shallowly inundated for several weeks at a time. In western Texas and the Edwards Plateau, this alliance occurs on limestone cobbles or flat-bedded limestone streambeds. New Mexico sites are reported to be bouldery or gravelly

Dynamics: *Juglans microcarpa* is shade-intolerant. Young individuals direct much of their energy into developing a large, deep taproot, which permits the walnut to survive the periods of extreme drought that are common.

DISTRIBUTION

Geographic Range: This alliance has been reported from the Edwards Plateau region of Texas.

CBR alliances

Nations: MX?, US

States/Provinces: TX

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- ? *Juglans microcarpa* Community Type (Szaró 1989)
- ? Little Walnut Series (Dick-Peddie 1993)

LOWER LEVEL UNITS

Associations:

- CEGLO02166 *Celtis laevigata* var. *reticulata* - *Juglans microcarpa* / *Leptochloa dubia* Riparian Woodland
- CEGLO04932 *Juglans microcarpa* - *Brickellia laciniata* / *Indigofera lindheimeriana* Edwards Plateau Riparian Scrub

AUTHORSHIP

Primary Concept Source: J. Teague, in Faber-Langendoen et al. (2013)

Author of Description: J. Teague and M. Pyne

Acknowledgments:

Version Date: 2014/12/19

REFERENCES

References: Diamond 1993, Dick-Peddie 1993, Faber-Langendoen et al. 2017b, Szaró 1989

1. Forest & Woodland

1.B.3.Nd. Western North American Interior Flooded Forest

G797. Western Interior Riparian Forest & Woodland

A3801. *Platanus wrightii* Riparian Forest Alliance

Type Concept Sentence: This alliance consists of riparian woodlands dominated by the broad-leaved, cold-deciduous tree *Platanus wrightii*. *Fraxinus velutina* and *Juglans major* are common associates in the upper canopy. It occurs along perennial or seasonally intermittent streams in Arizona, southwestern New Mexico and northern Mexico.

OVERVIEW

Scientific Name: *Platanus wrightii* Riparian Forest Alliance

Common Name (Translated Scientific Name): Arizona Sycamore Riparian Forest Alliance

Colloquial Name: Arizona Sycamore Riparian Forest

Type Concept: This alliance consists of riparian woodlands dominated by the broad-leaved cold-deciduous tree *Platanus wrightii*. *Fraxinus velutina* and *Juglans major* are common associates in the upper canopy. *Populus fremontii* can be an emergent tree but sites are not dominated by this species. Other trees present include *Celtis laevigata* var. *reticulata*, *Juglans major*, *Juniperus monosperma*, *Prosopis velutina*, *Quercus arizonica*, *Quercus emoryi*, *Robinia neomexicana*, and *Salix gooddingii*. The vine stratum is dominated by *Vitis arizonica*. The shrub layer is often present and contains several of the following: *Alnus oblongifolia*, *Amorpha fruticosa*, *Baccharis salicifolia*, *Rhus trilobata*, *Salix bonplandiana*, and *Toxicodendron radicans*. The herbaceous layer commonly includes *Aristida* spp., *Bouteloua curtipendula*, *Carex* spp., *Choisya dumosa* var. *arizonica* (= *Choisya arizonica*), *Datura inoxia* (= *Datura meteloides*), *Elymus elymoides*, *Eriogonum* spp., *Gutierrezia sarothrae*, *Marrubium vulgare*, *Muhlenbergia emersleyi*, *Muhlenbergia* spp., *Oenothera elata* ssp. *hookeri* (= *Oenothera hookeri*), and *Sporobolus cryptandrus*. This alliance is found in Arizona, southwestern New Mexico and northern Mexico. It occurs along perennial or seasonally intermittent streams, in narrow stream valleys, on gently sloping alluvial terraces. These vegetation types require reliable surface flow during the winter-spring months, they are periodically inundated during spring runoff and generally are found along small, perennial streams. The soils are depositional and silty loam in texture.

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:**VEGETATION**

Physiognomy and Structure: The tree canopy is dominated by a broad-leaved, cold-deciduous tree, from 3-15 m tall, with an understory of tree seedlings and shrubs from 0.5-3 m tall.

Floristics: Vegetation types within this alliance are characterized as temporarily flooded, cold-deciduous forests. *Platanus wrightii* dominates the tree stratum. *Fraxinus velutina* and *Juglans major* are common codominants. *Populus fremontii* often is an emergent tree from the canopy. The tree subcanopy species may include *Alnus oblongifolia*, *Celtis laevigata* var. *reticulata*, *Fraxinus pennsylvanica*, *Juglans major*, *Juniperus monosperma*, *Prosopis velutina*, *Quercus arizonica*, *Quercus emoryi*, *Robinia neomexicana*, *Salix bonplandiana*, and *Salix gooddingii*. The shrub layer is often present and contains any number of the following: *Alnus oblongifolia*, *Amorpha fruticosa*, *Baccharis salicifolia*, *Rhus trilobata*, *Salix bonplandiana*, and *Toxicodendron radicans*. The herbaceous layer is common (no percent cover data available) and can include *Aristida* spp., *Bouteloua curtipendula*, *Carex* spp., *Choisya dumosa* var. *arizonica* (= *Choisya arizonica*), *Datura innoxia* (= *Datura meteloides*), *Elymus elymoides*, *Eriogonum* spp., *Gutierrezia sarothrae*, *Marrubium vulgare*, *Muhlenbergia emersleyi*, *Muhlenbergia* spp., *Oenothera elata* ssp. *hookeri* (= *Oenothera hookeri*), and/or *Sporobolus cryptandrus*.

ENVIRONMENT & DYNAMICS

Environmental Description: This riparian forest and woodland alliance is located along perennial or seasonally intermittent streams in the American Southwest and adjacent Mexico. Stands occur in narrow stream valleys, on gently sloping alluvial terraces. Elevations range from 600-1800 m. These vegetation types require reliable surface flow during the winter-spring months. They are periodically inundated during spring runoff and generally are found along small, perennial streams. Soils are silty or sandy, shallow, with large cobbles. The surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface.

Dynamics: Occurrences require reliable surface flow during the winter-spring months. They are periodically inundated during spring runoff and generally are found along small, perennial streams. Anderson et al. (1985) state that this woodland type is very sensitive to even moderate levels of livestock grazing. Grazing can inhibit reproduction of the dominant tree species due to their high palatability.

DISTRIBUTION

Geographic Range: This alliance is common throughout lower elevations (<1800 m) in Arizona, New Mexico, and northern Mexico.

Nations: MX, US

States/Provinces: AZ, MXCH, MXSO, NM

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- >< Arizona Cypress: 240 (Eyre 1980)
- >< Forest Type: *Platanus wrightii* series (Bassett et al. 1987)
- >< Interior and Californian Riparian Deciduous Forests and Woodlands (Brown 1982a) [within Warm-Temperate Wetlands.]
- >< Temperate Riparian Deciduous Forest Biome: Mixed Broadleaf Series (Pase and Layser 1977)

LOWER LEVEL UNITS**Associations:**

- CEGLO00644 *Platanus wrightii* - *Fraxinus velutina* Riparian Forest
- CEGLO00645 *Platanus wrightii* - *Juglans major* Riparian Forest
- CEGLO00937 *Platanus wrightii* Riparian Woodland
- CEGLO02686 *Platanus wrightii* - *Alnus oblongifolia* / *Baccharis salicifolia* Riparian Forest
- CEGLO05338 *Platanus wrightii* / *Quercus oblongifolia* Riparian Woodland
- CEGLO02712 *Platanus wrightii* / *Sporobolus cryptandrus* Riparian Forest
- CEGLO05959 *Platanus wrightii* / *Brickellia californica* Riparian Forest
- CEGLO05960 *Platanus wrightii* / Sparse Riparian Forest
- CEGLO05991 *Platanus wrightii* / *Bouteloua curtipendula* Riparian Forest

- CEGLO02710 *Platanus wrightii* / *Muhlenbergia rigens* Riparian Forest

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Anderson et al. 1985, Bassett et al. 1987, Bourgeron et al. 1993b, Bourgeron et al. 1995a, Brown 1982a, Dick-Peddie 1993, Eyre 1980, Faber-Langendoen et al. 2017b, Hickman 1993, Kartesz 1994a, Kearney et al. 1969, Pase and Laysen 1977, Szaro 1989, Willis 1939

1. Forest & Woodland

1.B.3.Nd. Western North American Interior Flooded Forest

G797. Western Interior Riparian Forest & Woodland

A3798. *Populus deltoides* ssp. *wislizeni* - *Populus deltoides* ssp. *monilifera* - *Salix amygdaloides* Riparian Woodland Alliance

Type Concept Sentence: This alliance consists of woodlands dominated by *Populus deltoides* ssp. *wislizeni*, *Populus deltoides* ssp. *monilifera*, or *Salix amygdaloides*. Other tree species include *Acer negundo*. Stands are found on alluvial floodplains, terraces and streambanks of rivers and streams, and sometimes around lakes and ponds. These stands occur along rivers and streams of Wyoming, Colorado, New Mexico, and on to the Colorado Plateau of Utah.

OVERVIEW

Scientific Name: *Populus deltoides* ssp. *wislizeni* - *Populus deltoides* ssp. *monilifera* - *Salix amygdaloides* Riparian Woodland Alliance

Common Name (Translated Scientific Name): Rio Grande Cottonwood - Plains Cottonwood - Peachleaf Willow Riparian Woodland Alliance

Colloquial Name: Rio Grande Cottonwood - Plains Cottonwood - Peachleaf Willow Riparian Woodland

Type Concept: This alliance is dominated by *Populus deltoides* ssp. *wislizeni*, *Populus deltoides* ssp. *monilifera*, or *Salix amygdaloides*. Other tree species include *Acer negundo*. Shrub species present many include *Artemisia tridentata*, *Prunus virginiana*, *Rhus trilobata*, *Salix exigua*, and *Symphoricarpos occidentalis*. Typical herbaceous species include *Carex* spp., *Distichlis spicata*, *Elymus* spp., *Equisetum* spp., *Juncus* spp., and *Pascopyrum smithii*. Exotics found in this alliance are *Poa pratensis*, *Melilotus officinalis*, and *Bromus inermis*, among many others. Stands of this alliance are found on alluvial floodplains and terraces of rivers and streams, and sometimes around lakes and ponds. These communities tolerate and depend on periodic flooding and seasonal soil saturation in the spring and after heavy rains. The soils are silts, loams, and sands, and are derived from alluvial material. This alliance occurs near rivers and large streams of Montana, Wyoming, Colorado, Idaho, Arizona and New Mexico; from the western slope of Colorado it extends into mountain valleys and on to the Colorado Plateau of Utah.

Classification Comments:

Internal Comments: GK 9-16: ID added for Minidoka.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Riparian gallery forests and woodland dominated by *Populus deltoides* ssp. *wislizeni*, *Populus deltoides* ssp. *monilifera*, or *Salix amygdaloides*.

VEGETATION

Physiognomy and Structure: The tree layer is dominated by tall (20-35 m) single-stemmed, deciduous species. The canopy is open, generally forming 25-60% cover. The herbaceous layer is dominated by both graminoids and forbs with up to 20% cover.

Floristics: This alliance is dominated by *Populus deltoides* ssp. *wislizeni*, *Populus deltoides* ssp. *monilifera*, or *Salix amygdaloides*. Secondary canopy species include *Acer negundo* or (rarely) *Populus angustifolia*. A shrub layer may be present, including *Cornus sericea*, *Prunus virginiana*, *Salix exigua*, *Salix ligulifolia*, *Salix lucida*, *Salix lutea*, *Symphoricarpos occidentalis*, and others. Herbaceous layer may have *Carex pellita* (= *Carex lanuginosa*), *Carex* spp., *Cenchrus longispinus*, *Elymus* spp., *Equisetum* spp., *Glycyrrhiza lepidota*, *Juncus* spp., *Pascopyrum smithii*, *Phalaris arundinacea*, and *Poa palustris*. Common exotics found in this alliance are *Bromus inermis*, *Cirsium arvense*, *Melilotus officinalis* (= *Melilotus albus*), and *Poa pratensis*.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands of this alliance are found on level to gently sloping topography along rivers, streams, lakes, and ponds. The areas may have been very recently deposited by water action or they may have been deposited earlier and occupied by other communities. The water table fluctuates with the level of the adjacent water body. This can lead to periods of flooding and soil saturation in the spring and after heavy rains and also to periods of drought when the water level falls in the summer and fall. The soils are silts, loams, and sands, and are derived from alluvial material. Stands are located on immediate streambanks, or on distance river terraces, in backwater areas and overflow channels of large rivers, on narrow floodplains of small creeks, and on the edges of ponds and lakes. The water table is within 1 m of the soil surface during the growing season (Hansen et al. 1995), and the vegetation is tolerant of prolonged flooding.

Dynamics: Cottonwood forests grow within an alluvial environment that is continually changing due to the ebb and flow of the river. Riparian vegetation successional stage is "re-set" by flooding disturbance. Cottonwood communities are early-, mid- or late-seral, depending on the age class of the trees and the associated species of the stand. Mature cottonwood stands do not regenerate in place, but regenerate in different settings up and down a river reach. Over time, a healthy riparian area supports all stages of cottonwood communities. The process of cottonwood regeneration is well-documented. Periodic flooding events can leave sandbars of bare, mineral substrate. Cottonwood seedlings germinate and become established on newly-deposited, moist sandbars. In the absence of large floods in subsequent years, seedlings begin to trap sediment. In time, the sediment accumulates and the sandbar rises. The young forest community is then above the annual flood zone of the river channel. In addition, seasonal floods that leave fresh deposits of sediment are also areas available for colonization. This process often favors the establishment of aggressive native and exotic plants, as well as cottonwood seedlings.

Salix amygdaloides requires a moist, mineral substrate for seeds to germinate. Seeds can germinate under a sparse canopy of vegetation (Johnson 1992, cited in Jones and Walford 1995).

DISTRIBUTION

Geographic Range: This alliance occurs near rivers and large streams of Montana, Wyoming, Colorado, Idaho, Arizona and New Mexico; from the western slope of Colorado it extends into mountain valleys and on to the Colorado Plateau of Utah.

Nations: CA, US

States/Provinces: AZ, CO, ID, MT, NM, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Salix amygdaloides* Community Type (Hansen et al. 1995)
- >< Cottonwood: 63 (Eyre 1980)
- >< Eastern Broadleaf Forests: 98: Northern Floodplain Forest (*Populus-Salix-Ulmus*) (Küchler 1964)
- ? Peachleaf Willow Dominance Type (Jones and Walford 1995)

LOWER LEVEL UNITS

Associations:

- CEG000939 *Populus deltoides* (ssp. *wislizeni*, ssp. *monilifera*) / *Distichlis spicata* Riparian Woodland
- CEG002685 *Populus deltoides* (ssp. *wislizeni*, ssp. *monilifera*) / *Salix exigua* Riparian Woodland
- CEG000947 *Salix amygdaloides* Riparian Woodland
- CEG000948 *Salix amygdaloides* / *Salix exigua* Riparian Woodland
- CEG000940 *Populus deltoides* ssp. *wislizeni* / *Rhus trilobata* Riparian Woodland
- CEG002680 *Populus deltoides* (ssp. *wislizeni*, ssp. *monilifera*) / *Pascopyrum smithii* Riparian Woodland

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2016/09/29

REFERENCES

References: Bunin 1985, Christy 1973, Cooper 1988, Crouch 1961a, Crouch 1961b, Crouch 1978, Crouch 1979a, Crouch 1979b, Eyre 1980, Faber-Langendoen et al. 2017b, Fitzgerald 1978, Hansen et al. 1991, Hansen et al. 1995, Jackson 1972, Jackson and Lindauer

1978, Jones and Walford 1995, Keammerer 1974a, Keammerer 1974b, Kittel and Lederer 1993, Kittel et al. 1996, Kittel et al. 1997a, Kittel et al. 1999a, Knopf 1985, K uchler 1964, Lindauer 1970, Lindauer 1978, Lindauer and Christy 1972, Lindauer and Fitzgerald 1974, Lindauer and Ward 1968, Lindauer et al. 1973, Masek 1979, McEachern 1979, Moseley et al. 1992, Moulton et al. 1981, Thilenius and Smith 1985, Thilenius et al. 1995, USBOR 1976, Welsh et al. 1987

1. Forest & Woodland

1.B.3.Nd. Western North American Interior Flooded Forest

G797. Western Interior Riparian Forest & Woodland

A0644. *Populus fremontii* Great Basin Riparian Forest Alliance

Type Concept Sentence: This alliance contains riparian woodlands dominated by *Populus fremontii*. It occurs along stream channels on alluvial fans, in lower canyons in desert mountains, and valleys with dependable subsurface groundwater that varies considerably during the year. In the southwestern U.S., it occurs in western New Mexico, throughout Arizona, lower elevations of Utah, southern and central Nevada and just into the eastern desert of California.

OVERVIEW

Scientific Name: *Populus fremontii* Great Basin Riparian Forest Alliance

Common Name (Translated Scientific Name): Fremont Cottonwood Great Basin Riparian Forest Alliance

Colloquial Name: Great Basin Fremont Cottonwood Riparian Forest

Type Concept: This alliance contains riparian woodlands dominated by *Populus fremontii*. Individuals of *Populus fremontii* are scattered or occur in groves and may reach 30 m in height and 2 m in diameter. Other species that may occur in the canopy/subcanopy include *Baccharis salicifolia*, *Celtis laevigata* var. *reticulata*, *Fraxinus berlandieriana*, *Fraxinus velutina*, *Juglans microcarpa*, *Populus deltoides* ssp. *wislizeni*, *Prosopis glandulosa*, *Prosopis pubescens*, *Prosopis velutina*, *Salix amygdaloides*, *Salix exigua*, *Salix gooddingii*, and *Salix lasiolepis*. The understory of most examples has been considerably altered by grazing and other factors, thus the composition and cover of the native understory are difficult to ascertain, but frequently consists of shrubs and small trees (1-5 m tall). The herbaceous stratum varies in composition and coverage but is characterized by mixed annuals and short-lived perennials. Some areas have high amounts of *Tamarix* spp. and other exotic invasive trees. This woodland alliance occurs as small isolated stands or as linear bands that parallel stream channels on alluvial fans, in lower canyons in desert mountains, and valleys with dependable subsurface groundwater that varies considerably during the year. In the southwestern U.S., it occurs in western New Mexico, throughout Arizona, lower elevations of Utah, southern and central Nevada and just into the eastern desert of California.

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: *Populus fremontii* has >30% relative cover.

VEGETATION

Physiognomy and Structure: The tree stratum is dominated by a tall (10-25 to 30 m) broad-leaved deciduous tree. The canopy is open to dense (25-60%) depending on the stand. The tree subcanopy is dominated by multi-stemmed, broad-leaved shrubs. The herbaceous layer is sparse and often dominated by introduced hay grasses.

Floristics: The canopy is dominated by open stands of *Populus fremontii* generally forming 30-70% cover; individuals may be scattered or occur in groves. This species may reach 30 m in height and 2 m in diameter. Other woody species that may occur in the canopy/subcanopy include *Baccharis salicifolia*, *Celtis laevigata* var. *reticulata*, *Fraxinus berlandieriana*, *Fraxinus velutina*, *Juglans microcarpa*, *Populus deltoides* ssp. *wislizeni*, *Prosopis glandulosa*, *Prosopis pubescens*, *Prosopis velutina*, *Salix amygdaloides*, *Salix exigua*, *Salix gooddingii*, and *Salix lasiolepis*. The understories of most examples have been considerably altered by grazing and other factors, thus the composition and cover of the native understory is difficult to ascertain, but frequently consists of shrubs and small trees (1-5 m tall) of the above species. The herbaceous stratum varies in composition and coverage, but is characterized by mixed annuals and short-lived perennials.

ENVIRONMENT & DYNAMICS

Environmental Description: This riparian alliance is found in floodplains and on lower alluvial terraces along the perennial streams that occur in the southern deserts. Elevations range from 335-2500 m. Stands are restricted to the floodplains and corridors of perennial streams by the arid upland environment. This vegetation type is dependent on a subsurface water supply and varies

considerably with the water table levels. Major flood events and consequent flood scour, overbank deposition of water and sediments, and stream meandering are important factors that shape these woodlands. These woodlands occur as small isolated stands or as linear bands that parallel stream channels. Sites are flat to gently sloping and occur in lower canyons in desert mountains, alluvial fans and valleys. Substrates are generally well-drained, coarse-textured soils derived from stratified alluvium composed of sand, loam, gravel and cobbles. The soils may be slightly alkaline and saline. Climate is arid to semi-arid with hot summers and typically mild winters, but with freezing temperatures not uncommon in northern stands. Mean annual precipitation ranges from 15-28 cm, but can vary greatly from year to year. Drought is not uncommon.

Dynamics: This alliance is dependent on a subsurface water supply and varies considerably with the water table levels. Major flood events and consequent flood scour, overbank deposition of water and sediments, and stream meandering are important factors that shape these woodlands.

DISTRIBUTION

Geographic Range: This alliance is found in southeastern California, southern and central Nevada, Utah, Arizona and New Mexico.

Nations: US

States/Provinces: AZ, CA, NM, NV, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- >< *Populus fremontii* (Fremont cottonwood forest) Alliance (Sawyer et al. 2009) [61.130.00]
- ? *Populus fremontii* Alliance (Fremont cottonwood forest) (Buck-Diaz et al. 2012)
- ? Broadleaf Cottonwood-Mixed Deciduous Series (Dick-Peddie 1993) [included in the Montane Riparian Vegetation Type.]
- >< Central Coast Cottonwood-Sycamore Riparian Forest (#61210) (Holland 1986b)
- >< Cottonwood - Willow: 235 (Eyre 1980)
- ? Cottonwood Series (Dick-Peddie 1993) [included in the Floodplain Riparian Vegetation Type.]
- ? Cottonwood-Willow Series (Dick-Peddie 1993) [included in the Floodplain Riparian Vegetation Type.]
- ? Cottonwood-Willow Series (224.53) (Brown 1982a) [included within Sonoran Riparian and Oasis Forests]
- >< Fremont Cottonwood series (Sawyer and Keeler-Wolf 1995)
- >< Great Valley Cottonwood Riparian Forest (#61410) (Holland 1986b)
- >< Great Valley Mixed Riparian Forest (#61420) (Holland 1986b)
- >< IIA7d. Western Cottonwood - Willow Riverfront Forest (Allard 1990)
- >< Modoc-Great Basin Cottonwood-Willow Riparian Forest (#61610) (Holland 1986b)
- >< Mojave Riparian Forest (#61700) (Holland 1986b)
- >< Sonoran Cottonwood-Willow Riparian Forest (#61810) (Holland 1986b)
- >< Southern Cottonwood-Willow Riparian Forest (#61330) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEGLO00943 *Populus fremontii* / *Salix geyeriana* Riparian Woodland
- CEGLO00666 *Populus fremontii* / *Salix exigua* Riparian Forest
- CEGLO02756 *Populus fremontii* / *Leymus triticoides* Riparian Woodland
- CEGLO02981 *Populus fremontii* / *Betula occidentalis* Wooded Shrubland
- CEGLO02473 *Populus fremontii* / Mesic Graminoids Riparian Woodland
- CEGLO05365 *Populus fremontii* / *Artemisia tridentata* Riparian Woodland
- CEGLO02465 *Populus fremontii* / *Ericameria nauseosa* Riparian Woodland
- CEGLO03998 *Populus fremontii* / *Distichlis spicata* Riparian Woodland
- CEGLO04003 *Populus fremontii* / *Sporobolus airoides* Riparian Woodland
- CEGLO04002 *Populus fremontii* / *Salix (ligulifolia, lutea)* Riparian Woodland
- CEGLO03775 *Populus fremontii* / *Equisetum* spp. Riparian Woodland
- CEGLO02470 *Populus fremontii* / Mesic Forbs Riparian Woodland

AUTHORSHIP

Primary Concept Source: K.D. Patterson, D. Culver, G. Kittel, J. Evens, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:**Version Date:** 2014/09/26**REFERENCES**

References: Allard 1990, Barbour and Major 1977, Boles and Dick-Peddie 1983, Brown 1982a, Buck-Diaz et al. 2012, Campbell and Dick-Peddie 1964, Diamond et al. 1992, Dick-Peddie 1993, Evens and San 2006, Eyre 1980, Faber-Langendoen et al. 2017b, Holland 1986b, Klein and Evens 2006, Metcalfe 1902, Muldavin 1987, Muldavin et al. 2000a, NHNM unpubl. data, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Sproul et al. 2011, Stromberg 1993a, Stromberg 1995b, Szaro 1989, Von Loh et al. 2002, Webb and Brotherson 1988

1. Forest & Woodland

1.B.3.Nd. Western North American Interior Flooded Forest

G797. Western Interior Riparian Forest & Woodland

A3752. *Salix gooddingii* - *Salix laevigata* Riparian Forest Alliance

Type Concept Sentence: This alliance consists of riparian woodlands dominated by *Salix gooddingii* and/or *Salix laevigata*, either as single-species stands or as mixed stands. Stands are generally without *Populus fremontii*. It occurs in California.

OVERVIEW**Scientific Name:** *Salix gooddingii* - *Salix laevigata* Riparian Forest Alliance**Common Name (Translated Scientific Name):** Goodding's Willow - Red Willow Riparian Forest Alliance**Colloquial Name:** Goodding's Willow - Red Willow Riparian Forest

Type Concept: This alliance consists of riparian woodlands and forests dominated by *Salix gooddingii* and/or *Salix laevigata*, either as single-species stands or as mixed stands. Stands may or may not include *Populus fremontii*, and if they do, it is a minor component relative to dominant overstory canopy species. Other tree species present include *Acer macrophyllum*, *Alnus rhombifolia*, *Alnus rubra*, *Celtis laevigata* var. *reticulata*, *Fraxinus velutina*, *Juglans microcarpa*, *Platanus racemosa*, *Populus balsamifera*, *Prosopis glandulosa*, *Quercus pungens*, *Salix hookeriana*, *Salix sitchensis*, *Sapindus saponaria* var. *drummondii*, and/or *Ungnadia speciosa*. These stands occur throughout California riparian areas with deep alluvial soils generally restricted to less than 2000 m in elevation.

Classification Comments: For those stands without cottonwood.**Internal Comments:** mjr 3-16: WY added based on false attribute to CEGLO00950; WY removed. MSR 1-16: add NM, UT, WY.**Other Comments:****Similar NVC Types:**

Diagnostic Characteristics: One of the three nominals has 30% relative cover or combined have >30% relative cover and *Populus fremontii* is not present or, if present, then has <5% cover.

VEGETATION

Physiognomy and Structure: This seasonally flooded/saturated broad-leaved cold-deciduous forest forms a continuous tree canopy less than 15 m in height. Shrubs are sparse below the tree canopy, and the herbaceous layer is variable.

Floristics: These riparian woodland and forest stands are dominated by *Salix gooddingii* and/or *Salix laevigata*, either as single-species stands or as mixed stands. They generally are without *Populus fremontii*, but when present, it is not abundant. Other tree species present include *Acer macrophyllum*, *Alnus rhombifolia*, *Alnus rubra*, *Celtis laevigata* var. *reticulata*, *Fraxinus velutina*, *Juglans microcarpa*, *Platanus racemosa*, *Populus balsamifera*, *Populus fremontii*, *Prosopis glandulosa*, *Quercus pungens*, *Salix hookeriana*, *Salix sitchensis*, *Sapindus saponaria* var. *drummondii*, and/or *Ungnadia speciosa*. Shrubs may include *Baccharis emoryi*, *Baccharis salicifolia*, *Cornus sericea*, *Rhus trilobata*, *Salix exigua*, and/or *Sambucus nigra* ssp. *caerulea* (= *Sambucus mexicana*), as well as other riparian shrubs. The herbaceous layer is highly variable depending on season, length of time since last inundation, and degree of disturbance.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance occurs on floodplains, streamsides, ditches, lake edges, and low-gradient deposits along rivers, that are seasonally flooded or seasonally have saturated soils. Stands occur from sea level to 2700 m elevation. Because of the climate throughout the range of this alliance, flooding can occur throughout the winter and spring. Annual rainfall totals are between 60 and 80 cm.

Dynamics: This alliance requires seasonal inundation or seasonal saturation. Stands occur on low-gradient streamside depositions and in floodplains which receive low-intensity flooding at least every few years.

DISTRIBUTION

Geographic Range: This alliance ranges from California to New Mexico.

Nations: US

States/Provinces: CA, NM, UT

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007): 322Ad:CCC, 341Fe:CCC

Omernik Ecoregions:

Federal Lands [optional]: BLM (Carrizo Plain); NPS (Death Valley, Joshua Tree)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- >< *Salix gooddingii* (Black willow thickets) Alliance (Sawyer et al. 2009) [61.211.00]
- > *Salix gooddingii* Alliance (Black willow thickets) (Buck-Diaz et al. 2012)
- ? *Salix gooddingii* Community Type (Szaro 1989)
- > *Salix gooddingii* Woodland Alliance (Evens et al. 2012)
- > *Salix laevigata* (Red willow thickets) Alliance (Sawyer et al. 2009) [61.205.00]
- > *Salix laevigata* Temporarily Flooded Woodland Alliance (Keeler-Wolf et al. 2012)
- > *Salix laevigata* Alliance (Red willow thickets) (Buck-Diaz et al. 2012)
- > *Salix laevigata* Woodland Alliance (Evens et al. 2014)
- > *Salix lucida* Alliance (Shining willow groves) (Buck-Diaz et al. 2012)
- >< Central Coast Riparian Scrub (#63200) (Holland 1986b)
- >< Great Valley Mixed Riparian Forest (#61420) (Holland 1986b)
- >< Red Alder Riparian Forest (#61130) (Holland 1986b)

LOWER LEVEL UNITS**Associations:**

- CEGLO02874 *Salix laevigata* - *Salix lasiolepis* / *Baccharis salicifolia* Riparian Woodland
- CEGLO00950 *Salix laevigata* - *Fraxinus velutina* Riparian Woodland
- CEGLO05316 *Salix laevigata* / *Artemisia douglasiana* - *Rubus ursinus* Riparian Woodland
- CEGLO03778 *Salix gooddingii* / *Salix exigua* Riparian Woodland
- CEGLO02952 *Salix laevigata* Riparian Woodland

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2016/01/17

REFERENCES

References: Buck-Diaz et al. 2012, Evens et al. 2012, Evens et al. 2014, Faber-Langendoen et al. 2017b, Holland 1986b, Keeler-Wolf et al. 2012, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Sproul et al. 2011, Stout et al. 2013, Szaro 1989, VegCAMP and AIS 2013

M298. Interior West Ruderal Flooded & Swamp Forest & Woodland

This macrogroup consists of low-elevation riparian and lacustrine areas throughout the southwestern U.S. and into Mexico that are dominated by non-native invasive woody species such as *Tamarix* spp., *Elaeagnus angustifolia*, or *Phoenix dactylifera*.

1. Forest & Woodland

1.B.3.Nd. Western North American Interior Flooded Forest

1.B.3.Nd.90.a. M298 Interior West Ruderal Flooded & Swamp Forest & Woodland

G510. Interior West Ruderal Riparian Forest & Scrub

Type Concept Sentence: Stands of *Tamarix* spp., *Elaeagnus angustifolia*, or other introduced facultative wet-tolerant species in low-elevation riparian areas throughout the western U.S. and into Mexico.

OVERVIEW

Scientific Name: *Tamarix* spp. - *Elaeagnus angustifolia* Ruderal Riparian Forest & Scrub Group

Common Name (Translated Scientific Name): Tamarisk species - Russian-olive Ruderal Riparian Forest & Scrub Group

Colloquial Name: Ruderal Box-elder Riparian Forest

Type Concept: This group consists of low-elevation riparian areas, seeps and springs throughout the southwestern U.S. and into Mexico that are dominated by non-native invasive woody species. Present to abundant species include *Elaeagnus angustifolia*, *Myoporum laetum*, *Phoenix canariensis*, *Prunus mahaleb*, *Robinia pseudoacacia*, *Schinus molle*, *Schinus terebinthifolius*, *Tamarix* spp., *Ulmus pumila*, or *Washingtonia robusta*. Salt-cedar habitats tend to support fewer species and individuals than native habitats. If present, native species contribute less than 10% relative cover. Elevation ranges from sea level to above 2135 m (7000 feet). Sites are typically streambanks and benches, floodplains and canyons with permanent, intermittent or temporary waterflow.

Classification Comments: The name is "scrub" rather than forest or woodland to capture lower heights and more open canopy densities and the fact that some dominant species are multi-stemmed and may not meet "forest" or "woodland" criteria. Planted stands of *Washingtonia robusta*, *Washingtonia filifera*, and *Phoenix canariensis* are not part of this group but would be considered "cultural" vegetation. *Washingtonia robusta* is native to Mexico, so only naturalized stands within the U.S. belong to this group.

Similar NVC Types:

- G797 Western Interior Riparian Forest & Woodland

Diagnostic Characteristics: Tall, deciduous trees dominated by naturalized, invasive species not considered native to North America or, if native to North America, naturalized beyond their native ranges.

VEGETATION

Physiognomy and Structure: Open- to closed-canopy riparian woodlands that can have a scrubby appearance (multi-stemmed, 1-20 m tall) dominated by non-native woody species, generally following linear paths of adjacent streams, rivers and floodplains.

Floristics: Present to abundant species include *Elaeagnus angustifolia*, *Myoporum laetum*, *Phoenix canariensis*, *Prunus mahaleb*, *Robinia pseudoacacia*, *Schinus molle*, *Schinus terebinthifolius*, *Tamarix* spp., *Ulmus pumila*, or *Washingtonia robusta*. Some of these are not necessarily restricted to riparian/wetland settings. Salt-cedar habitats tend to support fewer species and individuals than native habitats (Smith and Douglas 1989, Barbour et al. 2007, Sogge et al. 2008, Sawyer et al. 2009). Non-native understory species may include *Acroptilon repens*, *Aegilops* sp., *Agrostis gigantea*, *Agrostis stolonifera*, *Alopecurus geniculatus*, *Alopecurus pratensis*, *Arundo donax*, *Conyza canadensis*, *Cirsium arvense*, *Echinochloa crus-galli*, *Eichhornia crassipes*, *Hordeum murinum*, *Phalaris arundinacea*, *Phleum pratense*, *Phragmites australis*, *Poa palustris*, *Poa pratensis*, *Rumex crispus*, and *Sonchus arvensis*.

ENVIRONMENT & DYNAMICS

Environmental Description: Elevation ranges from sea level to above 2135 m (7000 feet). *Climate:* Warm Temperate. *Soil/substrate/hydrology:* Sites are typically alluvial streambanks and floodplains, with slightly alkaline soils and water heavy in agricultural runoff (Smith and Douglas 1989, Barbour et al. 2007, Sogge et al. 2008, Sawyer et al. 2009).

Dynamics:

DISTRIBUTION

Geographic Range: This group is found throughout the western interior of the U.S. and into Mexico.

Spatial Scale & Pattern [optional]: Large patch, Linear

Nations: MX, US

States/Provinces: AZ, CA, ID, NM, NV, OK, TX

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Alliances:

- A4160 *Rubus armeniacus* - *Sesbania punicea* - *Ficus carica* Ruderal Riparian Scrub Alliance
- A4155 *Acer negundo* - *Populus* spp. - *Picea* spp. Ruderal Riparian Forest Alliance
- A4161 *Phoenix dactylifera* - *Washingtonia filifera* Ruderal Riparian Woodland Alliance

CBR alliances

- A4218 *Prosopis* spp. Lowland Ruderal Understory Wet Scrub Alliance
- A3566 *Elaeagnus angustifolia* Ruderal Riparian Scrub Alliance
- A0842 *Tamarix* spp. Ruderal Riparian Scrub Alliance
- A4192 *Salix alba* - *Salix fragilis* Ruderal Riparian Forest Alliance

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2011)

Author of Description: G. Kittel

Acknowledgments:

REFERENCES

1. Forest & Woodland

1.B.3.Nd. Western North American Interior Flooded Forest

G510. Interior West Ruderal Riparian Forest & Scrub

A4155. *Acer negundo* - *Populus* spp. - *Picea* spp. Ruderal Riparian Forest Alliance [Low - Poorly Documented]

Type Concept Sentence:

OVERVIEW

Scientific Name: *Acer negundo* - *Populus* spp. - *Picea* spp. Ruderal Riparian Forest Alliance

Common Name (Translated Scientific Name): Box-elder - Cottonwood species - Spruce species Ruderal Riparian Forest Alliance

Colloquial Name: Ruderal Box-elder Riparian Forest

Type Concept:

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure:

Floristics:

ENVIRONMENT & DYNAMICS

Environmental Description:

Dynamics:

DISTRIBUTION

Geographic Range:

Nations: US

States/Provinces: AZ, CO, ID, NM, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEG005485 *Populus fremontii* / *Tamarix* sp. Ruderal Riparian Woodland

- C EGL002693 *Acer negundo* / Disturbed Understory Riparian Woodland
- C EGL003749 *Populus angustifolia* / Invasive Perennial Grasses Ruderal Riparian Woodland
- C EGL005958 *Picea pungens* / *Poa pratensis* Ruderal Riparian Woodland
- C EGL003810 *Populus deltoides* ssp. *wislizeni* / Disturbed Understory Ruderal Flooded Woodland
- C EGL005961 *Populus angustifolia* - *Acer negundo* / *Poa pratensis* Ruderal Riparian Woodland

AUTHORSHIP

Primary Concept Source: G. Kittel

Author of Description:

Acknowledgments:

REFERENCES

1. Forest & Woodland

1.B.3.Nd. Western North American Interior Flooded Forest

G510. Interior West Ruderal Riparian Forest & Scrub

A3566. *Elaeagnus angustifolia* Ruderal Riparian Scrub Alliance [Low - Poorly Documented]

Type Concept Sentence: This alliance is dominated by the introduced tree species *Elaeagnus angustifolia* with a variety of native and introduced species in the shrub and herbaceous layers. It is a widespread woodland alliance found throughout much of the southwestern United States. It is a naturalized species whose seeds are spread by birds. Stands tend to be small and linear and occur in a variety of native habitats, particularly more mesic ones, such as near streams and rivers, upland basins and drainages.

OVERVIEW

Scientific Name: *Elaeagnus angustifolia* Ruderal Riparian Scrub Alliance

Common Name (Translated Scientific Name): Russian-olive Ruderal Riparian Scrub Alliance

Colloquial Name: Ruderal Russian-olive Riparian Scrub

Type Concept: This wooded alliance is dominated by the introduced tree species *Elaeagnus angustifolia* with a variety of native and introduced species in the shrub and herbaceous layers. Additional associated species have not been documented. The alliance is widespread and found throughout much of the southwestern United States. It is a naturalized species that has been widely planted in hedgerows for windbreaks. It has since spread (by birds distributing their seeds) to a variety of native habitats, particularly more mesic ones, such as near streams and rivers. Stands tend to be small and linear.

Classification Comments: Often a co-inhabitant with tamarisk but forms woodlands and stands in slightly less wet and less frequently flooded areas than tamarisk.

Internal Comments: GK 9-16: ID added for Minidoka.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Woodlands dominated by *Elaeagnus angustifolia*.

VEGETATION

Physiognomy and Structure:

Floristics: The vegetation in this ruderal alliance is characterized by the dominance of the introduced tree species *Elaeagnus angustifolia* with a variety of native and introduced species in the shrub and herbaceous layers. Native species present include (with less than 10% cover) *Amorpha fruticosa*, *Atriplex patula*, *Distichlis spicata*, *Hordeum jubatum*, *Pascopyrum smithii*, *Populus fremontii*, *Salix exigua*, and *Sporobolus airoides*. Introduced species that may also be present include *Bassia scoparia* (= *Kochia scoparia*), *Descurainia sophia*, *Lepidium latifolium*, *Tamarix ramosissima*, and many others.

ENVIRONMENT & DYNAMICS

Environmental Description: *Elaeagnus angustifolia* has since spread to a variety of native habitats, particularly more mesic ones, such as near streams and rivers. Habitats include shorelines of lakes, streambanks and floodplains of rivers, subirrigated upland basins and drainages.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is found throughout disturbed mesic areas of the southwestern U.S.

Nations: US

States/Provinces: AZ, CO, ID, ND, SD, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEG005269 *Elaeagnus angustifolia* Ruderal Riparian Woodland

AUTHORSHIP

Primary Concept Source: D. Faber-Langendoen and K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Faber-Langendoen et al. 2017b

1. Forest & Woodland

1.B.3.Nd. Western North American Interior Flooded Forest

G510. Interior West Ruderal Riparian Forest & Scrub

A4218. *Prosopis* spp. Lowland Ruderal Understory Wet Scrub Alliance [Low - Poorly Documented]

Type Concept Sentence:

OVERVIEW

Scientific Name: *Prosopis* spp. Lowland Ruderal Understory Wet Scrub Alliance

Common Name (Translated Scientific Name): Mesquite species Lowland Ruderal Understory Wet Scrub Alliance

Colloquial Name: Ruderal Lowland Mesquite Wet Scrub

Type Concept:

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure:

Floristics:

ENVIRONMENT & DYNAMICS

Environmental Description:

Dynamics:

DISTRIBUTION

Geographic Range:

Nations: MX?, US

CBR alliances

States/Provinces: AZ, MXSO?

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

LOWER LEVEL UNITS

Associations:

AUTHORSHIP

Primary Concept Source: M. Reid, in Faber-Langendoen et al.

Author of Description:

Acknowledgments:

REFERENCES

1. Forest & Woodland

1.B.3.Nd. Western North American Interior Flooded Forest

G510. Interior West Ruderal Riparian Forest & Scrub

A4160. Rubus armeniacus - Sesbania punicea - Ficus carica Ruderal Riparian Scrub Alliance

Type Concept Sentence: This ruderal shrubland alliance forms an open to continuous shrub layer with *Ficus carica* dominant and characteristic. *Nerium oleander* is sometimes present as an associated non-native. The alliance was sampled at only two mountain springs in the Death Valley region of California.

OVERVIEW

Scientific Name: *Rubus armeniacus* - *Sesbania punicea* - *Ficus carica* Ruderal Riparian Scrub Alliance

Common Name (Translated Scientific Name): Himalayan Blackberry - Rattlebox - Edible Fig Ruderal Riparian Scrub Alliance

Colloquial Name: Californian Ruderal Riparian Scrub

Type Concept: This ruderal shrubland alliance forms an open to continuous shrub layer. *Ficus carica* is the dominant and characteristic shrub. *Nerium oleander* is sometimes present as an associated non-native, and other shrubs may include *Ambrosia dumosa*, *Atriplex canescens*, *Ericameria cuneata*, and *Larrea tridentata*. Adjacent woody riparian stands include those dominated by *Baccharis sergilooides*, *Pluchea sericea*, *Populus fremontii*, *Prosopis glandulosa*, and *Salix laevigata*, as well as culturally planted stands of *Fraxinus velutina*, *Nerium oleander*, and *Tamarix aphylla*. The alliance was sampled at only two mountain springs in the Death Valley region of California, and patches are small in size (<0.1 ha). Elevations range from approximately 728 to 1401 m. This alliance requires more data to adequately describe, and its small stands are likely an artifact of cultural plantings with escaped individuals.

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: This alliance is characterized by an open to continuous shrub layer with *Ficus carica* strongly dominant. *Nerium oleander* is sometimes present as an associated non-native.

VEGETATION

Physiognomy and Structure:

Floristics: The alliance forms a continuous shrub layer and the overall shrub cover ranges from 60 to 100%. The tree layer is sparse or absent. *Ficus carica* is the dominant and characteristic shrub. *Nerium oleander* is sometimes present as an associated non-native, and other shrubs may include *Ambrosia dumosa*, *Atriplex canescens*, *Ericameria cuneata*, and *Larrea tridentata*. Adjacent woody riparian stands include those dominated by *Baccharis sergilooides*, *Pluchea sericea*, *Populus fremontii*, *Prosopis glandulosa*, and *Salix laevigata*, as well as culturally planted stands of *Fraxinus velutina*, *Nerium oleander*, and *Tamarix aphylla*.

ENVIRONMENT & DYNAMICS

Environmental Description: The alliance is found in localized mountain springs in Death Valley. The elevations range from mid to high (approximately 728-1401 m).

Dynamics: *Ficus carica* is not common in the region, and the fig's presence is apparently from cultural plantings and naturally escaping at a very small degree.

DISTRIBUTION

Geographic Range: The alliance is scattered in Death Valley National Monument in mid to upper elevation mountain springs. Samples were taken from two springs at Mint Spring and Warm Spring, and patches are small in size (<0.1 hectare).

Nations: US

States/Provinces: CA

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007): 322Af:CCC, 341Ff:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Ficus carica* Semi-Natural Shrubland Alliance (Evens et al. 2014)

LOWER LEVEL UNITS

Associations:

- CEPP006709 *Ficus carica* Ruderal Riparian Scrub

AUTHORSHIP

Primary Concept Source: J.M. Evens, K. Sikes, D. Hastings, and J. Ratchford (2014)

Author of Description: J. Evens

Acknowledgments:

Version Date: 2015/01/23

REFERENCES

References: Evens et al. 2014, Faber-Langendoen et al. 2017b

1. Forest & Woodland

1.B.3.Nd. Western North American Interior Flooded Forest

G510. Interior West Ruderal Riparian Forest & Scrub

A4192. *Salix alba* - *Salix fragilis* Ruderal Riparian Forest Alliance [Low - Poorly Documented]

Type Concept Sentence: Naturalized stands of *Salix fragilis* and/or *Salix alba* occurring along riverbanks and lakeside margins and found throughout the western U.S. and probably in the western Great Plains.

OVERVIEW

Scientific Name: *Salix alba* - *Salix fragilis* Ruderal Riparian Forest Alliance

Common Name (Translated Scientific Name): White Willow - Crack Willow Ruderal Riparian Forest Alliance

Colloquial Name: Ruderal White Willow - Crack Willow Riparian Forest

Type Concept: *Salix fragilis* and *Salix alba* are large tree willows that were introduced to the United States as ornamental and/or shade trees. These have naturalized along streams and rivers throughout the western U.S. and probably in the western Great Plains. They can reproduce vegetatively and will spread slowly, and usually not far from their source planting. They appear both as individual trees and in large stands. Ecologically they compete with the native tree willows, such as *Salix amygdaloides*, *Salix nigra*, and *Salix gooddingii*, as well as native cottonwoods. Native shrubs such as *Salix exigua*, and *Toxicodendron rydbergii* may be present. Understory species include native sedges, grasses and forbs such as *Beckmannia syzigachne*, *Carex aquatilis*, *Carex utriculata*, *Carex nebrascensis*, *Carex hystericina*, *Calamagrostis* spp., *Galium* spp., *Maianthemum stellatum*, *Mentha arvensis*, and *Urtica dioica*, and others. Non-native herbaceous species can also be abundant, such as *Arctium minus*, *Cynoglossum officinale*, *Bromus tectorum*, *Bromus inermis*, *Poa pratensis*, *Phleum pratense*, *Cirsium arvense*, *Melilotus officinalis*, *Dactylis glomerata*, *Conium maculatum*, and others. Stands are found in disturbed places, generally near settlements, that are wet naturally or irrigated, such as riparian areas, golf courses, city parks, floodplains, streambanks, ditches and lake margins below 2286 m (7500 feet) in elevation.

Classification Comments: Hybrids between *Salix fragilis* and *Salix alba* exist, and can be difficult to identify. Also, they are known to hybridize with native willows, such as *Salix nigra* and *Salix amygdaloides*.

Internal Comments: GK 9-16: AZ, CA, CO, MT, NM, NV, OR, UT, WA, WY added.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure:

Floristics: *Salix fragilis* and *Salix alba* are large tree willows that were introduced to the United States as ornamental and/or shade trees. These have naturalized along streams and rivers throughout the western U.S. and probably in the western Great Plains. They can reproduce vegetatively and will spread slowly, and usually not far from their source planting. They appear both as individual trees and in large stands. Ecologically it competes with the native tree willows, such as *Salix amygdaloides*, *Salix nigra*, and *Salix gooddingii*, as well as native cottonwoods. Native shrubs such as *Salix exigua*, and *Toxicodendron rydbergii* may be present. Understory species include native sedges, grasses and forbs such as *Beckmannia syzigachne*, *Carex aquatilis*, *Carex utriculata*, *Carex nebrascensis*, *Carex hystericina*, *Calamagrostis* spp., *Galium* spp., *Maianthemum stellatum*, *Mentha arvensis*, and *Urtica dioica*, and others. Non-native herbaceous species can also be abundant, such as *Arctium minus*, *Cynoglossum officinale*, *Bromus tectorum*, *Bromus inermis*, *Poa pratensis*, *Phleum pratense*, *Cirsium arvense*, *Melilotus officinalis*, *Dactylis glomerata*, *Conium maculatum*, and others.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands are found in disturbed places, generally near settlements, that are wet naturally or irrigated, such as riparian areas, golf courses, city parks, floodplains, streambanks, ditches and lake margins below 2286 m (7500 feet) in elevation.

Dynamics: *Salix fragilis* is called crack willow because it is highly susceptible to wind, ice and snow damage. It has escaped cultivation and can form pure stands. Willows can spread easily from detached twigs floating downstream.

DISTRIBUTION

Geographic Range: This alliance is known from throughout the western U.S. and probably also occurs in the western Great Plains.

Nations: US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEGL005622 *Salix (fragilis, alba)* Ruderal Riparian Woodland

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2015)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2016/09/28

REFERENCES

References: Czarapata 2005, Faber-Langendoen et al. 2017b, Hickman 1993

A0842. Tamarix spp. Ruderal Riparian Scrub Alliance [Low - Poorly Documented]

Type Concept Sentence: This alliance is composed of shrublands dominated by introduced species of *Tamarix*, including *Tamarix chinensis*, *Tamarix gallica*, *Tamarix parviflora*, and *Tamarix ramosissima*. It forms moderately dense to dense thickets on banks of larger streams, rivers and playas across the southwestern U.S. and northern Mexico.

OVERVIEW

Scientific Name: *Tamarix* spp. Ruderal Riparian Scrub Alliance

Common Name (Translated Scientific Name): Tamarisk species Ruderal Riparian Scrub Alliance

Colloquial Name: Ruderal Tamarisk Riparian Scrub

Type Concept: This alliance is composed of shrublands dominated by introduced species of *Tamarix*, including *Tamarix chinensis*, *Tamarix gallica*, *Tamarix parviflora*, and *Tamarix ramosissima*. It forms moderately dense to dense thickets on banks of larger streams, rivers and playas across the southwestern U.S. and northern Mexico. Introduced from the Mediterranean, *Tamarix* spp. have become naturalized in various sites, including salt flats, springs, and especially along streams and regulated rivers, often replacing *Salix* or *Prosopis* spp. shrublands or other native vegetation. A remnant herbaceous layer may be present, depending on the age and density of the shrub layer. These species have become a critical nuisance along most large rivers in the semi-arid western U.S.

Classification Comments: Stands also occur in Oklahoma, and this alliance includes them as well.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Riparian woodlands and washes dominated by *Tamarix* spp.

VEGETATION

Physiognomy and Structure:

Floristics: This alliance consists of shrublands with moderate to dense cover of a tall-shrub layer that is solely or strongly dominated by *Tamarix*, including (commonly) *Tamarix chinensis*, *Tamarix gallica*, *Tamarix parviflora*, and *Tamarix ramosissima*. Other introduced species of *Tamarix* have been documented in the U.S., but whether these form full stands is yet to be documented. Additional *Tamarix* species include *Tamarix africana*, *Tamarix aphylla*, *Tamarix aralensis*, *Tamarix canariensis*, and *Tamarix tetragyna* (Kartesz 1999). Other native shrubs may be present and include species of *Salix* (especially *Salix exigua*) and *Prosopis*, *Rhus trilobata*, and *Sarcobatus vermiculatus*, but with low cover (if shrub species are codominant, then stand may be classified as a native shrubland type). Scattered native *Acer negundo*, *Elaeagnus angustifolia*, *Populus* spp., or *Salix amygdaloides* trees may also be present. Depending on stand age and density of the shrub layer, an herbaceous layer may be present. Associated native species include *Distichlis spicata*, *Sporobolus airoides*, and introduced forage species such as *Agrostis gigantea*, *Agrostis stolonifera*, and *Poa pratensis*. Other introduced herbaceous species such as *Conyza canadensis*, *Lepidium latifolium*, and *Polypogon monspeliensis* may also be present.

ENVIRONMENT & DYNAMICS

Environmental Description: These widespread shrublands are common along larger streams, rivers, and around playas. Elevation ranges from 75 m below sea level to 1860 m. Sites include riverbanks, floodplains, basins, sandbars, side channels, springs, salt flats, and other saline habitats. Substrates are commonly thin sandy loam soil over alluvial deposits of sand, gravel or cobbles. Stands grow especially well along regulated rivers and rivers with agricultural runoff that increase the salts in the water.

Dynamics: *Tamarix* spp. are extremely drought- and salt-tolerant, produce prolific wind-dispersed seeds over much of the growing season, can resprout after burning or cutting, and, if kept moist, buried or broken branches will develop adventitious roots and grow. Stands seem to favor disturbed and flow-regulated rivers, but establish well in pristine areas, too. Once established, stands are extremely difficult to eradicate, requiring cutting and herbicide application on stumps to prevent resprouting (Smith and Douglas 1989).

In California, tamarisk species are among the most invasive, widely distributed, and troublesome non-natives to infest wetlands. Multiple, interacting factors facilitate tamarisk invasion, including intentional planting for erosion control and windbreaks; land conversion to agriculture; reduced flood frequencies after damming rivers; changing and stabilizing waterflows, times, and rates downstream from reservoirs; and increased salinity levels in the rivers from evaporation in the reservoirs (Everitt 1980). Tamarisk vigorously sprouts and increases flowering and seed production after fire. Mixed riparian stands often change to tamarisk-

dominated stands after fires (Zouhar 2003b, Brooks and Minnich 2006). Active programs to remove tamarisk are ongoing in the state (Lovich 2000). Discouraging tamarisk establishment by biological and mechanical control is the most effective method of control. Once established in large stands, control and eradication efforts are difficult and costly; many managers recommend integrated management approaches (Lovich 2000, Zouhar 2003b, Carpenter 2005).

DISTRIBUTION

Geographic Range: This alliance is found throughout the southwestern U.S. and northern Mexico.

Nations: MX, US

States/Provinces: AZ, CA, CO, MT, MXCH, MXCO, MXSO, NM, NV, OK, TX, UT, WY

TNC Ecoregions [optional]: 11:C, 13:C, 15:C, 16:C, 17:C, 23:C

USFS Ecoregions (2007): 261B:CC, 262A:CC, 322Ab:CCC, 322Al:CCC, 322At:CCC, 322Av:CCC, 322Ay:CCC, 322Az:CCC, 322B:CC, 322C:CC, 341Fc:CCC, M261A:CC, M261B:CC, M261C:CC, M261F:CC, M262A:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Joshua Tree, Lake Mead, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

- = *Tamarix* spp. (Tamarisk thickets) Semi-natural Stands (Sawyer et al. 2009) [63.810.00]
- ? *Tamarix chinensis* Community Type (Hansen et al. 1995)
- ? *Tamarix chinensis* shrubland alliance (Hoagland 1998a)
- ? *Tamarix pentandra* Community Type (Szaro 1989)
- ? *Tamarix ramosissima* (Salt cedar) Association (Nachlinger and Reese 1996)
- = *Tamarix* spp. Semi-Natural Shrubland Stands (Evens et al. 2012)
- = *Tamarix* spp. Semi-Natural Stands (Tamarisk thickets) (Buck-Diaz et al. 2012)
- = *Tamarix* spp. Semi-natural Shrubland Alliance (Evens et al. 2014)
- = *Tamarix* spp. Shrubland Semi-Natural Alliance (CNPS 2017) [63.810.00]
- ? Salt cedar series (Paysen et al. 1980)
- = Saltcedar Alliance (Muldavin et al. 2000a)
- ? Saltcedar Series (Dick-Peddie 1993)
- = Tamarisk Scrub (#63810) (Holland 1986b)
- = Tamarisk series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS

Associations:

- CEPP005697 *Tamarix chinensis* Ruderal Lakeshore Scrub
- CEGl003114 *Tamarix* spp. Ruderal Riparian Shrubland

AUTHORSHIP

Primary Concept Source: M.S. Reid and K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Brooks and Minnich 2006, Brown 1982a, Buck-Diaz et al. 2012, CNPS 2017, Campbell and Dick-Peddie 1964, Carpenter 2005, DiTomaso and Healy 2007, Dick-Peddie 1993, Evens and San 2006, Evens et al. 2012, Evens et al. 2014, Faber-Langendoen et al. 2017b, Hansen et al. 1995, Hefley 1937, Hoagland 1998a, Holland 1986b, Johnson 1987b, Keeler-Wolf et al. 1998a, Keeler-Wolf et al. 2005, Klein and Evens 2006, Little 1996, Lovich 2000, Muldavin et al. 2000a, Nachlinger and Reese 1996, Neill 1985, Paysen et al. 1980, Powell 1988b, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Smith and Douglas 1989, Sproul et al. 2011, Szaro 1989, Thomas et al. 2004, USBOR 1976, Von Loh et al. 2002, Zouhar 1993b

2. SHRUB & HERB VEGETATION

Grasslands, shrublands, open tree savannas, marshes, bogs and fens dominated by broadly mesomorphic (including scleromorphic) shrub and herb growth forms (including *broad-leaved*, *needle-leaved*, and *sclerophyllous shrubs*, and *forb* and *graminoid herbs*) with an irregular horizontal canopy structure, mesomorphic trees typically <10% cover (but tropical tree savannas typically <40%), tropical to boreal and subalpine climates, and wet to dry substrate conditions.

2.B. Temperate & Boreal Grassland & Shrubland

Temperate & Boreal Grassland & Shrubland is dominated by mesomorphic grasses and shrubs, with or without scattered trees (and trees typically <10% cover), ranging from temperate coastal to inland lowland and montane grasslands and shrublands, with a strongly seasonal climate and at least some frost to extended cold seasons.

2.B.1. Mediterranean Scrub & Grassland

Mediterranean Scrub & Grassland includes the sclerophyllous scrub that develops in Mediterranean climates found in the Mediterranean Basin, lowland California in the United States, west-central Chile, the western Cape Province of South Africa, and southwestern and southern Australia. It also includes Mediterranean grasslands, "wildflower fields," and prairies from California.

2.B.1.Na. Californian Scrub & Grassland

This division encompasses Californian scrub (chaparral), grassland and meadow vegetation within the warm-temperate Californian Floristic Province, from southwestern Oregon through California, west of the Sierra-Cascades divide and south into northwestern Baja California, Mexico.

M046. Californian Ruderal Grassland, Meadow & Scrub

This macrogroup encompasses non-native-dominated by annual grassland, forbland and scrub found in the "Mediterranean" region of California, especially in disturbed areas. Dominant introduced species include the herbs *Avena barbata*, *Avena fatua*, *Brassica nigra*, *Bromus diandrus*, *Bromus hordeaceus*, *Bromus rubens*, *Centaurea* spp., *Erodium* spp., *Lolium perenne* ssp. *multiflorum*, and *Raphanus sativus*. Species in non-native shrublands include *Ulex europaeus*, *Cytisus scoparius*, and species of *Genista* and *Spartium*, among others.

2. Shrub & Herb Vegetation

2.B.1.Na. Californian Scrub & Grassland

2.B.1.Na.90.a. M046 Californian Ruderal Grassland, Meadow & Scrub

G497. Californian Ruderal Grassland, Meadow & Scrub

Type Concept Sentence: This warm-temperate Californian ruderal grassland, forbland and scrub group is most commonly dominated by non-native annual or perennial herbaceous species which compose >75% of the foliar cover and include many graminoids such as *Avena barbata*, *Avena fatua*, *Bromus diandrus*, *Bromus hordeaceus*, *Bromus madritensis*, *Cortaderia jubata*, *Cortaderia selloana*, *Lolium perenne* ssp. *multiflorum*, *Hordeum murinum*, *Taeniatherum caput-medusae*, *Vulpia bromoides*, *Vulpia myuros*, and forbs, including *Carduus pycnocephalus*, *Centaurea* spp., *Erodium botrys*, *Erodium cicutarium*, *Medicago polymorpha*, *Geranium dissectum*, *Hypochaeris glabra*, and *Raphanus sativus*.

OVERVIEW

Scientific Name: *Avena fatua* - *Bromus diandrus* Ruderal Grassland, Meadow & Scrub Group

Common Name (Translated Scientific Name): Wild Oat - Ripgut Brome Ruderal Grassland, Meadow & Scrub Group

Colloquial Name: Californian Ruderal Annual Grassland

Type Concept: This group encompasses the non-native-dominated annual or perennial grasslands and forblands found in warm-temperate or Mediterranean California. They occur on the coastal plains, in the Central Valley, in the foothills and in disturbed rural and urban areas. Native graminoid and forb species can be present with low or insignificant cover. The overwhelming dominance of the introduced species is undeniable. Non-native species make up 50-96% of the foliar cover. Dominant introduced graminoid species include *Aegilops triuncialis*, *Avena fatua*, *Avena barbata*, *Bromus diandrus*, *Bromus hordeaceus*, *Bromus madritensis*, *Cortaderia jubata*, *Cortaderia selloana*, *Lolium perenne* ssp. *multiflorum* (= *Lolium multiflorum*), *Hordeum murinum*, *Pennisetum ciliare*, *Pennisetum setaceum*, *Taeniatherum caput-medusae*, *Vulpia bromoides*, and *Vulpia myuros*. Introduced forb species include *Brassica nigra*, *Carduus pycnocephalus*, *Centaurea* spp., *Erodium botrys*, *Erodium cicutarium*, *Medicago polymorpha*, *Geranium dissectum*, *Hypochaeris glabra*, *Medicago polymorpha*, and *Raphanus sativus*. Species in non-native shrublands include *Ulex europaeus*, *Cytisus scoparius*, and species of *Genista* and *Spartium*, among others. There are many more species that can be dominant. California annual grassland is found on a wide variety of soils, sometimes in complex mosaics. Most are noncalic Mollisols, medium to heavy texture, about 0.5 m deep.

Classification Comments: Non-native scrub types were added to this group. They need better characterization. Preliminary notes include the following observations: Some exotic grasses, forbs and shrubs of this macrogroup are shared with Southern Vancouverian Lowland Ruderal Grassland & Shrubland Group (G648), including *Cytisus scoparius* and *Ulex europaeus*. It is not clear

whether sufficient diagnostics provide an effective way to discriminate stands dominated by these exotics across divisions (cool-temperate Pacific coastal versus warm-temperate/Mediterranean California).

Similar NVC Types:

- G496 Californian Perennial Grassland: differs in that native species have 10% or greater relative cover in the herbaceous layer and 5% or greater absolute cover.
- G648 Southern Vancouverian Lowland Ruderal Grassland & Shrubland

Diagnostic Characteristics: Dominance by exotic, introduced and/or non-native annual or perennial grass and forb species, such as *Aegilops triuncialis*, *Avena barbata*, *Avena fatua*, *Brachypodium distachyon*, *Briza maxima*, *Bromus diandrus*, *Bromus hordeaceus*, *Bromus madritensis*, *Bromus rubens*, *Cortaderia jubata*, *Cortaderia selloana*, *Cynosurus echinatus*, *Hordeum murinum*, *Lolium perenne ssp. multiflorum*, *Hordeum murinum*, *Pennisetum ciliare*, *Pennisetum setaceum*, *Taeniatherum caput-medusae*, *Vulpia bromoides*, and *Vulpia myuros*. Introduced forb species include *Brassica nigra*, *Carduus pycnocephalus*, *Centaurea solstitialis*, *Centaurea melitensis*, *Centaurea virgata*, *Conium maculatum*, *Foeniculum vulgare*, *Erodium botrys*, *Erodium cicutarium*, *Medicago polymorpha*, *Geranium dissectum*, *Hypochaeris glabra*, *Medicago polymorpha*, and *Raphanus sativus*. Species in non-native shrublands include *Ulex europaeus*, *Cytisus scoparius*, and species of *Genista* and *Spartium*, among others. Native herbaceous species may be present, but these with less than 10% relative cover in the herbaceous layer.

VEGETATION

Physiognomy and Structure: Herbaceous vegetation composed of perennial or annual grasses and forbs. Height variable, but generally <0.5 m, although some can be much taller (e.g., *Cortaderia* spp. stands).

Floristics: Graminoids include *Aegilops triuncialis*, *Avena barbata*, *Avena fatua*, *Brachypodium distachyon*, *Briza maxima*, *Bromus diandrus*, *Bromus hordeaceus*, *Bromus madritensis*, *Bromus rubens*, *Cortaderia jubata*, *Cortaderia selloana*, *Cynosurus echinatus*, *Hordeum murinum*, *Lolium perenne ssp. multiflorum* (= *Lolium multiflorum*), *Pennisetum ciliare*, *Pennisetum setaceum*, *Schismus arabicus*, *Schismus barbatus*, *Taeniatherum caput-medusae*, *Vulpia bromoides*, and *Vulpia myuros*. Forb species include *Brassica nigra*, *Carduus pycnocephalus*, *Centaurea melitensis*, *Centaurea solstitialis*, *Centaurea virgata*, *Conium maculatum*, *Erodium botrys*, *Erodium cicutarium*, *Foeniculum vulgare*, *Geranium dissectum*, *Hypochaeris glabra*, *Medicago polymorpha*, and *Raphanus sativus*.

Species in non-native shrublands include *Ulex europaeus*, *Cytisus scoparius*, and species of *Genista* and *Spartium*, among others. Native herbaceous species may be present, but these with less than 10% relative cover in the herbaceous layer. The most ubiquitous ruderal shrub species in central California is *Genista monspessulana*. It tends to colonize bare soils exposed on construction sites in the California Coast Ranges and northern Sierra Nevada foothills. It quickly builds up a seed bank and, for invasives control, removal of shrubs must be followed up with repeated removal of seedlings for years. Hybrids of several species of introduced *Genista* and *Cytisus* have colonized slopes in central and southern coastal California.

Floristic information is summarized from the following sources: Evens and San (2004, 2006), Klein and Evens (2005), Keeler-Wolf and Evens (2006), and Sawyer et al. (2009).

ENVIRONMENT & DYNAMICS

Environmental Description:

Dynamics: Stands are a result of historic or recent heavy continuous grazing or other disturbance. Classification to this ruderal group does not preclude the possibility of successful restoration back to the native California grassland group. Stands dominated by these annual and perennial species are adapted to frequent fires and summer droughts. Stands dominated by introduced cool-season, annual grasses have germinating seeds that survive the sporadic wetting and drying cycles that occur though the growing season. Most seeds germinate after the first significant rain in the fall. Plants set seed and die by the end of the growing season in the spring (Sawyer et al. 2009).

DISTRIBUTION

Geographic Range: This group occurs in the warm-temperate ("Mediterranean") California coastal plain and Central Valley, also in the southeastern portions of the state in transitions to California desert regions.

Spatial Scale & Pattern [optional]:

Nations: MX, US

States/Provinces: CA, OR?

TNC Ecoregions [optional]: 13:C, 14:C, 15:C, 16:C

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL**USNVC Confidence Level with Comments:** Moderate.**SYNONYMY****LOWER LEVEL UNITS****Alliances:**

- A4214 *Brassica nigra* - *Raphanus* spp. Ruderal Annual Forb Meadow Alliance
- A3870 *Avena fatua* - *Bromus* spp. Ruderal Annual Grassland Alliance
- A3872 *Centaurea virgata* ssp. *squarrosa* - *Conium maculatum* - *Foeniculum vulgare* Ruderal Meadow Alliance
- A1203 *Cortaderia jubata* - *Cortaderia selloana* Ruderal Grassland Alliance
- A3871 *Lolium perenne* Ruderal Grassland Alliance

AUTHORSHIP**Primary Concept Source:** G. Kittel, in Faber-Langendoen et al. (2011)**Author of Description:** G. Kittel, M. Reid and D. Faber-Langendoen**Acknowledgments:****Version Date:** 01/13/2016**Classif Resp Region:** West**Internal Author:** GK 11-10, mod. MSR 9-13, mod. KAS 11-15, mod. DFL 1-16**REFERENCES**

References: Bartolome et al. 2007, Buck-Diaz and Evens 2011b, Buck-Diaz et al. 2012, Buck-Diaz et al. 2013, Evens and San 2004, Evens and San 2006, Faber-Langendoen et al. 2017a, Keeler-Wolf and Evens 2006, Klein and Evens 2006, Rodriguez et al. 2017, Sawyer et al. 2009, Shiflet 1994

2. Shrub & Herb Vegetation

2.B.1.Na. Californian Scrub & Grassland

G497. Californian Ruderal Grassland, Meadow & Scrub

A3870. *Avena fatua* - *Bromus* spp. Ruderal Annual Grassland Alliance

Type Concept Sentence: This is a non-native-dominated alliance of annual grasslands and forblands of California and Baja California. The composition varies widely. Many alien annual species may be present, including *Aegilops triuncialis*, *Aira caryophyllea*, *Avena barbata*, *Avena fatua*, *Brachypodium distachyon*, *Brassica* spp., *Bromus diandrus*, *Bromus hordeaceus*, *Bromus madritensis*, *Centaurea melitensis*, *Centaurea solstitialis*, and *Cynosurus echinatus*.

OVERVIEW**Scientific Name:** *Avena fatua* - *Bromus* spp. Ruderal Annual Grassland Alliance**Common Name (Translated Scientific Name):** Wild Oat - Brome species Ruderal Annual Grassland Alliance**Colloquial Name:** Californian Ruderal Annual Grassland

Type Concept: This alliance of non-native annual grasslands and forblands is composed of cool-season, annual grasses mostly introduced from Europe. They are invasive in disturbed areas throughout much of California. The composition varies widely. Many alien annual species may be present, including *Aegilops triuncialis*, *Aira caryophyllea*, *Avena barbata*, *Avena fatua*, *Brachypodium distachyon*, *Brassica* spp., *Bromus diandrus*, *Bromus hordeaceus*, *Bromus madritensis*, *Centaurea melitensis*, *Centaurea solstitialis*, and *Cynosurus echinatus*. The composition of this alliance is largely determined by amount of disturbance coupled with fall temperatures and precipitation, light intensity, litter thickness and microtopography. The percentage of exotic alien species is often directly related to disturbance history with heavy disturbance correlating with heavy exotic invasion. Annual grasses are supremely adapted to the Mediterranean climate of California; many species evolved under similar conditions in southern Europe and northern Africa. Plants germinate during winter rains, and complete their life cycles by the beginning of the summer drought. Seeds often remain viable for many years.

Classification Comments: This is a large alliance, but the high variability of the exotic annual-dominated grasslands of California suggests keeping all of these types together in one alliance. Name could be revised to include either *Centaurea* or *Brassica* instead of "annual forbs."

Internal Comments: mjr 1-15: AZ added for Lake Mead (MOJN).**Other Comments:****Similar NVC Types:**

- A4166 *Brassica tournefortii* - *Malcolmia africana* Ruderal Desert Forbs Alliance

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure: These short, temperate, annual grasslands and forblands form an herbaceous canopy less than 1 m in height. Emergent shrubs and trees may be present.

Floristics: The composition varies widely. Many alien annual species may be present, including *Aegilops triuncialis*, *Aira caryophyllea*, *Avena barbata*, *Avena fatua*, *Brachypodium distachyon*, *Brassica* spp., *Bromus diandrus*, *Bromus hordeaceus*, *Bromus madritensis*, *Centaurea melitensis*, *Centaurea solstitialis*, and *Cynosurus echinatus*.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance can be found where heavy disturbance occurs, but occurs largely outside of the highest elevations.

Dynamics: The composition of this alliance is largely determined by fall temperatures and precipitation, light intensity, litter thickness and microtopography. The percentage of exotic alien species is often directly related to the amount of disturbance history with heavy disturbance correlating with heavy exotic invasion. Annual grasses are supremely adapted to the Mediterranean climate of California; many species evolved under similar conditions in southern Europe and northern Africa. Plants germinate during winter rains, and complete their life cycles by the beginning of the summer drought. Seeds often remain viable for many years.

DISTRIBUTION

Geographic Range: This alliance occurs in California south into Baja California, Mexico.

Nations: MX, US

States/Provinces: AZ, CA, MXBC

TNC Ecoregions [optional]: 4:C, 5:C, 12:C, 13:C, 14:C, 15:C, 16:C

USFS Ecoregions (2007): 261A:CC, 261B:CC, 262A:CC, 263A:CC, M261B:CC, M261C:CC, M261D:CC, M261E:CC, M261F:CC, M261G:CC, M262A:CC, M262B:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Channel Islands)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- > *Aegilops triuncialis* (Barbed goatgrass patches) Provisional Semi-natural Stands (Sawyer et al. 2009) [42.003.00]
- > *Avena (barbata, fatua)* (Wild oats grasslands) Semi-natural Stands (Sawyer et al. 2009) [44.150.00]
- > *Avena (barbata, fatua)* Semi-Natural Stands (Wild oats grasslands) (Buck-Diaz et al. 2012)
- = *Avena* spp. - *Bromus* spp. Semi-natural Alliance (Klein et al. 2015)
- = *Avena* spp. - *Bromus* spp. Semi-natural Grassland Alliance (Rodriguez et al. 2017)
- > *Brassica nigra* and Other Mustards Semi-Natural Stands (Upland mustards) (Buck-Diaz et al. 2012)
- > *Brassica nigra* and other mustards (Upland mustards) Semi-natural Stands (Sawyer et al. 2009) [42.011.00]
- > *Bromus (diandrus, hordeaceus)* - *Brachypodium distachyon* (Annual brome grasslands) Semi-natural Stands (Sawyer et al. 2009) [42.026.00]
- > *Bromus (diandrus, hordeaceus)*-*Brachypodium distachyon* Semi-Natural Stands (Annual brome grasslands) (Buck-Diaz et al. 2012)
- >< *Centaurea (solstitialis, melitensis)* (Yellow star-thistle fields) Semi-natural Stands (Sawyer et al. 2009) [42.042.00]
- > *Centaurea (solstitialis, melitensis)* Semi-Natural Stands (Yellow star-thistle fields) (Buck-Diaz et al. 2012)
- ? *Centaurea solstitialis* Herbaceous Alliance (Keeler-Wolf et al. 2012)
- > *Cynosurus echinatus* (Annual dogtail grasslands) Semi-natural Stands (Sawyer et al. 2009) [42.044.00]
- ? California Annual Herbland Alliance (Keeler-Wolf et al. 2012)
- >< Non-native Grassland (#42200) (Holland 1986b)
- >< Valley and Foothill Grassland (#42000) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEGLO02906 *Bromus diandrus* Ruderal Grassland
- CEGLO02916 *Bromus diandrus* - *Avena* spp. Ruderal Grassland
- CEGLO02878 *Avena fatua* Ruderal Grassland
- CEPP005712 *Bromus hordeaceus* - *Erodium botrys* Ruderal Annual Grassland

CBR alliances

- C EGL003018 *Bromus (diandrus, hordeaceus, madritensis)* Ruderal Grassland
- C EGL003374 *Brachypodium distachyon* Ruderal Grassland
- C EPP005678 *Atriplex semibaccata - Hordeum murinum* Ruderal Coastal Scrub
- C EGL008666 *Bromus diandrus - Bromus hordeaceus - Trifolium spp. - Daucus pusillus* Ruderal Grassland

AUTHORSHIP

Primary Concept Source: M.S. Reid, in Faber-Langendoen et al. (2015)

Author of Description: M.S. Reid

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Buck-Diaz et al. 2012, Evens and San 2004, Faber-Langendoen et al. 2017b, Holland 1986b, Jimerson et al. 2000, Keeler-Wolf and Evens 2006, Keeler-Wolf et al. 2003b, Keeler-Wolf et al. 2012, Keeley 2006b, Klein and Evens 2006, Klein et al. 2007, Klein et al. 2015, Rodriguez et al. 2017, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Schlising and Sanders 1982, Solomeshch and Barbour 2006, Sproul et al. 2011, VegCAMP and AIS 2013

2. Shrub & Herb Vegetation

2.B.1.Na. Californian Scrub & Grassland

G497. Californian Ruderal Grassland, Meadow & Scrub

A4214. Brassica nigra - Raphanus spp. Ruderal Annual Forb Meadow Alliance [Low - Poorly Documented]

Type Concept Sentence:

OVERVIEW

Scientific Name: *Brassica nigra - Raphanus spp.* Ruderal Annual Forb Meadow Alliance

Common Name (Translated Scientific Name): Black Mustard - Radish species Ruderal Annual Forb Meadow Alliance

Colloquial Name: Californian Ruderal Annual Forb Meadow

Type Concept:

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure:

Floristics:

ENVIRONMENT & DYNAMICS

Environmental Description:

Dynamics:

DISTRIBUTION

Geographic Range:

Nations: US

States/Provinces: CA

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- C EGL002879 *Brassica nigra* Ruderal Grassland
- C EGL003465 *Raphanus sativus* Ruderal Forbland
- C EGL002880 *Brassica nigra* - *Bromus diandrus* Ruderal Grassland
- C EGL002881 *Brassica nigra* - *Centaurea melitensis* Ruderal Grassland

AUTHORSHIP

Primary Concept Source: M. Reid, in Faber-Langendoen et al.

Author of Description:

Acknowledgments:

REFERENCES

2. Shrub & Herb Vegetation

2.B.1.Na. Californian Scrub & Grassland

G497. Californian Ruderal Grassland, Meadow & Scrub

A3872. *Centaurea virgata* ssp. *squarrosa* - *Conium maculatum* - *Foeniculum vulgare* Ruderal Meadow Alliance

Type Concept Sentence: This alliance consists of meadows dominated by non-native perennial forbs such as *Centaurea stoebe* ssp. *micranthos*, *Centaurea diffusa*, *Centaurea virgata* ssp. *squarrosa*, *Centaurea calcitrapa*, *Conium maculatum*, *Daucus carota*, and/or *Foeniculum vulgare*. This alliance is found in California and probably north into Oregon.

OVERVIEW

Scientific Name: *Centaurea virgata* ssp. *squarrosa* - *Conium maculatum* - *Foeniculum vulgare* Ruderal Meadow Alliance

Common Name (Translated Scientific Name): Squarrose Knapweed - Poison-hemlock - Sweet Fennel Ruderal Meadow Alliance

Colloquial Name: Pacific Ruderal Perennial Meadow

Type Concept: This alliance consists of meadows dominated by perennial herbs, including *Centaurea stoebe* ssp. *micranthos*, *Centaurea calcitrapa*, *Centaurea diffusa*, *Centaurea virgata* ssp. *squarrosa*, *Conium maculatum*, *Daucus carota*, and/or *Foeniculum vulgare*, that are dominant or codominant with other non-natives in the herbaceous layer. This alliance is found in California and probably north into Oregon, at elevations ranging from sea level to 2000 m. Habitats are open disturbed sites, roadsides, upland grasslands, moist meadows, rangeland, and open hillsides.

Classification Comments: Combined two Sawyer et al. (2009) semi-natural stand types on the basis of being primarily perennial forb-dominated, and occurring in a variety of disturbed areas, including wet meadows or wetlands, as well as drier sites (pastures, roadsides, etc.). Some of these dominant species are FACW plants (USFWS Wetland Inventory 1996).

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Alliance is primarily perennial forb-dominated, occurring in a variety of disturbed areas, including wet meadows or wetlands, as well as drier sites (pastures, roadsides, etc.). Dominated by *Centaurea stoebe* ssp. *micranthos*, *Centaurea diffusa*, *Centaurea virgata*, *Centaurea calcitrapa*, *Conium maculatum*, *Daucus carota*, and/or *Foeniculum vulgare*.

VEGETATION

Physiognomy and Structure: Perennial herbaceous forbs <2 m in height.

Floristics: This alliance consists of meadows dominated by perennial herbs, including *Centaurea stoebe* ssp. *micranthos*, *Centaurea calcitrapa*, *Centaurea diffusa*, *Centaurea virgata* ssp. *squarrosa*, *Conium maculatum*, *Daucus carota*, and/or *Foeniculum vulgare*, that are dominant or codominant with other non-natives in herbaceous layer.

ENVIRONMENT & DYNAMICS

Environmental Description: Habitats are open disturbed sites, roadsides, upland grasslands, moist meadows, rangeland, and open hillsides. Elevation ranges from sea level to 2000 m.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is found in California and probably north into Oregon.

Nations: US

States/Provinces: CA, OR?

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- > *Centaurea (virgata)* (Knapweed and purple-flowered star-thistle fields) Provisional Semi-natural Stands (Sawyer et al. 2009) [42.043.00]
- > *Conium maculatum - Foeniculum vulgare* (Poison hemlock or fennel patches) Semi-natural Stands (Sawyer et al. 2009) [45.556.00]
- > *Conium maculatum-Foeniculum vulgare* Semi-Natural Stands (Poison hemlock or fennel patches) (Buck-Diaz et al. 2012)
- > *Foeniculum vulgare* Herbaceous Alliance (Keeler-Wolf and Evens 2006)
- < Non-native Grassland (#42200) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

AUTHORSHIP

Primary Concept Source: M.S. Reid after Sawyer et al. (2009)

Author of Description: M.S. Reid

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Buck-Diaz et al. 2012, Faber-Langendoen et al. 2017b, Holland 1986b, Keeler-Wolf and Evens 2006, Sawyer et al. 2009, Sproul et al. 2011

2. Shrub & Herb Vegetation
2.B.1.Na. Californian Scrub & Grassland
G497. Californian Ruderal Grassland, Meadow & Scrub

A1203. Cortaderia jubata - Cortaderia selloana Ruderal Grassland Alliance

Type Concept Sentence: This alliance consists of stands dominated by *Cortaderia jubata* and/or *Cortaderia selloana*. It occurs primarily in coastal California in disturbed areas, estuaries, inland grasslands, urban areas, and wetlands.

OVERVIEW

Scientific Name: *Cortaderia jubata - Cortaderia selloana* Ruderal Grassland Alliance

Common Name (Translated Scientific Name): Purple Pampas Grass - Uruguayan Pampas Grass Ruderal Grassland Alliance

Colloquial Name: Ruderal Pampas Grass Tussock Grassland

Type Concept: This alliance consists of invading patches of *Cortaderia jubata* and/or *Cortaderia selloana* where they are dominant in the herbaceous and shrub layers. Emergent shrubs and trees may be present in low cover. Herbs are <4 m in height, and the canopy cover is open to continuous. It occurs in California at elevations ranging from sea level to 800 m. Habitats are coastal land, disturbed areas, estuaries, grasslands, urban areas, and wetlands. Areas where this alliance thrives receive between 100-200 cm of rain per year. Stands of *Cortaderia* invade coastal bluff and coastal scrub stands of *Artemisia californica*, *Baccharis pilularis*, and *Eriogonum fasciculatum*. They also invade moist forest stands of *Picea sitchensis*, *Pseudotsuga menziesii*, and *Sequoia sempervirens*, and invade inland riparian stands of herbs and trees in the Central Valley.

Classification Comments: The nominal species of this alliance are exotic and invasive. Stands of *Cortaderia* invade coastal bluff and coastal scrub stands of *Artemisia californica*, *Baccharis pilularis*, and *Eriogonum fasciculatum* alliances. They grow in moist, open forest stands and infest inland riparian stands in the Great Valley.

CBR alliances

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure: This tall, temperate bunch grassland forms an open canopy of graminoids less than 4 m in height. An understory of shrubs, or emergent trees (0-10%), may be present.

Floristics: In this invasive herbaceous grassland of California, *Cortaderia jubata* or *Cortaderia selloana* are the sole or dominant species in the herbaceous layer. Shrub species present may include *Artemisia californica*, *Eriogonum fasciculatum*, and *Baccharis pilularis*. In disturbed forest areas emergent trees may be present and could include *Pseudotsuga menziesii*, *Sequoia sempervirens*, and *Picea sitchensis*.

ENVIRONMENT & DYNAMICS

Environmental Description: This herbaceous alliance of the temperate regions of California invades several shrubland vegetation types and disturbed forest sites. Stands are found on all topographic positions, from sea level to 800 m. Areas where this alliance thrives receive between 100-200 cm of rain per year.

Dynamics: In forested areas the nominal species of this alliance require a disturbance such as logging to open the canopy for invasion to occur. As the forest grows, stands of *Cortaderia* spp. gradually decline as light levels decrease. In shrub alliances, *Cortaderia* spp. can be much more persistent and invasive. Seeds are windblown and can germinate under all but the densest shrub canopies. Disturbed shrublands along the outer Coast Ranges can be replaced by virtual monocultures of *Cortaderia*. These species can increase fire fuel loads and fire intensity, especially in areas already altered by other non-natives with which they commonly grow.

DISTRIBUTION

Geographic Range: This alliance occurs in California, primarily in coastal areas.

Nations: US

States/Provinces: CA

TNC Ecoregions [optional]: 13:C, 14:C, 15:C, 16:C

USFS Ecoregions (2007): 261A:CC, 261B:CC, 262A:CC, 263A:CC, M261B:CC, M262A:CC, M262B:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Cortaderia (jubata, selloana)* (Pampas grass patches) Semi-natural Stands (Sawyer et al. 2009) [42.070.00]
- = *Cortaderia (jubata, selloana)* Semi-Natural Stands (Pampas grass patches) (Buck-Diaz et al. 2012)
- = *Cortaderia (jubata, selloana)* Herbaceous Semi-Natural Alliance (CNPS 2017) [42.070.00]
- < Non-native Grassland (#42200) (Holland 1986b)
- = Pampas grass series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS

Associations:

AUTHORSHIP

Primary Concept Source: J.O. Sawyer et al. (2009)

Author of Description: M.S. Reid

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Buck-Diaz et al. 2012, CNPS 2017, DiTomaso et al. 1999, Faber-Langendoen et al. 2017b, Fuller 1976, Hickson and Keeler-Wolf 2007, Holland 1986b, Lambrinos 2000, Lambrinos 2001, Lambrinos 2002, Peterson and Russo 1988, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Vaghti and Keeler-Wolf 2004, Walgren et al. 2005

2. Shrub & Herb Vegetation

2.B.1.Na. Californian Scrub & Grassland

G497. Californian Ruderal Grassland, Meadow & Scrub

A3871. *Lolium perenne* Ruderal Grassland Alliance [Low - Poorly Documented]

Type Concept Sentence: This alliance consists of meadows where *Lolium perenne* is dominant or codominant with other non-natives in the herbaceous layer. It occurs throughout California. Generally, this type occurs in seasonally moist to wet environments that are regularly disturbed through grazing, fire, flooding, or mechanical means.

OVERVIEW

Scientific Name: *Lolium perenne* Ruderal Grassland Alliance

Common Name (Translated Scientific Name): Perennial Ryegrass Ruderal Grassland Alliance

Colloquial Name: Ruderal Ryegrass Grassland

Type Concept: This alliance consists of meadows where *Lolium perenne* is dominant or codominant with other non-natives in the herbaceous layer, including *Agrostis stolonifera*, *Alopecurus aequalis*, *Asclepias fascicularis*, *Avena fatua*, *Brassica nigra*, *Bromus diandrus*, *Bromus hordeaceus*, *Centaureum muhlenbergii*, *Cirsium vulgare*, *Cryptantha flaccida*, *Euphorbia spathulata*, *Schedonorus arundinaceus* (= *Festuca arundinacea*), *Holcus lanatus*, *Hordeum brachyantherum*, *Hordeum murinum*, *Leontodon taraxacoides*, *Leymus triticoides*, *Lotus corniculatus*, *Microseris douglasii*, *Nassella pulchra*, *Phalaris aquatica*, *Plantago erecta*, *Poa pratensis*, *Nasturtium officinale* (= *Rorippa nasturtium-aquaticum*), *Rumex crispus*, and *Trifolium* spp. Herbs are <1 m tall and the canopy cover is intermittent to continuous. Emergent trees and shrubs may be present at low cover. It occurs throughout California at elevations ranging from sea level to 1000 m. Generally, this type occurs in seasonally moist to wet environments that are regularly disturbed through grazing, fire, flooding, or mechanical means. Habitats are lowlands with periodic flooding, disked fields, and uplands, including serpentine substrates.

Classification Comments: The USFWS Wetland Inventory (1996 National List) lists *Lolium perenne* as a FAC+ plant.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: *Lolium perenne* is dominant or codominant.

VEGETATION

Physiognomy and Structure: Annual or perennial grasses <1 m tall.

Floristics: *Lolium perenne* is dominant or codominant with other non-natives in the herbaceous layer, including *Agrostis stolonifera*, *Alopecurus aequalis*, *Asclepias fascicularis*, *Avena fatua*, *Brassica nigra*, *Bromus diandrus*, *Bromus hordeaceus*, *Centaureum muhlenbergii*, *Cirsium vulgare*, *Cryptantha flaccida*, *Euphorbia spathulata*, *Schedonorus arundinaceus* (= *Festuca arundinacea*), *Holcus lanatus*, *Hordeum brachyantherum*, *Hordeum murinum*, *Leontodon taraxacoides*, *Leymus triticoides*, *Lotus corniculatus*, *Microseris douglasii*, *Nassella pulchra*, *Phalaris aquatica*, *Plantago erecta*, *Poa pratensis*, *Nasturtium officinale* (= *Rorippa nasturtium-aquaticum*), *Rumex crispus*, and *Trifolium* spp. Herbs are <1 m tall and the canopy cover is intermittent to continuous. Emergent trees and shrubs may be present at low cover.

ENVIRONMENT & DYNAMICS

Environmental Description: Generally, this type occurs in seasonally moist to wet environments that are regularly disturbed through grazing, fire, flooding, or mechanical means. Habitats are lowlands with periodic flooding, disked fields, and uplands including serpentine substrates. Elevation ranges from 0-1000 m.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is found throughout California.

Nations: US

States/Provinces: CA

TNC Ecoregions [optional]: 13:C, 14:C, 15:C, 16:C

USFS Ecoregions (2007): 261A:CC, 261B:CC, 262A:CC, 263A:CC, M261F:CC, M262A:CC

Omernik Ecoregions:

Federal Lands [optional]:**CONFIDENCE LEVEL****USNVC Confidence Level with Comments:** Low - Poorly Documented.**SYNONYMY**

- = *Lolium perenne* (Perennial rye grass fields) Semi-natural Stands (Sawyer et al. 2009) [41.321.00]
- = *Lolium perenne* Semi-Natural Stands (Perennial rye grass fields) (Buck-Diaz et al. 2012)
- = *Lolium perenne* Herbaceous Semi-Natural Alliance (CNPS 2017) [41.321.00]
- < California Annual Grassland Series (Sawyer and Keeler-Wolf 1995)
- < Non-native Grassland (#42200) (Holland 1986b)

LOWER LEVEL UNITS**Associations:****AUTHORSHIP****Primary Concept Source:** M.S. Reid, in Faber-Langendoen et al. (2013)**Author of Description:** M.S. Reid**Acknowledgments:****Version Date:** 2014/12/18**REFERENCES**

References: Buck-Diaz et al. 2012, CNPS 2017, Evens and San 2004, Evens et al. 2004, Faber-Langendoen et al. 2017b, Hickson and Keeler-Wolf 2007, Holland 1986b, Junak et al. 2007, Keeler-Wolf and Evens 2006, Keeler-Wolf and Vaghti 2000, Keeler-Wolf et al. 2007, Klein et al. 2007, Pickart 2006, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Sproul et al. 2011, Sullivan 1992

2.B.2. Temperate Grassland & Shrubland

Temperate Grassland, Meadow & Shrubland is dominated by perennial grasses, forbs and shrubs typical of moderately dry to moist habitats, and is found in the mid-latitude regions of all continents (23° to 55°N and S), varying from large open grassland landscapes to droughty hillside meadows in forested landscapes.

2.B.2.Na. Western North American Grassland & Shrubland

This division contains cool-temperate lowland to subalpine shrubland, grassland, and meadow communities that are dominated by cold-deciduous shrubs or cool-season bunchgrasses or mesic forbs in the mountainous regions of western North America, from Alaska's Aleutian Islands south to the central coast of California, and down through the Intermountain West ranges and Rocky Mountains to Arizona and New Mexico.

M049. Southern Rocky Mountain Montane Shrubland

This shrubland macrogroup is found in the foothills, canyon slopes and montane zone of mountains of the southern Rocky Mountains and Colorado Plateau and extends out onto outcrops and canyon slopes in the western and southern Great Plains. The vegetation is characterized by an open to dense shrub layer typically dominated by *Cercocarpus montanus*, *Purshia tridentata*, and/or *Quercus gambelii*, and several other characteristic shrubs.

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

2.B.2.Na.1.a. M049 Southern Rocky Mountain Montane Shrubland

G277. Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland

Type Concept Sentence: This group occurs in the mountains, plateaus and foothills of the southern Rocky Mountains and Colorado Plateau, and is typically dominated by *Quercus gambelii* alone or codominant with *Amelanchier alnifolia*, *Amelanchier utahensis*, *Artemisia tridentata*, *Cercocarpus montanus*, *Fraxinus anomala*, *Prunus virginiana*, *Purshia stansburiana*, *Purshia tridentata*, *Robinia neomexicana*, *Symphoricarpos oreophilus*, or *Symphoricarpos rotundifolius*.

OVERVIEW**Scientific Name:** *Quercus gambelii* - *Amelanchier* spp. - *Prunus virginiana* Southern Rocky Mountain Montane Shrubland Group**Common Name (Translated Scientific Name):** Gambel Oak - Serviceberry species - Chokecherry Southern Rocky Mountain Montane Shrubland Group**Colloquial Name:** Fendler's Ceanothus Shrubland & Shrub-Steppe

Type Concept: This group occurs in the mountains, plateaus and foothills of the southern Rocky Mountains and Colorado Plateau, including the Uinta and Wasatch ranges and the Mogollon Rim. The vegetation is typically dominated by *Quercus gambelii* alone or codominant with *Amelanchier alnifolia*, *Amelanchier utahensis*, *Artemisia tridentata*, *Cercocarpus montanus*, *Fendlera rupicola*, *Fraxinus anomala*, *Holodiscus dumosus*, *Jamesia americana*, *Prunus virginiana*, *Purshia stansburiana*, *Purshia tridentata*, *Robinia neomexicana*, *Symphoricarpos oreophilus*, or *Symphoricarpos rotundifolius*. There may be inclusions of other mesic montane shrublands with *Quercus gambelii* absent or as a relatively minor component. These shrublands are most commonly found along dry foothills, lower mountain slopes, and at the edge of the western Great Plains from approximately 2000 to 2900 m in elevation, and are often situated above pinyon-juniper woodlands. Substrates are variable and include soil types ranging from calcareous, heavy, fine-grained loams to sandy loams, gravelly loams, clay loams, deep alluvial sand, or coarse gravel. This group intergrades with Southern Rocky Mountain Mountain-mahogany - Mixed Foothill Shrubland Group (G276) and shares many of the same site characteristics. However, this group includes more mesic communities. Density and cover of *Quercus gambelii* and *Amelanchier* spp. often increase after fire.

Classification Comments: Disjunct *Quercus gambelii*-dominated shrublands found in the Davis Mountains and probably the Guadalupe Range in the Trans-Pecos of Texas are included in the concept of Eastern Madrean Chaparral Group (G280). *Quercus gambelii* apparently occurs as a significant component of a shrubland of the Trans-Pecos of Texas; however, most of the other species that codominate in this group do not occur in the Trans-Pecos. This group is not currently attributed to Texas, and it seems more appropriate to modify the description of Eastern Madrean Chaparral Group (G280) to allow for the presence of *Quercus gambelii* as a significant component of some occurrences. However, *Quercus gambelii* / *Symphoricarpos oreophilus* Shrubland (CEGL001117) is an association found in the Trans-Pecos. Also, there is a need to clarify the concept of Southern Rocky Mountain Mountain-mahogany - Mixed Foothill Shrubland Group (G276).

Similar NVC Types:

- G272 Central Rocky Mountain Montane-Foothill Deciduous Shrubland
- G276 Southern Rocky Mountain Mountain-mahogany - Mixed Foothill Shrubland

Diagnostic Characteristics: Stands of this group are typically dominated by broad-leaved, deciduous shrubs, which are typical of the montane zones of the southern Rocky Mountains. *Quercus gambelii* is the main species in most occurrences, although some may have equal amounts of (or only) *Amelanchier alnifolia*, *Amelanchier utahensis*, *Artemisia tridentata*, *Cercocarpus montanus*, *Ceanothus fendleri*, *Fendlera rupicola*, *Fraxinus anomala*, *Holodiscus dumosus*, *Jamesia americana*, *Prunus virginiana*, *Purshia stansburiana*, *Purshia tridentata*, *Rhus trilobata*, *Robinia neomexicana*, *Symphoricarpos oreophilus*, or *Symphoricarpos rotundifolius*. The herbaceous layer is not consistent, having sparse to moderately dense cover and mostly composed of graminoids, including *Carex geyeri*, *Carex inops*, *Festuca thurberi*, *Hesperostipa comata*, *Muhlenbergia montana*, and *Poa fendleriana*.

VEGETATION

Physiognomy and Structure: The vegetation may occur as sparse to dense broad-leaved deciduous shrublands composed of moderate to tall shrubs, or occasionally small trees. Occurrences may be multi-layered, with some short shrubby species occurring in the understory of the dominant overstory species. They can range from dense thickets with little understory to relatively mesic mixed shrublands with a rich understory of shrubs, grasses and forbs. These shrubs often have a patchy distribution with grass growing in between. Scattered trees are occasionally present in stands.

Floristics: In many occurrences of this group, the canopy is dominated by the broad-leaved deciduous shrub *Quercus gambelii*, which occasionally reaches small tree size. It may form dense thickets with little understory or be relatively open with a rich understory of shrubs, grasses and forbs. Scattered trees are occasionally present and typically include species of *Juniperus* or *Pinus*. Characteristic shrubs that may co-occur, or be singularly dominant, include *Amelanchier alnifolia*, *Amelanchier utahensis*, *Arctostaphylos patula*, *Artemisia tridentata*, *Ceanothus fendleri*, *Cercocarpus montanus*, *Fendlera rupicola*, *Fraxinus anomala*, *Holodiscus dumosus*, *Jamesia americana*, *Ptelea trifoliata*, *Prunus virginiana*, *Purshia stansburiana*, *Robinia neomexicana*, *Rosa* spp., *Symphoricarpos oreophilus*, and *Symphoricarpos rotundifolius*. The herbaceous layer is sparse to moderately dense, ranging from 1-40% cover. Perennial graminoids are the most abundant species, particularly *Bouteloua curtipendula*, *Bouteloua eriopoda*, *Bouteloua gracilis*, *Aristida* spp., *Carex inops*, *Carex geyeri*, *Elymus arizonicus*, *Eragrostis* spp., *Festuca* spp., *Koeleria macrantha*, *Muhlenbergia* spp., and *Hesperostipa* spp. Many forb and fern species can occur, but none have much cover. Commonly present forbs include *Achillea millefolium*, *Artemisia* spp., *Geranium* spp., *Maianthemum stellatum*, *Thalictrum fendleri*, and *Vicia americana*. Ferns include species of *Cheilanthes* and *Woodsia*. Annual grasses and forbs are seasonally present, and weedy annuals are often present, at least seasonally.

ENVIRONMENT & DYNAMICS

Environmental Description: This group typically occupies the lower slope positions of the foothill and lower montane zones. Stands may occur on level to steep slopes, cliffs, escarpments, rimrock slopes, rocky outcrops, and scree slopes. Climate is semi-arid and

characterized by mostly hot-dry summers with mild to cold winters and annual precipitation of 25 to 70 cm. Precipitation mostly occurs as winter snows but may also consist of some late-summer rains. Soils are typically poorly developed, rocky to very rocky, and well-drained. Parent materials include alluvium, colluvium, and residuum derived from igneous, metamorphic or sedimentary rocks such as granite, gneiss, limestone, quartz, monzonite, rhyolite, sandstone, schist, and shale.

Climate: Climate is semi-arid and characterized by mostly hot-dry summers with mild to cold winters and annual precipitation of 25 to 70 cm. Precipitation mostly occurs as winter snows but may also consist of some late-summer or monsoonal rains.

Soil/substrate/hydrology: Soils are typically poorly developed, rocky to very rocky, and well-drained. Parent materials include alluvium, colluvium, and residuum derived from igneous, metamorphic or sedimentary rocks such as granite, gneiss, limestone, quartz, monzonite, rhyolite, sandstone, schist, and shale.

Dynamics: Fire typically plays an important role, causing die-back of the dominant shrub species in some areas, promoting stump sprouting of the dominant shrubs in other areas, and controlling the invasion of trees into the shrubland system. Natural fires typically result in a mosaic of dense shrub clusters and openings dominated by herbaceous species. In some instances, these associations may be seral to the adjacent *Pinus ponderosa*, *Abies concolor*, and *Pseudotsuga menziesii* woodlands and forests. Ream (1964) noted that on many sites in Utah, Gambel oak may be successional and replaced by *Acer grandidentatum*.

DISTRIBUTION

Geographic Range: This group occurs in the mountains, plateaus and foothills of the southern Rocky Mountains and Colorado Plateau, including the Uinta and Wasatch ranges and the Mogollon Rim.

Spatial Scale & Pattern [optional]: Large patch

Nations: US

States/Provinces: AZ, CO, NM, NV?, UT, WY

TNC Ecoregions [optional]: 9:P, 10:P, 11:P, 18:C, 19:C, 20:C, 21:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313C:C?, 313D:CC, 315A:CC, 315B:CC, 315H:CC, 321A:CC, 322A:CC, 331B:CC, 331F:CC, 331G:CC, 331I:CC, 331J:CC, 331M:CC, 341A:CC, 341B:CC, 341C:CC, 341F:CC, 342A:CC, 342E:CC, 342G:CC, 342J:CC, M313A:CC, M313B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M334A:??, M341A:CC, M341B:CC, M341C:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Arches)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = Gambel Oak (413) (Shiflet 1994)

LOWER LEVEL UNITS

Alliances:

- A3737 *Ceanothus fendleri* Shrubland & Shrub-Steppe Alliance
- A3735 *Quercus gambelii* - *Symphoricarpos oreophilus* Shrubland Alliance
- A3738 *Quercus gambelii* - *Robinia neomexicana* Shrubland Alliance
- A3736 *Fraxinus anomala* - *Rhus trilobata* - *Fendlera rupicola* Talus & Rock Outcrop Shrubland Alliance

AUTHORSHIP

Primary Concept Source: R.D. Ream (1960)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 11/09/2015

Classif Resp Region: West

Internal Author: MEH 3-10, 9-13, mod. KAS 11-15

REFERENCES

References: Christensen 1955, Faber-Langendoen et al. 2017a, Kunzler and Harper 1980, Kunzler et al. 1981, McKell 1950, Ream 1960, Ream 1964, Shiflet 1994

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

G277. Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland

A3737. *Ceanothus fendleri* Shrubland & Shrub-Steppe Alliance

Type Concept Sentence: This alliance is characterized by either shrubland and shrub-steppe vegetation where the dominant shrub is *Ceanothus fendleri*. It is described from Bandelier National Monument in north-central New Mexico and Grand Canyon National Park in northern Arizona and likely occurs elsewhere in the southern Rocky Mountains and Colorado Plateau.

OVERVIEW

Scientific Name: *Ceanothus fendleri* Shrubland & Shrub-Steppe Alliance

Common Name (Translated Scientific Name): Fendler's *Ceanothus* Shrubland & Shrub-Steppe Alliance

Colloquial Name: Fendler's *Ceanothus* Shrubland & Shrub-Steppe

Type Concept: The vegetation is characterized by an open to moderately dense short-shrub layer dominated by *Ceanothus fendleri*. The herbaceous layer is usually moderately dense to dense (to 80% total cover) with *Muhlenbergia montana* or *Poa fendleriana* predominant. Codominants often include *Elymus elymoides*, *Muhlenbergia wrightii*, *Pascopyrum smithii*, or *Schizachyrium scoparium*. Forb cover is highly variable. This montane shrubland and steppe alliance is described from Bandelier National Monument in north-central New Mexico and Grand Canyon National Park in northern Arizona and likely occurs elsewhere in the southern Rocky Mountains and Colorado Plateau. Stands are found on gently rolling mesatops and high level plateaus (5-15% slope), though occasionally they can be found on moderately steep upper sideslopes (30% slope). Aspect is variable. Soils are primarily well-developed, silty or sandy loams. This alliance occurs in areas that have experienced somewhat recent high-intensity, stand-replacing fire events, and typically occurs within a matrix of live *Pinus ponderosa* woodlands, so scattered *Pinus ponderosa* are occasionally present as seedlings or remnant live mature trees.

Classification Comments: This alliance is geographically broad, but conceptually narrow in scope consisting of two poorly documented associations documented only from Grand Canyon National Park and Bandelier National Monument. More survey and classification work are needed to fully characterize this type.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Temperate broad-leaved, deciduous shrubland or shrub-steppe in which *Ceanothus fendleri* is the dominant shrub. The understory is dominated by perennial grasses and may reach as much as 80% cover. The most common dominants are *Poa fendleriana* and *Muhlenbergia montana*.

VEGETATION

Physiognomy and Structure: Vegetation in this shrubland and shrub-steppe alliance is characterized by a moderately dense cover of broad-leaved deciduous short shrubs (2-8 cm tall). The graminoid layer is open to dense (to 80% cover) and dominated by medium-tall bunchgrasses. The forb layer is generally sparse but may have high species diversity. Annual grasses and forbs are seasonally present.

Floristics: This shrubland and shrub-steppe alliance is characterized by an open to moderately dense short-shrub layer dominated by *Ceanothus fendleri*. *Quercus gambelii* and *Robinia neomexicana* are frequent associates, but are usually poorly represented and are clearly not dominant. The herbaceous layer is usually moderately dense to dense (>80% total cover) with *Muhlenbergia montana* or *Poa fendleriana* predominant. Codominants often include *Elymus elymoides*, *Muhlenbergia wrightii*, *Pascopyrum smithii*, or *Schizachyrium scoparium*. Forb cover is highly variable from stand to stand; common associates include *Artemisia carruthii*, *Chenopodium* sp., *Epilobium brachycarpum*, *Erigeron divergens*, *Gayophytum diffusum*, *Heterotheca villosa* and *Solidago velutina*. Exotic species *Bromus tectorum* and *Conyza canadensis* are frequent in disturbed stands. Scattered *Pinus ponderosa* saplings and mature trees can occur, but cover is less than 10%.

ENVIRONMENT & DYNAMICS

Environmental Description: This montane shrubland and shrub-steppe is described from Bandelier National Monument in north-central New Mexico and Grand Canyon National Park in northern Arizona and likely occurs elsewhere in the southern Rocky Mountains and Colorado Plateau. Elevation ranges between 2200 and 2575 m (7210-8422 feet). Stands are found on gently rolling mesatops and high level plateaus (5-15% slope), though occasionally they can be found on moderately steep upper sideslopes (30% slope). Aspect is variable with lower elevation stands occurring on north-facing slopes and higher elevation stands occurring on warmer south-facing slopes. Soils are primarily well-developed, silty or sandy loams, including Mollisols derived from pumice or rhyolitic tuff alluvium or colluvium parent materials, or on occasion, fine-textured Alfisols developed from eolian deposits over rhyolitic tuff parent materials. The ground surface is characterized by scattered patches of exposed soil and herbaceous litter amid an abundant herbaceous layer. This alliance occurs in areas that have experienced somewhat recent high-intensity, stand-replacing

fire events, and typically occurs within a matrix of live *Pinus ponderosa* woodlands, so scattered *Pinus ponderosa* are occasionally present as seedlings or remnant live mature trees.

Dynamics: This seral alliance occurs in areas that have experienced somewhat recent high-intensity, stand-replacing fire events.

DISTRIBUTION

Geographic Range: This montane shrubland and shrub-steppe alliance is described from Bandelier National Monument in north-central New Mexico and Grand Canyon National Park in northern Arizona and likely occurs elsewhere in the southern Rocky Mountains and Colorado Plateau.

Nations: US

States/Provinces: AZ, NM

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- C EGL005501 *Ceanothus fendleri* / *Poa fendleriana* Shrub-Steppe
- C EGL005376 *Ceanothus fendleri* / *Muhlenbergia montana* Shrubland

AUTHORSHIP

Primary Concept Source: E. Muldavin et al. (2011b)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by K. Christie and K.S. King after A. Browder and E. Muldavin.

Version Date: 2014/12/18

REFERENCES

References: Faber-Langendoen et al. 1996, Faber-Langendoen et al. 2017b, Muldavin et al. 2011b, Reid and Hall 2010

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

G277. Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland

A3736. *Fraxinus anomala* - *Rhus trilobata* - *Fendlera rupicola* Talus & Rock Outcrop Shrubland Alliance

Type Concept Sentence: This mixed shrub alliance of the southern Rocky Mountains encompasses shrublands dominated by *Brickellia californica*, *Fraxinus anomala*, *Fendlera rupicola*, *Jamesia americana*, *Prunus virginiana*, and/or *Rhus trilobata* occupying talus, scree, rock outcrop and moderate to steep colluvial slope sites.

OVERVIEW

Scientific Name: *Fraxinus anomala* - *Rhus trilobata* - *Fendlera rupicola* Talus & Rock Outcrop Shrubland Alliance

Common Name (Translated Scientific Name): Singleleaf Ash - Skunkbush Sumac - Cliff Fendlerbush Talus & Rock Outcrop Shrubland Alliance

Colloquial Name: Singleleaf Ash - Skunkbush Sumac - Cliff Fendlerbush Talus & Rock Outcrop Shrubland

Type Concept: This shrubland alliance occurs in Colorado Plateau, southern Rocky Mountains, and Great Basin. Vegetation in this mixed, short (<2 m tall) shrubland alliance is variable. The shrub canopy has sparse to moderate cover, often with irregularly distributed dense shrub patches located below cliffs, on benches, in dry channels, on toeslopes and lower slopes, and near seeps where soil moisture is more available. Stands are often characterized by a sparse to low cover (<15% total cover) mix of xeric shrubs; *Brickellia californica*, *Fraxinus anomala*, *Fendlera rupicola*, and *Rhus trilobata* are conspicuous and usually at least codominant. At higher elevations and in microsites, mesic- and cool-site shrubs such as *Jamesia americana*, *Prunus virginiana*, *Ribes cereum*, *Rubus deliciosus*, *Holodiscus dumosus*, *Dasiphora fruticosa* ssp. *floribunda*, and *Acer glabrum* are characteristic. Many other shrub species may be present. The herbaceous layer is also variable depending on site characteristics and may include many species but none provides more than a few percent cover. Biological soil crust formation is rare on active slopes. Lichens provide large amounts of foliar cover, at times from 30-60% on more stable rock. This shrubland alliance occurs in canyons, plateaus, foothill and mountain

slopes or rocky colluvial slopes and rock outcrop/large cliff faces. Elevations range from 1268 to 2715 m (4160-8900 feet). Slopes are moderate to very steep and are often oriented to the cooler north or east aspects. Soils tend to be sandy and skeletal.

Classification Comments: Associations included here not only have overlapping environmental characteristics, but floristics as well with the exception of *Jamesia americana* - (*Physocarpus monogynus*, *Holodiscus dumosus*) Rock Outcrop Shrubland (CEGL002783) which has a more unique suite of species and has been added here provisionally.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Temperate cold-deciduous shrublands dominated by *Brickellia californica*, *Fraxinus anomala*, *Fendlera rupicola*, *Jamesia americana*, *Prunus virginiana*, and/or *Rhus trilobata* occupying talus, scree, rock outcrop and moderate to steep colluvial slope sites.

VEGETATION

Physiognomy and Structure: Temperate cold-deciduous shrublands with sparse to moderately dense, often patchy short-shrub layer (<20 tall) with a sparse herbaceous layer of a mixture of species.

Floristics: Vegetation in this mixed, short (<20 m tall) shrubland alliance is variable. The shrub canopy has sparse to moderate cover, often with irregularly distributed dense shrub patches located below cliffs, on benches, in dry channels, on toeslopes and lower slopes, and near seeps where soil moisture is more available. Stands are often characterized by a sparse to low cover (<15% total cover) mix of xeric shrubs; *Brickellia californica*, *Fraxinus anomala*, *Fendlera rupicola*, and *Rhus trilobata* are conspicuous and usually at least codominant. At higher elevations and in microsites, mesic- and cool-site shrubs such *Jamesia americana*, *Prunus virginiana*, *Ribes cereum*, *Rubus deliciosus*, *Holodiscus dumosus*, *Dasiphora fruticosa* ssp. *floribunda*, and *Acer glabrum* are characteristic. Many other shrub species may be present, including *Artemisia bigelovii*, *Artemisia tridentata*, *Atriplex confertifolia*, *Cercocarpus montanus*, *Chrysothamnus viscidiflorus*, *Ephedra torreyana*, *Ephedra viridis*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Opuntia* spp., and *Philadelphus microphyllus*. If *Quercus gambelii* is present, it has low cover (<5%) and does not dominate the site. The herbaceous layer is also variable depending on site characteristics and may include many species but none provides more than a few percent cover. *Achnatherum hymenoides*, *Artemisia dracuncululus*, *Artemisia ludoviciana*, *Bouteloua gracilis*, *Chamaesyce fendleri*, *Muhlenbergia montana*, *Pleuraphis jamesii*, *Stanleya pinnata*, and *Xylorhiza* spp. are the most consistent species. Biological soil crust formation is rare on active slopes. Lichens provide large amounts of foliar cover, at times from 30-60% on more stable rock.

ENVIRONMENT & DYNAMICS

Environmental Description: This shrubland alliance occurs in canyons, foothill, plateaus and mountain slopes or rocky colluvial slopes and rock outcrop/large cliff faces in the Colorado Plateau, southern Rocky Mountains, and Great Basin. Elevations range from 1268 to 2715 m (4160-8900 feet). Slopes are moderate to very steep and are often oriented to cooler north or east aspects. The shrubs often grow within the cracks on the rocks and around the base of the rocks where accumulations of small gravel and soil occur. The high cover of rock on the ground surface acts both to concentrate runoff and as mulch to slow evaporation from the soil. Thus, relatively mesic species are able to persist on otherwise dry sites. The unvegetated surface is mostly covered by rocks, gravel, boulders, bedrock and bare soil, with little litter or dead wood evident. Soils tend to be sandy, skeletal, with a few stands on silt loams or clay loams derived from shale.

Dynamics:

DISTRIBUTION

Geographic Range: This shrubland alliance is known from canyons, plateaus and mountain slopes in the Colorado Plateau, southern Rocky Mountains, and Great Basin of Utah, Colorado, New Mexico and Nevada.

Nations: US

States/Provinces: CO, NM, NV, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > *Fendlera rupicola* Shrubland Alliance (Coles et al. 2009a)
- > *Jamesia americana* Shrubland Alliance (Muldavin et al. 2011b)
- > *Prunus virginiana* Shrubland Alliance (Schulz and Hall 2011)

LOWER LEVEL UNITS**Associations:**

- CEG003493 *Brickellia californica* - *Rhus trilobata* Shrubland
- CEG002783 *Jamesia americana* - (*Physocarpus monogynus*, *Holodiscus dumosus*) Rock Outcrop Shrubland
- CEG005444 *Prunus virginiana* - Mixed Shrub Talus Shrubland
- CEG002765 *Fendlera rupicola* Talus Shrubland
- CEG003963 *Fraxinus anomala* - *Rhus trilobata* Dry Talus and Slickrock Shrubland

AUTHORSHIP

Primary Concept Source: M.E. Hall, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by G. Kittel and M.E. Hall.

Version Date: 2014/12/18

REFERENCES

References: Coles et al. 2009a, Faber-Langendoen et al. 2017b, Muldavin et al. 2011b, Reid and Hall 2010, Schulz and Hall 2011

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

G277. Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland

A3735. *Quercus gambelii* - *Symphoricarpos oreophilus* Shrubland Alliance

Type Concept Sentence: This shrubland alliance of the Colorado Plateau and southern Rocky Mountains is characterized by dominance or codominance of *Quercus gambelii* in association with other mid-elevation shrubs.

OVERVIEW

Scientific Name: *Quercus gambelii* - *Symphoricarpos oreophilus* Shrubland Alliance

Common Name (Translated Scientific Name): Gambel Oak - Mountain Snowberry Shrubland Alliance

Colloquial Name: Gambel Oak - Mountain Snowberry Shrubland

Type Concept: This shrubland alliance occurs in the Colorado Plateau and southern Rocky Mountains and is characterized by dominance or codominance of *Quercus gambelii* in a moderately dense to dense tall- or short-shrub layer, typically 2-5 m tall, but can also occur as 1-m tall clumps to small trees over 5 m tall. The variable structure includes patches of oak shrubs with grass growing in between, dense oak thickets with little understory, and relatively mesic, tall shrublands with a rich understory of short shrubs, grasses and forbs. Scattered trees are occasionally present in stands and typically include species of *Pinus* or *Juniperus*. Characteristic shrubs that may codominate or form a separate short-shrub layer include *Amelanchier alnifolia*, *Amelanchier utahensis*, *Artemisia tridentata*, *Cercocarpus montanus*, *Fendlera rupicola*, *Prunus virginiana*, *Rhus trilobata*, *Symphoricarpos oreophilus*, and *Symphoricarpos rotundifolius*. The herbaceous layer is sparse to moderately dense, ranging from 1-40% cover and is dominated by perennial graminoids, particularly *Bouteloua curtipendula*, *Bouteloua gracilis*, *Carex geyeri*, *Carex inops*, *Elymus arizonicus*, *Festuca thurberi*, *Koeleria macrantha*, *Muhlenbergia montana*, *Hesperostipa comata*, and *Poa fendleriana*. Many forb and fern species can occur, but none has much cover. Stands occur in the foothills and lower montane slopes, mesas and canyons. Elevations range from 1550-2950 m. Sites range from nearly level mesatops to steep (to 80%), rocky slopes on upper slopes and ridgetops. Other stands occur in canyon bottoms and along drainages. Soils are generally deep, coarse-textured, and well-drained.

Classification Comments:

Internal Comments: KAS 12-14: move CEG002951 *Symphoricarpos oreophilus* Shrubland to A3208 *Artemisia tridentata* ssp. *vaseyana* - Mixed Shrubland Alliance (better fit).

Other Comments:

Similar NVC Types:

- A3738 *Quercus gambelii* - *Robinia neomexicana* Shrubland Alliance: is dominated or codominated by *Robinia neomexicana* and occurs in the southern extent of this group's range.

Diagnostic Characteristics: Temperate cold-deciduous shrublands 1-2 m tall dominated or codominated by *Quercus gambelii* in association with other mid-elevation shrubs. Understories are sparse to dense and typically grass- or sedge-dominated. Stands codominated by *Robinia neomexicana* are not included in this alliance.

VEGETATION

Physiognomy and Structure: Vegetation in this shrubland alliance is characterized by a moderately dense cover of broad-leaved deciduous shrubs. The graminoid layer is sparse to moderately dense and dominated by medium-tall bunchgrasses. The forb layer is generally sparse but may have high species diversity. Annual grasses and forbs are seasonally present.

Floristics: This shrubland alliance is characterized by dominance or codominance of *Quercus gambelii* in a moderately dense to dense tall- or short-shrub layer, typically 2-5 m tall, but can also occur as 1-m tall clumps to small trees over 5 m tall. The variable structure includes patches of oak shrubs with grass growing in between, dense oak thickets with little understory, and relatively mesic, tall shrublands with a rich understory of short shrubs, grasses and forbs. Scattered trees are occasionally present in stands and typically include *Pinus edulis*, *Pinus ponderosa*, or *Juniperus* spp. Characteristic shrubs that may codominate or form a separate short-shrub layer include *Arctostaphylos patula*, *Amelanchier alnifolia*, *Amelanchier utahensis*, *Artemisia tridentata*, *Cercocarpus montanus*, *Fendlera rupicola*, *Holodiscus dumosus*, *Paxistima myrsinites*, *Ptelea trifoliata*, *Prunus virginiana*, *Rhus trilobata*, *Rosa* spp., *Symphoricarpos oreophilus*, and *Symphoricarpos rotundifolius*. The herbaceous layer is sparse to moderately dense, ranging from 1-40% cover and is dominated by perennial graminoids, particularly *Bouteloua curtipendula*, *Bouteloua eriopoda*, *Bouteloua gracilis*, *Carex geyeri*, *Carex inops*, *Elymus arizonicus*, *Festuca thurberi*, *Koeleria macrantha*, *Muhlenbergia montana*, *Hesperostipa comata*, and *Poa fendleriana*. Many forb and fern species can occur, but none has much cover. Commonly present forbs include *Achillea millefolium*, *Artemisia* spp., *Geranium* spp., *Maianthemum stellatum*, *Thalictrum fendleri*, and *Vicia americana*. Ferns include species of *Cheilanthes* and *Woodsia*. Annual grasses and forbs are seasonally present. In Texas occurrences, associated species can include *Holodiscus dumosus* and *Symphoricarpos oreophilus*. Additional species found in associations of this alliance include *Cercocarpus montanus*, *Carex geyeri*, *Amelanchier alnifolia*, *Amelanchier utahensis*, *Artemisia tridentata*, *Carex inops*, *Paxistima myrsinites*, *Rhus trilobata* and *Symphoricarpos rotundifolius*.

ENVIRONMENT & DYNAMICS

Environmental Description: Shrublands included in this alliance occur in the foothills and lower montane slopes of isolated desert mountain ranges, mesas and canyons from Nevada to western Texas, as well as in the lower montane zone of the southern Rocky Mountains, Uinta Mountains and high plateaus of southern Utah. Elevations range from 1550-2950 m. Climate is semi-arid. Summers are generally hot, and winters range from mild with cold periods and occasional snows in the southern part of its range to extended periods of freezing temperatures in the northern part of its range. The seasonality of precipitation varies, but most of the 35-70 cm of mean annual precipitation occurs during the growing season. Stands occur on nearly level to steep (to 80%), rocky slopes in canyons, mountain slopes and ridgetops while other stands occur in canyon bottoms and along drainages. Aspect does not seem important except in the southern range extent where stands are restricted to the more mesic north slopes. Soils are generally deep, coarse-textured, and well-drained. Soil texture is typically a cobbly and gravelly loamy sand and gravelly loam, but the alliance also occurs on well-drained clay soil. Parent materials are varied and include quartzite, monzonite, shale and alluvium. Adjacent vegetation at higher elevations is typically conifer woodlands or forests dominated by *Pinus ponderosa*, *Pinus contorta*, or *Pseudotsuga menziesii*, but *Populus tremuloides* forests are also common in the northern part of its range. Adjacent vegetation below these stands is often medium-tall grasslands in southeastern Colorado or shrublands dominated by *Artemisia* spp. in western Colorado.

Dynamics: The distribution of *Quercus gambelii* was studied by Neilson and Wullstein (1983) with respect to climatic patterns. They found the species to be limited by seedling mortality from severe spring frosts and summer drought. The northern extent of the species is in alignment with the winter polar front that runs along the boundary between southern Wyoming and Colorado and Utah. Its western range limit aligns with the westward extent of summer moisture from the Arizona monsoon, which approximates the western Arizona border. Reproducing stands in northern Utah that exist north of summer monsoon moisture are restricted to more mesic sites. Seedling recruitment is more common in the southern part of its range than the northern (Neilson and Wullstein 1983).

Quercus gambelii is a fire-adapted species (Clary 1992). The root systems are well-developed and draw moisture from a large volume of soil allowing for rapid resprouting after fire. Muldavin et al. (1998b) reported that, in the Organ Mountains in southwestern New Mexico after a severe fire, *Quercus gambelii* resprouted into a dense thicket that excluded both herbaceous understory and conifer species. They suggested frequent small cool fires would favor the establishment of conifers and maintain an herbaceous understory. *Quercus gambelii* shrubs also resprout vigorously after stems are killed with almost all herbicides or removed by chaining or cutting for firewood (Clary 1992). Altered fire regimes, fuelwood harvest, and grazing by livestock have significant impacts to the quality of sites. More study is needed to understand and manage these shrublands ecologically.

DISTRIBUTION

Geographic Range: This alliance is known from the Colorado Plateau, southern Rocky Mountains, Great Basin, Utah High Plateaus, and Wyoming basins of Utah, Colorado, Wyoming, New Mexico and Arizona.

Nations: US

States/Provinces: AZ, CO, NM, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = *Quercus gambelii* Association (132.111) (Brown 1982a) [included within Great Basin Montane Scrub, Oak-scrub Series]
- = *Quercus gambelii* Series (Johnston 1987)

LOWER LEVEL UNITS

Associations:

- CEG002695 *Arctostaphylos patula* - *Quercus gambelii* - (*Amelanchier utahensis*) Shrubland
- CEG005995 *Quercus gambelii* / *Carex geyeri* Shrubland
- CEG001113 *Quercus gambelii* - *Cercocarpus montanus* / (*Carex geyeri*) Shrubland
- CEG001109 *Quercus gambelii* / *Amelanchier alnifolia* Shrubland
- CEG001111 *Quercus gambelii* / *Artemisia tridentata* Shrubland
- CEG002915 *Quercus gambelii* / *Hesperostipa comata* Shrubland
- CEG002949 *Quercus gambelii* / *Poa fendleriana* Shrubland
- CEG001114 *Quercus gambelii* / *Paxistima myrsinites* Shrubland
- CEG001117 *Quercus gambelii* / *Symphoricarpos oreophilus* Shrubland
- CEG002805 *Quercus gambelii* / *Festuca thurberi* Shrubland
- CEG001112 *Quercus gambelii* / *Carex inops* Shrubland
- CEG002910 *Rhus trilobata* Rocky Mountain Shrubland
- CEG002337 *Quercus gambelii* / Sparse Understory Shrubland
- CEG002338 *Quercus gambelii* / *Rhus trilobata* Shrubland
- CEG002341 *Quercus gambelii* - *Holodiscus dumosus* Shrubland
- CEG002477 *Quercus gambelii* Shrubland
- CEG004010 *Quercus gambelii* / *Fendlera rupicola* Shrubland
- CEG005994 *Quercus gambelii* / *Prunus virginiana* Shrubland
- CEG001110 *Quercus gambelii* / *Amelanchier utahensis* Shrubland

AUTHORSHIP

Primary Concept Source: D.E. Brown (1982a)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Anderson et al. 1985, Baker 1982b, Barbour and Major 1977, Blackhawk Coal Company 1981, Boucek 1986, Brown 1982a, Cedar Creek Associates, Inc. 1987, Christensen 1949, Christensen 1955, Clary 1992, Conard and Radosevich 1982, Dillinger 1970, Ellis and Hackney 1981, Erdman 1962, Evans 1926, Evans 1936, Faber-Langendoen et al. 2017b, Ferchau 1973, Forsling and Storm 1929, Hanson and Ball 1928, Hess and Wasser 1982, Hinckley 1944, Hoffman and Alexander 1980, Johnston 1987, Keammerer and Peterson 1981, Kittel et al. 1994, Kittel et al. 1999a, Komarkova et al. 1988a, Komarkova et al. 1988b, Kunzler et al. 1981, Livingston 1947, Livingston 1949, McKell 1950, Mazingo 1987, Muldavin 1994, Muldavin and Mehlhop 1992, Muldavin et al. 1998b, Neilson and Wullstein 1983, Ream 1960, Schmoll 1935, Soil Conservation Service 1978, Thorne Ecological Institute 1973a, Townsend 1966, Vories 1974, Warren and Treadwell 1980, Warren et al. 1982, Watson 1912

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

2.B.2.Na.1.b. M049 Southern Rocky Mountain Montane Shrubland

G276. Southern Rocky Mountain Mountain-mahogany - Mixed Foothill Shrubland

Type Concept Sentence: This foothills shrubland group occurs in the Rocky Mountains and Colorado Plateau from lower montane zone to canyons and breaks in the western Great Plains and is characterized by an open to closed shrub layer of nearly pure *Cercocarpus montanus* or a mixed shrub layer with *Amelanchier utahensis*, *Quercus x pauciloba*, *Purshia tridentata*, *Rhus trilobata*, *Ribes cereum*, or *Symphoricarpos oreophilus*.

OVERVIEW

Scientific Name: *Cercocarpus montanus* - *Quercus x pauciloba* - *Rhus trilobata* Foothill Shrubland Group

Common Name (Translated Scientific Name): Alderleaf Mountain-mahogany - Wavyleaf Oak - Skunkbush Sumac Foothill Shrubland Group

Colloquial Name: Utah Serviceberry - Mountain-mahogany Shrubland

Type Concept: This Rocky Mountain foothill shrubland group ranges from southern New Mexico north into Wyoming, and west into the Intermountain West region. *Cercocarpus montanus* dominates pure stands in parts of Wyoming and Colorado. The vegetation is typically dominated by a variety of shrubs, including *Amelanchier utahensis*, *Cercocarpus montanus*, *Quercus x pauciloba*, *Purshia tridentata*, *Rhus trilobata*, *Ribes cereum*, *Symphoricarpos oreophilus*, or *Yucca glauca*. Grasses and sedges are dominant in the understory and may include *Achnatherum scribneri*, *Bouteloua curtipendula*, *Carex geyeri*, *Elymus lanceolatus*, *Hesperostipa comata*, *Hesperostipa neomexicana*, *Leymus ambiguus*, *Muhlenbergia montana*, and *Pseudoroegneria spicata*. Scattered trees or inclusions of grassland patches or steppe may be present. Stands are found in the foothills, canyon slopes and lower mountains of the Rocky Mountains and on outcrops and canyon slopes in the western Great Plains. These shrublands occur between 1500 and 2900 m elevation and are usually associated with exposed sites, rocky substrates, and dry conditions, which limit tree growth. It is common where *Quercus gambelii* is absent, such as the northern Colorado Front Range and in drier foothills and prairie hills. This group is generally drier than Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland Group (G277), but may include mesic montane shrublands where *Quercus gambelii* does not occur. Fires play an important role in this group as the dominant shrubs usually have a severe die-back, although some plants will stump sprout. *Cercocarpus montanus* requires a disturbance such as fire to reproduce, either by seed sprout or root-crown sprouting. Fire suppression may have allowed an invasion of trees into some of these shrublands, but in many cases, sites are too xeric for tree growth.

Classification Comments: While *Cercocarpus montanus* is the common dominant shrub in this group, it is not the only dominant, and in many occurrences is not found at all. In addition, in some occurrences, shrub cover is low, which allows for some stands to be graminoid-dominated. In Wyoming, stands where *Cercocarpus montanus* is a component of mixed shrublands are placed in Central Rocky Mountain Montane-Foothill Deciduous Shrubland Group (G272).

Similar NVC Types:

- G277 Southern Rocky Mountain Gambel Oak - Mixed Montane Shrubland
- G272 Central Rocky Mountain Montane-Foothill Deciduous Shrubland

Diagnostic Characteristics: Open to dense broadleaf shrublands or shrub-grasslands where *Cercocarpus montanus* occurs as the most often dominant shrub, but may be a codominant or be absent in some stands. Other characteristic shrubs include *Amelanchier utahensis*, *Artemisia tridentata*, *Cercocarpus intricatus*, *Fallugia paradoxa*, *Fendlera rupicola*, *Glossopetalon spinescens*, *Purshia tridentata*, *Quercus x pauciloba*, *Ribes cereum*, and *Rhus trilobata*. The herbaceous layer is characterized by an open to dense layer of grasses and sedges. Typical species include *Achnatherum scribneri*, *Bouteloua curtipendula*, *Carex geyeri*, *Elymus lanceolatus*, *Hesperostipa comata*, *Hesperostipa neomexicana*, *Leymus ambiguus*, *Muhlenbergia montana*, and *Pseudoroegneria spicata*.

VEGETATION

Physiognomy and Structure: Open to dense, broadleaf deciduous shrublands or shrub-grasslands with canopies 1-2 m tall. Occurrences are typically multi-layered shrub-dominated stands where grasses occur in canopy openings. In occurrences where shrub cover is open, grasses may attain higher cover than overstory shrubs.

Floristics: This group consists of two major cover types: those most commonly dominated by *Cercocarpus montanus* or by *Purshia tridentata*. Within these communities, either nominal may be dominant, codominant or absent. Other shrubs include *Amelanchier utahensis*, *Artemisia tridentata*, *Cercocarpus intricatus*, *Fallugia paradoxa*, *Fendlera rupicola*, *Glossopetalon spinescens*, *Quercus x pauciloba*, *Rhus trilobata*, *Ribes cereum*, *Symphoricarpos oreophilus*, or *Yucca glauca*. Grasses are prominent and include *Andropogon gerardii*, *Achnatherum scribneri*, *Bouteloua curtipendula*, *Elymus lanceolatus* ssp. *lanceolatus*, *Hesperostipa comata*, *Hesperostipa neomexicana*, *Muhlenbergia montana*, and *Pseudoroegneria spicata*.

ENVIRONMENT & DYNAMICS

Environmental Description: This group is found on gentle to extremely steep slopes (5-60%) on slopes, ridges, canyons, mesas, and less often sand dunes. Sites are often subject to drought stress. Elevations range from 1500 to 2700 m. Geologic substrates can include sandstone, shale, basalt, and limestone. Soils are generally poorly developed, rapidly drained and include sand, sandy loam, coarse gravels, loams, and clay loams.

Dynamics:**DISTRIBUTION**

Geographic Range: This group is found in the foothills, canyon slopes and lower mountains of the southern Rocky Mountains and on outcrops and canyon slopes in the western and southern Great Plains. It ranges from southern New Mexico, extending north into Wyoming, and west into the Intermountain West region.

Spatial Scale & Pattern [optional]: Large patch

Nations: US

States/Provinces: CO, MT, NE?, NM, NV?, SD, TX, UT, WY

TNC Ecoregions [optional]: 9:P, 10:C, 11:P, 18:C, 19:C, 20:C, 21:C, 25:C, 26:C, 27:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 315A:CC, 315B:CC, 315H:CP, 321A:CC, 331B:CC, 331F:CC, 331G:CC, 331H:CC, 331I:CC, 331J:CC, 341B:CC, 341C:CC, 342E:CC, 342F:CC, 342G:CC, M313B:CC, M331A:CP, M331B:CP, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332G:??, M334A:??, M341B:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = Mountain Mahogany - Mixed Shrub Series (Dick-Peddie 1993)

LOWER LEVEL UNITS**Alliances:**

- A3733 *Cercocarpus montanus* - *Quercus x pauciloba* Shrubland Alliance
- A3731 *Purshia tridentata* - *Ribes cereum* Shrubland Alliance
- A3730 *Fallugia paradoxa* - *Rhus trilobata* Shrubland Alliance
- A3732 *Amelanchier utahensis* - *Cercocarpus montanus* - *Cercocarpus intricatus* Shrubland Alliance

AUTHORSHIP

Primary Concept Source: K. Hess and C.H. Wasser (1982)

Author of Description: M.E. Hall and K.A. Schulz

Acknowledgments:

Version Date: 11/09/2015

Classif Resp Region: West

Internal Author: MEH 3-10, 9-13, mod, KAS 11-15

REFERENCES

References: Dick-Peddie 1993, Faber-Langendoen et al. 2017a, Hess 1981, Hess and Wasser 1982, Johnston 1987, Marriott and Faber-Langendoen 2000, Muldavin 1994, Muldavin et al. 2000b, Shiflet 1994, Thilenius et al. 1995

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

G276. Southern Rocky Mountain Mountain-mahogany - Mixed Foothill Shrubland

A3732. Amelanchier utahensis - Cercocarpus montanus - Cercocarpus intricatus Shrubland Alliance

Type Concept Sentence: This alliance is characterized by shrublands dominated by *Amelanchier utahensis*, *Cercocarpus montanus* or *Cercocarpus intricatus* in the southern Rocky Mountains, Wyoming Basins, Colorado Plateau and extending west to the Great Basin.

OVERVIEW

Scientific Name: *Amelanchier utahensis* - *Cercocarpus montanus* - *Cercocarpus intricatus* Shrubland Alliance

Common Name (Translated Scientific Name): Utah Serviceberry - Alderleaf Mountain-mahogany - Littleleaf Mountain-mahogany Shrubland Alliance

Colloquial Name: Utah Serviceberry - Mountain-mahogany Shrubland

Type Concept: This alliance is known from the southern Rocky Mountains, Wyoming Basins, Colorado Plateau and extending west to the Great Basin. Stands are characterized by mixed tall-shrub canopies dominated by *Amelanchier utahensis*, *Cercocarpus montanus*, or *Cercocarpus intricatus*. Species that may codominate in some stands include *Artemisia tridentata*, *Fendlera rupicola*, *Glossopetalon spinescens*, and *Rhus trilobata*. Total canopy cover ranges from sparse to moderately dense. Occasional trees, such as *Juniperus* spp., *Quercus* spp., *Pinus edulis*, *Pinus ponderosa*, or *Pseudotsuga menziesii*, may be scattered in some stands. The herbaceous layer is variable and may have sparse to moderate cover. The most typical dominants are graminoids and may include *Carex geyeri*, *Elymus lanceolatus* ssp. *lanceolatus*, *Hesperostipa comata*, and *Pseudoroegneria spicata*. Elevations range from 1800-2700 m. Sites are variable but are generally xeric and rocky with moderate to very steep slopes or on ridges. Stands are found on various aspects, but typically the higher elevation and northern sites are on warmer, southern exposures, and lower elevation and southern stands are restricted to more mesic north slopes.

Classification Comments: Inclusion of *Cercocarpus intricatus* Montane Shrubland (CEGL002587) is tentative as it occupies the same geographic range and montane environments of other associations in this alliance and has similar floristics. *Cercocarpus intricatus* - *Glossopetalon spinescens* Shrubland (CEGL005426) is included in that it is montane with some floristic overlap, but is a geographic outlier, therefore placement here is low in confidence. Other *Cercocarpus intricatus* associations are more associated with slickrock environments and range more western and southern.

Internal Comments: mjr 12-14: CA added for MOJN.

Other Comments:

Similar NVC Types: This alliance is distinguished from the alliance listed above in have species with more northern distributions.

- A3733 *Cercocarpus montanus* - *Quercus x pauciloba* Shrubland Alliance: has species with more southern distributions.

Diagnostic Characteristics: Mixed montane shrublands dominated *Amelanchier utahensis*, *Cercocarpus montanus*, or occasionally *Cercocarpus intricatus*. Shrub cover may be sparse to moderate. These shrublands may be either codominated by other shrub species or have sparse to dense understories of graminoids. Tree may be present, but are scattered and have low cover.

VEGETATION

Physiognomy and Structure: This alliance is characterized by a moderate to dense canopy of cold-deciduous shrubs up to 4 m in height. There is often another stratum (sometimes two) of low cold-deciduous shrubs from 0.5-2 m tall. The ground layer is usually a species-rich assemblage of caespitose graminoids and erect forbs.

Floristics: These shrublands are typically sparse to dense and tall with multiple vegetation layers. The upper shrub layer is typically dominated by *Amelanchier utahensis*, *Cercocarpus montanus*, or *Cercocarpus intricatus*. Species that may codominate in some stands include *Artemisia tridentata*, *Fendlera rupicola*, *Glossopetalon spinescens*, and *Rhus trilobata*. Other shrub associates may include *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Eriogonum corymbosum*, *Holodiscus dumosus*, *Mahonia repens*, *Purshia tridentata*, *Ribes cereum*, *Rosa woodsii*, *Symphoricarpos oreophilus*, and *Tetradymia canescens*. Occasional trees, such as *Juniperus* spp., *Quercus* spp., *Pinus edulis*, *Pinus ponderosa* or *Pseudotsuga menziesii*, may be scattered in some stands. The herbaceous layer is variable and may have sparse to moderate cover and is most often dominated by graminoids. Dominant graminoids may include *Carex geyeri*, *Elymus lanceolatus* ssp. *lanceolatus*, *Hesperostipa comata*, and *Pseudoroegneria spicata*. Other associated graminoids may include *Achnatherum hymenoides*, *Koeleria macrantha*, *Leymus salinus*, *Poa fendleriana*, and *Poa fendleriana*. Forbs do not contribute significant cover, but may be diverse in some stands. Associates may include *Artemisia ludoviciana*, *Balsamorhiza sagittata*, *Collinsia parviflora*, *Hedeoma hispida*, *Lathyrus pauciflorus*, and *Symphytotrichum oblongifolium* (= *Aster oblongifolius*).

ENVIRONMENT & DYNAMICS

Environmental Description: Plant associations in this alliance occur at middle elevations (1850-2700 m) of mountains. Climate is semi-arid. Summers are hot and winters are typically cold, with freezing temperatures and snow common, however, stands on the southwestern U.S. may have mild winter temperatures. Precipitation ranges from 30-50 cm annually with a large proportion falling as winter snow. Sites are variable but are generally xeric and rocky with moderate to very steep slopes or on ridges. Stands are found on various aspects, but typically the higher elevation and northern sites are on warmer, southern exposures, and lower elevation and southern stands are restricted to more mesic north slopes. Environments include sheltered rocky canyons, mesa slopes, slickrock, moderate to very steep slopes and ridges. Soils are variable, from shallow and skeletal near rock outcroppings, to moderately deep with abundant organic matter. Soil textures range from sandy loam to clay. Soils range from slightly acidic to slightly alkaline depending on parent material, which includes alluvium, colluvium and residuum from igneous, metamorphic or sedimentary rocks such as granite, gneiss, limestone, quartz monzonite, rhyolite, sandstone, schist and shale.

Dynamics: Yake and Brotherson (1979) noted that regeneration of *Amelanchier utahensis* was most favorable on moderately deep, fine-textured soils of northerly-aspected sites. They noted that seedling herbivory by native ungulates was greater at such sites. Annual grasses were noted to have a negative effect on seedling densities. *Amelanchier utahensis* hybridizes with *Amelanchier*

alnifolia, and distinctions between the two species may become blurred in areas where their ranges overlap. *Cercocarpus montanus* is a dominant understory species in several woodland and forests dominated by *Juniperus deppeana*, *Juniperus monosperma*, *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus edulis*, *Pinus ponderosa*, *Pseudotsuga menziesii*, *Quercus gambelii*, *Quercus grisea*, and *Quercus x pauciloba*. *Cercocarpus montanus* stands often occur in the more xeric habitat below these woodland and forest stands. In xeric habitats studied by Greenwood and Brotherson (1978), *Cercocarpus montanus* sites had significantly more rock than the *Pinus edulis* and *Juniperus osteosperma* sites. Brotherson et al. (1984) suggested that stands are moisture-limited because stands on southern aspects were always higher in elevation than stands on northern aspects. They also found that the *Cercocarpus montanus* stands were more likely to occur on northern slopes than on southern in central Utah. However, *Cercocarpus montanus* did not typically occur with mesic shrubs such as *Symphoricarpos oreophilus* and *Amelanchier alnifolia*. There is often a broad *Cercocarpus montanus* shrub/herbaceous ecotone between these shrublands and grasslands. Ecological factors that control shrub densities such as fire and drought need more investigation. Unlike other species of *Cercocarpus*, *Cercocarpus montanus* is a fire-resistant species because it can resprout from the base after a fire has killed the top (Cronquist et al. 1997). In the southern portion of its range, *Cercocarpus montanus* functions as an evergreen shrub by retaining leaves during mild winters and losing them during cold winters (Dick-Peddie 1993). *Cercocarpus montanus* is preferred winter range browse for deer (Roughton 1966, 1972, Hoffman and Alexander 1987). Stands can also produce significant forage that can be utilized by grazing livestock provided the slopes are not too steep (Hoffman and Alexander 1987). More information is needed on the effects of livestock grazing and wildlife browsing on the structure and function of these shrublands.

DISTRIBUTION

Geographic Range: This alliance is known from the southern Rocky Mountains, Arizona-New Mexico mountains, north to the Wyoming Basins, east to escarpments of the Great Plains and west to the Colorado Plateau and parts of the Great Basin.

Nations: US

States/Provinces: AZ, CA, CO, NE, NM, NV, SD, TX, UT, WY

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007): 322Aj:CCC, 341Fb:CCC, 341Fc:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Great Basin, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- > *Cercocarpus intricatus* (Small leaf mountain mahogany scrub) Provisional Alliance (Sawyer et al. 2009) [76.300.00]
- > *Cercocarpus intricatus* Shrubland Alliance (Evens et al. 2014)

LOWER LEVEL UNITS

Associations:

- C EGL003494 *Chamaebatiaria millefolium* - *Yucca baccata* - (*Mahonia repens*) Shrubland
- C EGL001069 *Amelanchier utahensis* / *Pseudoroegneria spicata* Shrubland
- C EGL001067 *Amelanchier utahensis* Shrubland
- C EGL001090 *Cercocarpus montanus* / *Pseudoroegneria spicata* Shrubland
- C EGL002912 *Cercocarpus montanus* - *Rhus trilobata* / *Andropogon gerardii* Shrubland
- C EGL001087 *Cercocarpus montanus* / *Elymus lanceolatus* ssp. *lanceolatus* Shrubland
- C EGL001070 *Amelanchier (utahensis, alnifolia)* - *Cercocarpus montanus* Shrubland
- C EGL001092 *Cercocarpus montanus* / *Hesperostipa comata* Shrubland
- C EGL002798 *Cercocarpus montanus* Shale Shrubland
- C EGL002587 *Cercocarpus intricatus* Montane Shrubland
- C EGL003817 *Amelanchier utahensis* - *Fendlera rupicola* Shrubland
- C EGL003820 *Cercocarpus montanus* - *Fendlera rupicola* Shrubland
- C EGL005805 *Cercocarpus montanus* - *Artemisia tridentata* Shrubland
- C EGL005393 *Cercocarpus intricatus* - (*Quercus turbinella*) Mixed Shrubland
- C EGL005426 *Cercocarpus intricatus* - *Glossopetalon spinescens* Shrubland
- C EGL001068 *Amelanchier utahensis* - Mixed Shrub / *Carex geyeri* Shrubland

AUTHORSHIP

Primary Concept Source: D. Sarr, J. Coles, K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Brotherson and Barnes 1984, Cronquist et al. 1997, Dick-Peddie 1993, Evens et al. 2014, Faber-Langendoen et al. 2017b, Greenwood and Brotherson 1978, Hoffman and Alexander 1987, Roughton 1966, Roughton 1972, Sawyer et al. 2009, Thomas et al. 2004, Yake and Brotherson 1979

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

G276. Southern Rocky Mountain Mountain-mahogany - Mixed Foothill Shrubland

A3730. *Fallugia paradoxa* - *Rhus trilobata* Shrubland Alliance

Type Concept Sentence: This alliance is characterized by short, open shrublands occupying lava flows of El Malpais National Monument dominated by *Fallugia paradoxa*, *Ribes cereum*, or *Rhus trilobata* singly or in combination.

OVERVIEW

Scientific Name: *Fallugia paradoxa* - *Rhus trilobata* Shrubland Alliance

Common Name (Translated Scientific Name): Apache Plume - Skunkbush Sumac Shrubland Alliance

Colloquial Name: Apache Plume - Skunkbush Sumac Shrubland

Type Concept: This alliance is characterized by short, open shrublands occupying lava flows of El Malpais National Monument dominated by *Fallugia paradoxa*, *Ribes cereum*, or *Rhus trilobata* singly or in combination. Tree species such as *Juniperus monosperma*, *Pinus edulis*, or *Populus tremuloides* are frequently present in these shrublands as saplings or mature individuals, but never exceed 10% total cover. Frequent shrub associates include *Forestiera pubescens* and *Holodiscus dumosus*. *Bouteloua gracilis*, *Bouteloua curtipendula*, *Elymus elymoides*, *Piptatheropsis micrantha* (= *Piptatherum micranthum*), *Poa fendleriana*, and *Schizachyrium scoparium* are the most frequently occurring graminoids, though cover of any individual species is low. Forbs can range as high as 20% total cover and may include *Artemisia carruthii* and *Heterotheca villosa*. These shrublands occur between 2000-2400 m in elevation on gently rolling lava plateaus and collapse features. The ground surface cover is composed of lava rock and gravel, with areas interspersed where finer wind- or water-borne soils have accumulated.

Classification Comments: This alliance is poorly documented, but likely found elsewhere regionally on coarse volcanic substrates within the region. This could be potentially grouped into another alliance within this group, but is distinguished by occurring on volcanic substrates.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Vegetation is characterized by short shrublands of varying cover, ranging from sparse to well-developed on volcanic substrates and dominated by *Fallugia paradoxa*, *Ribes cereum*, or *Rhus trilobata* singly or in combination.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance is dominated by a moderately dense layer of cold-deciduous shrubs. A sparse to moderately dense herbaceous layer may be present that is dominated by perennial graminoids. Scattered perennial forbs are usually present. Annual forbs and grasses are seasonally present.

Floristics: These shrublands are dominated by *Fallugia paradoxa*, *Ribes cereum*, or *Rhus trilobata* singly or in combination. Tree species such as *Juniperus monosperma*, *Pinus edulis*, or *Populus tremuloides* are frequently present in these shrublands as saplings or mature individuals, but never exceed 10% total cover. Frequent shrub associates include *Forestiera pubescens* and *Holodiscus dumosus*. *Bouteloua gracilis*, *Bouteloua curtipendula*, *Elymus elymoides*, *Piptatheropsis micrantha* (= *Piptatherum micranthum*), *Poa fendleriana*, and *Schizachyrium scoparium* are the most frequently occurring graminoids, though cover of any individual species is low. Forbs can range as high as 20% total cover and may include *Artemisia carruthii* and *Heterotheca villosa*.

ENVIRONMENT & DYNAMICS

Environmental Description: These shrublands occur between 2000-2400 m in elevation on gently rolling lava plateaus and collapse features. The ground surface cover is composed of lava rock and gravel, with areas interspersed where finer wind- or water-borne soils have accumulated.

Dynamics: *Rhus trilobata* has seeds that are impermeable and exhibit embryonic dormancy. Germination requires scarification either through cold stratification, fire, or animal ingestion. However, the primary means of reproduction is vegetative through root sprouts which can result in dense thickets.

DISTRIBUTION

Geographic Range: This alliance is currently only known from El Malpais National Monument in northwestern New Mexico.

Nations: US

States/Provinces: NM

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > *Fallugia paradoxa* - *Rhus trilobata* Shrubland (Muldavin et al. 2013c)

LOWER LEVEL UNITS**Associations:**

- CEGLO02330 *Fallugia paradoxa* / Rockland Shrubland
- CEGLO02222 *Fallugia paradoxa* - *Rhus trilobata* Shrubland
- CEGLO02333 *Rhus trilobata* - *Ribes cereum* Shrubland

AUTHORSHIP

Primary Concept Source: E. Muldavin et al. (2013c)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Faber-Langendoen et al. 2017b, Muldavin et al. 2013c

M168. Rocky Mountain-Vancouverian Subalpine-High Montane Mesic Meadow

This macrogroup includes montane and subalpine mesic meadows from the Rocky Mountains west to the Sierra Nevada and eastern Cascades, and drier grasslands from the southern Rocky Mountains west in the high plateaus and ranges. Vegetation is composed of low (<1 m) open to dense perennial graminoid layer. Characteristic grassland species include *Danthonia intermedia*, *Danthonia parryi*, *Festuca arizonica*, *Festuca thurberi*, and *Muhlenbergia montana* in montane and subalpine grasslands in the southern Rocky Mountains. Dominant mesic meadow species include *Achillea millefolium*, *Carex spectabilis*, *Chamerion angustifolium*, *Erigeron speciosus*, *Lupinus latifolius*, *Senecio hydrophiloides*, *Senecio serra*, *Solidago canadensis*, *Symphotrichum* spp., *Thalictrum occidentale*, and *Zigadenus elegans*.

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

2.B.2.Na.3.a. M168 Rocky Mountain-Vancouverian Subalpine-High Montane Mesic Meadow

G268. Southern Rocky Mountain Montane-Subalpine Grassland

Type Concept Sentence: This southern Rocky Mountains grassland group typically occurs between 2200 and 3000 m elevation on flat to rolling plains and parks or on lower sideslopes that are dry, and is characterized by an open to dense perennial graminoid layer dominated by *Blepharoneuron tricholepis*, *Danthonia intermedia*, *Danthonia parryi*, *Festuca arizonica*, *Festuca idahoensis*, *Festuca thurberi*, *Muhlenbergia filiculmis*, *Muhlenbergia montana*, *Pascopyrum smithii*, or *Pseudoroegneria spicata*.

OVERVIEW

Scientific Name: *Festuca arizonica* - *Festuca thurberi* - *Muhlenbergia montana* Grassland Group

Common Name (Translated Scientific Name): Arizona Fescue - Thurber's Fescue - Mountain Muhly Grassland Group

Colloquial Name: Southern Rocky Mountain Montane Arizona Fescue - Muhly Grassland

Type Concept: This southern Rocky Mountains group extends west to high plateaus and mountains in the Colorado Plateau. Vegetation is characterized by an open to dense perennial graminoid layer. Larger occurrences usually consist of a mosaic of two or three plant associations with one of the following dominant grasses: *Blepharoneuron tricholepis*, *Danthonia parryi*, *Festuca arizonica*, *Muhlenbergia montana*, *Pascopyrum smithii*, or *Pseudoroegneria spicata* at lower elevation / warmer aspects, or *Danthonia intermedia*, *Festuca idahoensis*, *Festuca thurberi*, or *Muhlenbergia filiculmis* at subalpine elevation / cooler aspects. The common subdominants include *Bouteloua gracilis*, *Hesperostipa comata*, or *Poa secunda*. *Bouteloua gracilis* often dominates sites with warm

aspects and heavy grazing history. Forb species such as *Potentilla hippiana* may be present to codominant. These large-patch grasslands are intermixed with matrix stands of spruce-fir, lodgepole pine, ponderosa pine, and aspen forests. In limited circumstances (e.g., South Park in Colorado), they form the "matrix" of high-elevation plateaus and inter-montane valleys. Stands typically occur between 2200 and 3000 m elevation on flat to rolling plains and parks or on lower sideslopes that are dry, but may extend up to 3350 m on warm aspects. Soils resemble prairie soils in that the A-horizon is dark brown, relatively high in organic matter, slightly acidic, and usually well-drained. Small-patch representations of this group do occur at high elevations of the Trans-Pecos where they present as occurrences of *Festuca arizonica* - *Blepharoneuron tricholepis* Grassland (CEGL004508). These occurrences often occupy sites adjacent to Eastern Madrean Chaparral Group (G280).

Classification Comments: Montane grasslands are very similar and intergrade with their montane and subalpine counterparts. The transition of this group to Central Rocky Mountain Montane Grassland Group (G267) probably occurs somewhere in central Colorado or southern Wyoming. This Southern Rockies grassland group may co-occur with patches of the more mesic Rocky Mountain-North Pacific Subalpine-Montane Mesic Grassland & Meadow Group (G271), which is distinguished by dominance of mesic forb and grass species such as *Deschampsia cespitosa* and *Mertensia ciliata*. *Pascopyrum smithii*-dominated grasslands tend to be restricted to mesic swales within drier upland types.

Similar NVC Types:

- G271 Rocky Mountain-North Pacific Subalpine-Montane Mesic Grassland & Meadow
- G267 Central Rocky Mountain Montane Grassland

Diagnostic Characteristics: Vegetation is composed of an open to dense perennial graminoid layer that is generally less than 1 m tall. *Danthonia parryi*, *Festuca arizonica*, and *Muhlenbergia montana* are important species and typically dominate montane grasslands; *Danthonia intermedia* and *Festuca thurberi* are typical of subalpine grasslands in the southern Rocky Mountains. Other characteristic graminoid species that may be present to dominant include *Achnatherum lettermanii*, *Blepharoneuron tricholepis*, *Bouteloua gracilis*, *Carex duriuscula*, *Carex rossii*, *Carex siccata*, *Elymus lanceolatus*, *Festuca calligera*, *Festuca idahoensis*, *Hesperostipa comata*, *Muhlenbergia filiculmis*, *Poa fendleriana*, *Poa nervosa*, *Poa lettermanii*, and *Pseudoroegneria spicata*.

VEGETATION

Physiognomy and Structure: Vegetation is composed of an open to dense perennial graminoid layer that is generally less than 1 m tall. Forb cover is variable and may be present to codominant.

Floristics: Vegetation in this group is characterized by an open to dense perennial graminoid layer. Larger occurrences usually consist of a mosaic of two or three plant associations with one of the following dominant grasses: *Blepharoneuron tricholepis*, *Danthonia parryi*, *Festuca arizonica*, *Muhlenbergia montana*, *Pascopyrum smithii*, or *Pseudoroegneria spicata* at lower elevation / warmer aspects, or *Danthonia intermedia*, *Festuca idahoensis*, *Festuca thurberi*, or *Muhlenbergia filiculmis* at subalpine elevation / cooler aspects. Other characteristic graminoid species that may be present to dominant include *Achnatherum lettermanii*, *Blepharoneuron tricholepis*, *Bouteloua gracilis*, *Carex duriuscula*, *Carex rossii*, *Carex siccata*, *Elymus lanceolatus*, *Festuca calligera*, *Hesperostipa comata*, *Poa fendleriana*, *Poa nervosa*, and *Poa lettermanii*. The common subdominants include *Bouteloua gracilis*, *Hesperostipa comata*, or *Poa secunda*. *Bouteloua gracilis* often dominates sites with warm aspects and heavy grazing history. Forb species such as *Achillea millefolium*, *Castilleja* spp., *Erigeron simplex*, *Erigeron ursinus*, *Eriogonum umbellatum*, *Geranium viscosissimum*, *Hymenoxys richardsonii*, *Lathyrus lanszwertii*, *Oxytropis oreophila*, *Penstemon secundiflorus*, *Potentilla hippiana*, *Solidago multiradiata*, and *Symphotrichum foliaceum* (= *Aster foliaceus*) may be present to codominant. In disturbed stands, species such as *Heterotheca villosa* may codominant. These large-patch grasslands are intermixed with matrix stands of spruce-fir, lodgepole pine, ponderosa pine, and aspen forests. In limited circumstances (e.g., South Park in Colorado), they form the "matrix" of high-elevation plateaus and inter-montane valleys. Small-patch representations of this group do occur at high elevations of the Trans-Pecos where they present as occurrences of *Festuca arizonica* - *Blepharoneuron tricholepis* Grassland (CEGL004508). These occurrences often occupy sites adjacent to Eastern Madrean Chaparral Group (G280).

ENVIRONMENT & DYNAMICS

Environmental Description: This Rocky Mountain grassland group typically occurs between 2200 and 3000 m elevation on flat to rolling plains and inter-montane parks or on lower sideslopes that are dry, but it may extend up to 3350 m on warm aspects. Soils resemble prairie soils in that the A-horizon is dark brown, relatively high in organic matter, slightly acidic, and usually well-drained.

Dynamics:

DISTRIBUTION

Geographic Range: This grassland group occurs between 2200 and 3000 m elevation in the southern Rocky Mountains and extends west to high plateaus and mountains in the Colorado Plateau.

CBR alliances

Spatial Scale & Pattern [optional]: Large patch

Nations: US

States/Provinces: AZ, CO, NM, NV, SD, UT, WY

TNC Ecoregions [optional]: 11:C, 18:C, 19:C, 20:C, 21:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313C:CP, 313D:CP, 315A:CC, 315H:CP, 321A:PP, 322A:??, 331B:CC, 331G:CC, 331H:CC, 331I:CC, 331J:CC, 341A:CC, 341B:CC, 341C:CC, 341F:CP, 342A:CC, 342E:CC, 342F:CC, 342G:CC, 342J:CC, M313A:CC, M313B:CC, M331A:CP, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M341A:CC, M341B:CC, M341C:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Great Basin)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = Rocky Mountain Alpine and Subalpine Grassland, Bunchgrass Series - 141.41 (Brown et al. 1979)

LOWER LEVEL UNITS

Alliances:

- A3953 *Festuca arizonica* - *Muhlenbergia montana* - *Poa fendleriana* Southern Rocky Mountain Montane Grassland Alliance
- A3954 *Festuca thurberi* - *Danthonia intermedia* - *Poa lettermanii* Southern Rocky Mountain Subalpine Grassland Alliance

AUTHORSHIP

Primary Concept Source: D.E. Brown, C.H. Lowe, and C.P. Pase (1979)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 11/09/2015

Classif Resp Region: West

Internal Author: KAS 3-10, 11-15

REFERENCES

References: Bowns and Bagley 1986, Brown 1982a, Brown et al. 1979, Faber-Langendoen et al. 2017a, Hess 1981, Hess and Wasser 1982, Moir 1967, Passey et al. 1982, Shepherd 1975, Stewart 1940, Turner 1975, Turner and Dortignac 1954

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

G268. Southern Rocky Mountain Montane-Subalpine Grassland

A3953. *Festuca arizonica* - *Muhlenbergia montana* - *Poa fendleriana* Southern Rocky Mountain Montane Grassland Alliance

Type Concept Sentence: This grassland alliance is characterized by an open to dense perennial graminoid layer composed of bunchgrasses *Festuca arizonica* and *Muhlenbergia montana*, which are widespread dominants. It occurs largely in the southern Rocky Mountains extending west to the mountains and high plateaus of Arizona, Utah and Nevada and northeast to the Black Hills. Stands occur primarily in the montane zone (2440-3050 m [8000-10,000 feet]), but may extend down into the foothills.

OVERVIEW

Scientific Name: *Festuca arizonica* - *Muhlenbergia montana* - *Poa fendleriana* Southern Rocky Mountain Montane Grassland Alliance

Common Name (Translated Scientific Name): Arizona Fescue - Mountain Muhly - Muttongrass Southern Rocky Mountain Montane Grassland Alliance

Colloquial Name: Southern Rocky Mountain Montane Arizona Fescue - Muhly Grassland

Type Concept: Vegetation of this grassland alliance is characterized by an open to dense perennial graminoid layer composed of bunchgrasses *Festuca arizonica* and *Muhlenbergia montana*, which are widespread dominants, with *Achnatherum lettermanii*, *Blepharoneuron tricholepis*, *Carex duriuscula*, *Carex rossii*, *Carex siccata*, *Elymus lanceolatus*, *Hesperostipa comata*, *Muhlenbergia filiculmis*, *Poa fendleriana*, *Pseudoroegneria spicata*, or *Schizachyrium scoparium* often present to codominant. Forb species such as *Potentilla hippiana* may be present to codominant. This alliance occurs largely in the southern Rocky Mountains extending west to the mountains and high plateaus of Arizona, Utah and Nevada and northeast to the Black Hills. It primarily occurs in the montane zone (2440-3050 m [8000-10,000 feet]), but may extend down into the foothills. Stands are typically found in xeric forest openings or parks in the ponderosa pine zone with southern aspects on moderately steep slopes and ridgetops. Occasionally the stands occupy rolling parklands. The xeric nature of sites appears to be an important environmental factor. Soils are moderately deep Mollisols, with high coarse-fragment content, sandy loam textures, and a distinct clay horizon. Parent materials are primarily colluvium derived from granite and gneiss. Bare soil, exposed gravels, and small rocks account for as much as 50% of the ground

surface area. These large-patch grasslands are intermixed with matrix stands of ponderosa pine, Douglas-fir and aspen forests. In limited circumstances (e.g., South Park in Colorado), they form the "matrix" of high-elevation plateaus and inter-montane valleys.

Classification Comments: Some characteristic species such as *Danthonia parryi* and *Achnatherum lettermanii* have wide ecological amplitudes occurring in subalpine also. Associations are classified as a best fit.

Internal Comments: KAS-1-14: with more time I might find a published Primary Concept Source.

Other Comments:

Similar NVC Types: This alliance has similarities to montane grassland alliances in other groups in the Rocky Mountain region, such as G267, G271, G273, and G274.

- A3954 *Festuca thurberi* - *Danthonia intermedia* - *Poa lettermanii* Southern Rocky Mountain Subalpine Grassland Alliance: is similar but floristic composition is representative of cooler, subalpine grasslands in the southern Rocky Mountains.

Diagnostic Characteristics: Dominant/diagnostic species of this montane grassland alliance are *Festuca arizonica* and *Muhlenbergia montana*. Other species with high fidelity include *Blepharoneuron tricholepis*, *Carex rossii*, *Hesperostipa comata*, *Muhlenbergia filiculmis*, *Poa fendleriana*, or *Pseudoroegneria spicata*.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a sparse to moderately dense graminoid layer dominated by medium-tall and short, bunch and sod grasses. Forbs usually have sparse cover (<10%), although degraded sites may exhibit higher cover. Lichen ground cover ranges from 2-12%.

Floristics: Vegetation is characterized by an open to dense perennial graminoid layer composed of bunchgrasses *Festuca arizonica* and *Muhlenbergia montana*, which are widespread dominants, with *Achnatherum lettermanii*, *Achnatherum richardsonii*, *Blepharoneuron tricholepis*, *Carex duriuscula*, *Carex rossii*, *Carex siccata*, *Elymus lanceolatus*, *Festuca calligera*, *Geranium caespitosum*, *Hesperostipa comata*, *Muhlenbergia filiculmis*, *Poa fendleriana*, *Pseudoroegneria spicata*, *Schizachyrium scoparium*, or *Sporobolus heterolepis* often present to codominant. Other common graminoids include *Bouteloua curtipendula*, *Bouteloua gracilis*, *Carex inops ssp. heliophila*, *Carex obtusata*, *Carex occidentalis*, *Danthonia parryi*, *Festuca brachyphylla*, *Koeleria macrantha*, *Pascopyrum smithii*, *Poa secunda*, and *Schizachyrium scoparium*. The non-native perennial grass *Poa pratensis* is common in some of these stands. The typically sparse forb layer may be diverse with a variety of taxa, such as *Achillea millefolium*, *Agoseris glauca*, *Allium geyeri*, *Antennaria parvifolia*, *Antennaria rosea*, *Arenaria fendleri*, *Castilleja flava*, *Castilleja integra*, *Eriogonum racemosum*, *Eriogonum umbellatum*, *Harbouria trachypleura*, *Heterotheca villosa*, *Hymenoxys richardsonii*, *Hymenoxys subintegra*, *Lupinus argenteus*, *Mertensia lanceolata*, *Opuntia polyacantha*, *Penstemon secundiflorus*, *Phlox diffusa*, *Potentilla concinna*, *Potentilla hippiana*. *Pseudocymopterus montanus*, *Ranunculus cardiophyllus*, *Sphaeralcea coccinea*, *Solidago nana*, and *Vicia americana*. Except for the abundant dwarf-shrub *Artemisia frigida*, scattered *Amelanchier utahensis*, *Artemisia tridentata*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Ericameria parryi*, *Krascheninnikovia lanata*, *Ribes cereum*, *Symphoricarpos oreophilus*, and *Tetradymia canescens* shrubs, or occasional *Pinus ponderosa* trees, woody species are sparse (<10% cover) or absent. *Selaginella densa* is common, and lichens are important on the soil surface, sometimes providing abundant cover (about 25%).

In stands in the Black Hills, *Achnatherum richardsonii*, *Danthonia intermedia*, and *Sporobolus heterolepis* are prominent with a rich diversity of grasses and forbs, including *Astragalus alpinus*, *Balsamorhiza sagittata*, *Delphinium bicolor*, *Hesperostipa curtisetata*, *Hesperostipa spartea*, *Iris missouriensis*, *Lupinus sericeus*, *Nassella viridula*, and *Oryzopsis asperifolia*.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance primarily occurs in the montane zone (2440-3050 m [8000-10,000 feet]), but may extend down into the foothills to 1600 m (5250 feet). Stands are typically found in xeric forest openings or parks in the ponderosa pine zone with southern aspects on moderately steep slopes and ridgetops. Occasionally the stands occupy rolling parklands. Climate is cool temperate. Summers are warm and winters are cold with freezing temperatures and often heavy snow. Summer precipitation peaks during the monsoon in July and August. The mean annual precipitation is 25-90 cm. Sites are gentle to moderately steep (5-30%) slopes with southern and western aspects. Rocks and boulders are common, especially on the steeper slopes. The xeric nature of sites appears to be an important environmental factor in maintaining the grassland. Soils are moderately deep Mollisols, with high coarse-fragment content, sandy loam textures, and a distinct clay horizon. Parent material includes alluvium, colluvium and residuum from a variety of igneous, metamorphic and sedimentary rocks such as andesite, basalt, cinder, gneiss, granite, limestone, rhyolite, sandstone, schist, shale and tuff. Bare soil, exposed gravels, and small rocks account for as much as 50% of the ground surface area. These large-patch grasslands are intermixed with matrix stands of ponderosa pine, Douglas-fir and aspen forests. In limited circumstances (e.g., South Park in Colorado), they form the "matrix" of high-elevation plateaus and inter-montane valleys.

Dynamics: Historically, much of the area where this alliance occurs was heavily grazed by livestock, primarily sheep and cattle (Shepherd 1975). Under moderate grazing, the shorter grass *Muhlenbergia filiculmis* may have had a competitive advantage over the

taller and more palatable *Festuca arizonica* (West 1992). Season of use is also important. In stands with cool-season *Festuca arizonica* or *Hesperostipa comata* and warm-season *Muhlenbergia montana*, fall grazing will favor the cool-season grasses over the later-blooming, warm-season *Muhlenbergia montana* (Clary 1978). The reverse is true if grazing is always limited to late summer. Overgrazing will reduce or eliminate *Festuca arizonica*, *Hesperostipa comata*, *Muhlenbergia filiculmis*, *Muhlenbergia montana*, and the other palatable species, leaving the more grazing-tolerant *Bouteloua gracilis* and less palatable plants such as *Hymenoxys*, *Artemisia* and *Chrysothamnus* species to dominate the site (West 1992). Clary (1978) reported that complete natural recovery of montane *Festuca arizonica* range may require over 100 years, based on areas where recovery had reached only the "half-shrub" stage after 10 years. Because of the long time needed for recovery, much of the range may be in a seral state. If the range is properly managed, *Muhlenbergia* and *Festuca arizonica* grasslands could potentially become more common.

DISTRIBUTION

Geographic Range: This grassland alliance occurs largely in the southern Rocky Mountains extending west to the mountains and high plateaus of Utah and Arizona and northeast to the Black Hills.

Nations: US

States/Provinces: AZ, CO, MT, NM, NV, SD, TX?, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > *Festuca arizonica* Series (Johnston 1987)
- > *Muhlenbergia montana* Series (Johnston 1987)
- > *Muhlenbergia montana* Series (Muldavin 1994) [includes *Muhlenbergia montana*/*Trisetum montanum* Plant Association that is not yet included in this alliance.]
- > *Stipa comata*-*Muhlenbergia montana* Habitat Type (Hess 1981)
- = Fescue Series (Dick-Peddie 1993) [includes *Festuca arizonica*-*Muhlenbergia montana* Vegetation Type]
- > Habitat types #13 and #35 (Shepherd 1975)
- > Pine Dropseed-Mountain Muhly Series (Dick-Peddie 1993)

LOWER LEVEL UNITS

Associations:

- CEGLO02240 *Sporobolus heterolepis* - *Achnatherum richardsonii* - *Danthonia intermedia* Grassland
- CEGLO01874 *Carex duriuscula* Grassland
- CEGLO04508 *Festuca arizonica* - *Blepharoneuron tricholepis* Grassland
- CEGLO01647 *Muhlenbergia montana* - *Hesperostipa comata* Grassland
- CEGLO01646 *Muhlenbergia montana* Grassland
- CEGLO01606 *Festuca arizonica* - *Muhlenbergia montana* Grassland
- CEGLO01925 *Poa fendleriana* Grassland
- CEGLO01660 *Pseudoroegneria spicata* Grassland
- CEGLO01780 *Muhlenbergia filiculmis* Grassland
- CEGLO02588 *Elymus lanceolatus* Grassland
- CEGLO05354 *Achnatherum lettermanii* Grassland
- CEGLO05388 *Carex siccata* - *Carex rossii* Grassland
- CEGLO05381 *Muhlenbergia montana* - *Schizachyrium scoparium* Grassland
- CEGLO01605 *Festuca arizonica* - *Muhlenbergia filiculmis* Grassland
- CEGLO05500 *Festuca* (*calligera*, *arizonica*, *brachyphylla*) Grassland
- CEGLO01676 *Pseudoroegneria spicata* - *Poa fendleriana* Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Baumann 1978a, Buttery 1955, Clary 1978, Currie 1975, Dick-Peddie 1993, Faber-Langendoen et al. 2017b, Fish 1966, Hess 1981, Johnson 1953, Johnson 1956a, Johnson and Niederhof 1941, Johnson and Reid 1958, Johnson and Reid 1964, Johnston 1987, Komarkova 1986, Loveless 1963, Loveless 1967, McIntosh 1923, Merkle 1962, Muldavin 1994, Muldavin et al. 1994a, Mutel 1976, Ramaley 1915, Ramaley 1916a, Ramaley 1916b, Reid 1974, Reid et al. 1994, Shepherd 1975, Smith 1967, Soil Conservation Service 1978, Stewart 1940, USFS 1983b, Wasser and Hess 1982, West 1992

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

G268. Southern Rocky Mountain Montane-Subalpine Grassland

A3954. *Festuca thurberi* - *Danthonia intermedia* - *Poa lettermanii* Southern Rocky Mountain Subalpine Grassland Alliance

Type Concept Sentence: This grassland alliance is characterized by an open to dense perennial graminoid layer composed of bunchgrasses, especially *Festuca thurberi* and *Danthonia intermedia*, with other diagnostic and sometimes dominant species that include *Festuca idahoensis*, *Poa lettermanii*, and *Poa nervosa*. It occurs largely in the southern Rocky Mountains extending west to the high plateaus and mountains of Arizona, Utah and Nevada primarily in the subalpine zone.

OVERVIEW

Scientific Name: *Festuca thurberi* - *Danthonia intermedia* - *Poa lettermanii* Southern Rocky Mountain Subalpine Grassland Alliance

Common Name (Translated Scientific Name): Thurber's Fescue - Timber Oatgrass - Letterman's Bluegrass Southern Rocky Mountain Subalpine Grassland Alliance

Colloquial Name: Southern Rocky Mountain Subalpine Thurber's Fescue - Timber Oatgrass Grassland

Type Concept: Vegetation of this subalpine grassland alliance is characterized by an open to dense perennial graminoid layer composed of bunchgrasses, especially *Festuca thurberi* and *Danthonia intermedia*. Other diagnostic and sometimes dominant species include *Achnatherum richardsonii*, *Danthonia parryi*, *Festuca idahoensis*, *Geranium viscosissimum*, *Lathyrus lanszwertii* var. *leucanthus*, *Poa lettermanii*, *Poa nervosa*, *Potentilla hippiana*, *Solidago multiradiata*, and *Sporobolus heterolepis*. This alliance occurs largely in the southern Rocky Mountains extending west to the high mountains and plateaus of Arizona, Utah and Nevada. Stands primarily occur in the subalpine and lower alpine slopes in dry meadows and on ridges above subalpine forests in the southern Rocky Mountains, but may extend up into lower alpine and down into montane zones. Elevations range from 2500-3810 m. Climate is temperate with short growing seasons and heavy snowfall in winter. Stands are found on level valley bottoms, expansive park meadow openings in the subalpine forest, and on ridges above subalpine forests. Sites are nearly level to steeply sloping, typically on southern or western exposures. Soils are generally deep, well-drained loams or silt loams with pH of 5.8-7.0, and derived from alluvium and colluvium.

Classification Comments: Some characteristic species such as *Danthonia parryi* and *Achnatherum lettermanii* have wide ecological amplitudes occurring in montane zone also. Associations are classified as a "best fit" into the USNVC alliances.

Internal Comments: KAS-1-14: with more time I might find a published Primary Concept Source.

Other Comments:

Similar NVC Types: This alliance has similarities to subalpine grassland alliances in other groups in the Rocky Mountain region, such as G267 and G271.

- A3953 *Festuca arizonica* - *Muhlenbergia montana* - *Poa fendleriana* Southern Rocky Mountain Montane Grassland Alliance: is similar but floristic composition is representative of warmer, montane grasslands in the southern Rocky Mountains.

Diagnostic Characteristics: These subalpine grasslands are typically dominated or codominated by *Danthonia intermedia*, *Danthonia parryi*, *Festuca idahoensis*, *Festuca thurberi*, *Poa lettermanii*, and *Poa nervosa*.

VEGETATION

Physiognomy and Structure: Vegetation in this alliance is characterized by a moderate to dense cover of graminoids that is dominated by perennial bunch grasses. There is also a sparse to moderate cover of perennial forbs. Annual forbs and grasses are seasonally present.

Floristics: Vegetation included in this alliance has a moderately sparse to dense herbaceous layer, depending on the amount of rock cover. These grasslands are characterized by an open to dense perennial graminoid layer composed bunchgrasses, especially *Festuca thurberi* and *Danthonia intermedia*. Other diagnostic and sometimes dominant species include *Achnatherum richardsonii*, *Danthonia parryi*, *Festuca idahoensis*, *Geranium viscosissimum*, *Lathyrus lanszwertii* var. *leucanthus*, *Poa lettermanii*, *Poa nervosa*, *Potentilla*

hippiana, *Solidago multiradiata* and *Sporobolus heterolepis*. *Muhlenbergia montana* and *Festuca arizonica* may be present to codominant (on warmer/drier sites). These grasslands have high diversity of species. Other characteristic graminoids may include *Agrostis variabilis*, *Bromus* spp., *Carex engelmannii*, *Carex geyeri*, *Carex haydeniana*, *Carex microptera*, *Carex siccata* (= *Carex foenea*), *Carex scirpoidea*, *Danthonia parryi*, *Elymus trachycaulus*, *Festuca brachyphylla*, *Juncus drummondii*, and *Trisetum spicatum*. Forb species are diverse and may codominate the herbaceous layer with species such as *Achillea millefolium*, *Arenaria capillaris*, *Artemisia* spp., *Cerastium beeringianum*, *Erigeron simplex*, *Erigeron speciosus*, *Erigeron ursinus*, *Eriogonum umbellatum* var. *majus* (= *Eriogonum subalpinum*), *Geum rossii* var. *turbinatum*, *Hymenoxys hoopesii*, *Iris missouriensis*, *Lewisia pygmaea*, *Minuartia obtusiloba*, *Polygonum bistortoides*, *Potentilla diversifolia*, *Saxifraga rhomboidea*, *Solidago multiradiata*, *Symphyotrichum foliaceum* (= *Aster foliaceus*), *Vicia americana*, and many others. On moist sites *Veratrum californicum* may be codominant. Grazed stands often have moderate cover of non-native species such as *Poa pratensis* and *Taraxacum officinale*. The ground surface is often covered with nonvascular plants such as lichens, liverworts, and mosses forming a biological crust. Adjacent stands include subalpine conifer woodlands, and herbaceous- or shrub-dominated wetlands.

ENVIRONMENT & DYNAMICS

Environmental Description: This grassland alliance occurs largely in the southern Rocky Mountains extending west to the high plateaus and mountains of Arizona, Utah and Nevada. Stands primarily occur in the subalpine and lower alpine slopes in dry meadows and on ridges above subalpine forests in the southern Rocky Mountains, but extend up into lower alpine and down into montane zones. Elevations range from 2500-3810 m (8200-12500 feet). Climate is temperate with short growing seasons and heavy snowfall in winter, although prevailing winter winds allow only moderate snow accumulations in high-elevation stands. Stands are found on level valley bottoms, expansive park meadow openings in the subalpine forest, and on ridges above subalpine forests. Sites are nearly level to steeply sloping, typically on southern or western exposures. Soils are shallow to deep, well-drained, acidic (pH of 5.8-7.0), nutrient-poor, gravelly loams to silt loams and gravelly clay loams derived from basalt lava, granite, schist and sandstone. The ground surface has a biological crust of lichens, liverworts, and mosses.

Dynamics: *Festuca thurberi* grasslands typically have sharp ecotones with adjacent *Picea engelmannii*- and *Abies lasiocarpa*-dominated subalpine forests. There is rarely any invasion by tree seedlings in the adjacent grasslands. These high-elevation meadows are typically dry with southern or western aspects. The soils are deep and well-developed, typical of sites with long histories of being grassland. They may need catastrophic disturbance, such as forest-destroying crown fire, to be created. It is unclear how these grasslands were maintained in the subalpine forest zone; however, it is thought to be by a combination of factors such as herbivory, fire, deep soils, early summer drought and competition from grass species (Moir 1967, Andrews 1983). In addition, south- and west-facing clearcuts are often difficult to reforest because seedlings are damaged by full sun. The ecotones between stands adjacent to *Populus tremuloides*-dominated subalpine forests are not as sharp because the forest understory consists of the same graminoid and forb species (Anderson 1983).

Where the soil is thinner and rockier in these subalpine parks, *Danthonia parryi* becomes the dominant species with *Festuca thurberi* and *Artemisia* spp. subdominant (Anderson 1983). The spread of the exotic species *Poa pratensis* and *Taraxacum officinale* in subalpine parks is likely from heavy grazing by livestock (Moir 1967, Anderson 1983). These species are more common in heavily grazed bottomlands and near trails in the uplands (Moir 1967).

DISTRIBUTION

Geographic Range: This grassland alliance occurs largely in the southern Rocky Mountains extending west to the high mountains and plateaus of Arizona, Utah and Nevada.

Nations: US

States/Provinces: AZ, CO, NM, NV, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- > *Festuca thurberi* Series (Johnston 1987) [includes five *Festuca thurberi* dominated plant associations.]
- > *Festuca thurberi* Series (Komarkova 1986) [includes seven *Festuca thurberi* dominated habitat types/associations.]
- >< Alpine Dwarf Shrublands, Fellfields, and Sedge Turf (Chappell et al. 1997)

LOWER LEVEL UNITS

Associations:

- C EGL001630 *Festuca thurberi* - (*Lathyrus lanszwertii* var. *leucanthus*, *Potentilla* spp.) Grassland
- C EGL001656 *Poa nervosa* - *Achnatherum lettermanii* Grassland

- C EGL001927 *Poa lettermanii* Grassland
- C EGL001794 *Danthonia intermedia* Grassland
- C EGL001618 *Festuca idahoensis* - *Geranium viscosissimum* Grassland
- C EGL005377 *Festuca thurberi* - *Danthonia parryi* / *Potentilla hippiana* Grassland
- C EGL001631 *Festuca thurberi* Subalpine Grassland
- C EGL001879 *Danthonia intermedia* - *Solidago multiradiata* Grassland
- C EGL001617 *Festuca idahoensis* - *Festuca thurberi* Grassland
- C EGL001795 *Danthonia parryi* Grassland
- C EGL002734 *Achnatherum lettermanii* - *Oxytropis oreophila* Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Anderson 1983, Andrews 1983, Baker 1983a, Boyce 1977, Chappell et al. 1997, Eddleman 1967, Faber-Langendoen et al. 2017b, Giese 1975, Hall 1971, Harrington 1978, Hess 1981, Hess and Wasser 1982, Holway 1962a, Johnson 1939, Johnson 1970a, Johnston 1987, Johnston 2001, Keammerer and Stoecker 1980, Klemmedson 1953, Klish 1977, Komarkova 1976, Komarkova 1986, Komarkova and Gordon 1982, Komarkova and Webber 1978, Langenheim 1956, Marr et al. 1974, Miller 1964, Moir 1967, Morgan 1969, Paulsen 1960, Paulsen 1970a, Paulsen 1970b, Ramaley 1942, Rydberg 1915, Turner and Dortignac 1954, Wasser and Hess 1982

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

2.B.2.Na.3.b. M168 Rocky Mountain-Vancouverian Subalpine-High Montane Mesic Meadow

G271. Rocky Mountain-North Pacific Subalpine-Montane Mesic Grassland & Meadow

Type Concept Sentence: This Rocky Mountain, northern Vancouverian and Sierran group is typically lush meadow dominated by a diversity of taller forbs, including *Achillea millefolium*, *Agastache urticifolia*, *Balsamorhiza sagittata*, *Geranium viscosissimum*, *Ligusticum* spp., *Rudbeckia occidentalis*, *Thalictrum occidentale*, *Valeriana sitchensis*, and *Xerophyllum tenax*, typically with grasses intermingled in many of them. However, it includes stands dominated by grasses with relatively broad and soft blades and a few mesic Carices, such as *Calamagrostis breweri*, *Carex filifolia*, *Carex straminiformis*, *Elymus trachycaulus*, *Festuca viridula*, and *Phleum alpinum*.

OVERVIEW

Scientific Name: *Festuca viridula* - *Deschampsia cespitosa* - *Ligusticum* spp. Rocky Mountain-Vancouverian Grassland & Meadow Group

Common Name (Translated Scientific Name): Greenleaf Fescue - Tufted Hairgrass - Licorice-root species Rocky Mountain-Vancouverian Grassland & Meadow Group

Colloquial Name: Montane Nettleleaf Giant-hyssop - Sticky Purple Geranium - Western Brackenfern Mesic Meadow

Type Concept: This Rocky Mountain, northern Vancouverian and Sierran group is restricted to sites from lower montane to subalpine where finely textured soils, snow deposition, rocky substrates, or windswept dry conditions limit tree establishment. Many occurrences are small-patch in spatial character, and are often found in mosaics with woodlands, more dense shrublands, or just below alpine communities. These are typically lush meadows dominated by a diversity of tall forbs, with grasses intermingled in many of them. The vegetation is typically forb-rich, with forbs often contributing more to overall herbaceous cover than graminoids. However, some stands are composed of dense grasslands, these often being taxa with relatively broad and soft blades, such as *Elymus trachycaulus*, *Festuca viridula*, and *Phleum alpinum*, but where the moist habitat promotes a rich forb component. Important taxa includes *Achillea millefolium*, *Balsamorhiza sagittata*, *Rudbeckia occidentalis*, *Thalictrum occidentale*, *Valeriana sitchensis*, *Xerophyllum tenax*, and numerous species of Asteraceae, *Campanula*, *Erigeron*, *Ligusticum*, *Lomatium*, *Lupinus*, *Mertensia*, *Phlox*, *Penstemon*, *Solidago*, and *Wyethia*. Important graminoids include *Deschampsia cespitosa*, *Koeleria macrantha*, *Luzula glabrata*, perennial *Bromus* spp., and a number of *Carex* species. In the Cascades, this group includes *Festuca viridula* meadows. *Dasiphora fruticosa* ssp. *floribunda* and *Symphoricarpos* spp. are occasional but not abundant. In the Sierra Nevada *Calamagrostis breweri*, *Carex filifolia*, *Carex straminiformis*, *Juncus drummondii*, *Oreostemma alpigenum*, *Solidago canadensis*, and *Trisetum spicatum* may dominate stands with diagnostics forbs *Oreostemma alpigenum*, and *Solidago canadensis*. Dwarf-shrubs such as *Vaccinium cespitosum* may have significant cover. Burrowing mammals can increase the forb diversity. This group is typically found above 2000 m in elevation in the southern part of its range and above 600 m in the northern part. These upland communities occur on gentle to

moderate-gradient slopes and relatively moist habitats. The soils are typically seasonally moist to saturated in the spring but, if so, will dry out later in the growing season. These sites are not as wet as those found in Vancouverian-Rocky Mountain Subalpine-Alpine Snowbed, Wet Meadow & Dwarf-Shrubland Group (G520) and Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh Group (G521), although some species are certainly shared with wet meadows, such as *Deschampsia*.

Classification Comments: The Rockies and Cascades support a number of forb types found on talus and rocky scree slopes, which are not sparsely vegetated, and which often have little to no grass component, though Carices may be abundant. These types often have heavy snow loading in winter, or are adjacent to snowfields, and subsurface moisture below the rocks/scree is significant throughout the growing season. These forb types are poorly documented; for now they are placed in this group, as many of the taxa are also found in mesic grassy meadows. Splitting them into a separate group would be hard to justify floristically.

Similar NVC Types:

- G267 Central Rocky Mountain Montane Grassland
- G273 Central Rocky Mountain Lower Montane, Foothill & Valley Grassland
- G268 Southern Rocky Mountain Montane-Subalpine Grassland
- G520 Vancouverian-Rocky Mountain Subalpine-Alpine Snowbed, Wet Meadow & Dwarf-shrubland
- G320 North Pacific Alpine-Subalpine Tundra
- G317 North Pacific Alpine-Subalpine Dwarf-shrubland & Heath
- G316 Rocky Mountain-Sierran Alpine Dwarf-shrubland & Krummholz

Diagnostic Characteristics: Herbaceous communities found in the mountains of the Rockies and eastern Cascades, dominated by forbs and graminoids. These are relatively mesic or sometimes seasonally wet communities, and the combination of moisture and soil conditions results in forbs, often tall, being the predominant lifeform. Grasses and sedges are common, typically being taxa with broad and soft blades. Forb communities found on talus and scree slopes with subsurface moisture are included here, in particular when they are not sparsely vegetated.

VEGETATION

Physiognomy and Structure: This group includes herbaceous communities found in the montane and subalpine throughout much of the Rockies, eastern Cascades and Sierra Nevada, dominated by flowering forbs, often tall (but still <1 m in height usually). Grasses with broad, soft blades are common, but these are more typically forb-rich meadows with grasses or other graminoids not the dominant lifeform. Cover is generally dense or can be patchy. Burrowing mammals in places will disrupt the soil.

Floristics: Species composition in this mesic meadow differs some between montane and subalpine elevations, but across its range, this is a very diverse group. Tall forb-dominated mesic meadows are typically composed of a wide diversity of genera and contribute more to overall herbaceous cover than graminoids. At montane elevations, important forbs include *Allium schoenoprasum*, *Angelica arguta*, *Arnica chamissonis*, *Athyrium filix-femina*, *Camassia quamash*, *Campanula rotundifolia*, *Chamerion angustifolium*, *Delphinium x occidentale*, *Erigeron speciosus*, *Eucephalus* spp., *Geum macrophyllum*, *Hackelia* spp., *Heraclium maximum*, *Ligusticum porteri*, *Ligusticum tenuifolium*, *Lupinus parviflorus*, *Mertensia* spp., *Osmorhiza occidentalis*, *Pteridium aquilinum*, *Senecio hydrophiloides*, *Senecio serra*, *Solidago canadensis*, *Symphyotrichum* spp., *Thalictrum occidentale*, *Trollius laxus*, *Vicia americana* and *Zigadenus elegans*. Early-successional stages may be dominated by *Achillea millefolium*, *Agastache urticifolia*, *Chamerion angustifolium*, *Urtica dioica*, and small amounts of mesic grasses such as *Bromus carinatus* and *Deschampsia cespitosa*. At montane elevations, graminoids form a minor component and are usually taxa with relatively broad and soft blades such as *Bromus carinatus*, *Bromus sitchensis*, *Carex geyeri*, *Carex hoodii*, *Carex microptera*, *Carex raynoldsii*, *Deschampsia cespitosa*, *Elymus glaucus*, *Festuca rubra*, and *Melica spectabilis*. Broadleaf deciduous shrubs such as *Dasiphora fruticosa* ssp. *floribunda* and *Symphoricarpos* spp. are occasional, but not abundant.

At subalpine elevations, *Angelica* spp., *Arnica latifolia*, *Castilleja miniata*, *Erigeron peregrinus*, *Erythronium grandiflorum*, *Eucephalus ledophyllus*, *Ligusticum* spp., *Lupinus argenteus* var. *laxiflorus*, *Lupinus latifolius*, *Senecio triangularis*, *Valeriana* spp., and *Veratrum viride* are commonly the dominant forbs. Other locally abundant forbs include *Hydrophyllum fendleri*, *Phacelia hastata*, *Phlox diffusa*, *Saussurea americana*, and *Xerophyllum tenax*. Burrowing mammals can increase the forb diversity. Graminoids are typically a minor component of the canopy, with typically less than 20% cover. Common species include *Agrostis variabilis*, *Carex microptera*, *Carex paysonis*, *Carex spectabilis*, *Deschampsia cespitosa*, *Elymus trachycaulus*, *Juncus drummondii*, *Luzula glabrata*, *Luzula parviflora*, *Phleum alpinum*, *Poa alpina*, and *Vahlodea atropurpurea*. However, this group also includes *Festuca viridula*-dominated meadows in the Cascades. In the Sierra Nevada *Calamagrostis breweri*, *Carex filifolia*, *Carex stramineiformis*, *Juncus drummondii*, and *Trisetum spicatum* may dominate stands with diagnostic forbs *Oreostemma alpigenum*, and *Solidago canadensis*. Dwarf-shrubs such as *Vaccinium cespitosum* may have moderate cover in some stands. Early-successional stages may be dominated by *Achillea millefolium*, *Hypericum scouleri*, *Sibbaldia procumbens*, and other forbs, and small amounts of mesic graminoids such as *Carex* spp., *Deschampsia cespitosa*, *Phleum alpinum*, and *Poa alpina*.

ENVIRONMENT & DYNAMICS

Environmental Description: In the Rocky Mountains, these meadows occupy a wide variety of environments, including moderate to steep slopes and glacio-fluvial flats and swales that lose their snow cover relatively late in the season. Generally the group is restricted to sites from lower montane to subalpine where finely textured soils, snow deposition, rocky substrates, or windswept dry conditions limit tree establishment. Many occurrences are small-patch in spatial character, and are often found in mosaics with woodlands, more dense shrublands, or just below alpine communities. This group is typically found above 2000 m to 3700 m in elevation in the southern part of its range and above 600 m in the northern extent. These upland communities occur on gentle to moderate-gradient slopes and relatively moist habitats. The soils are typically seasonally moist to saturated in the spring but, if so, will dry out later in the growing season. At montane elevations, this group occurs within *Pinus-Pseudotsuga* or mixed conifer-dominated forests. At subalpine elevations, these meadows are found below treeline, usually within *Abies lasiocarpa-Picea* species-dominated forests.

Climate: Approximately two-thirds of the region's precipitation occurs in just half the year (October from March), with the remaining third occurring in late spring to early summer. Generally, the east slopes of the Cascades and Sierra Nevada ranges east to the northern Rocky Mountains of Montana and Wyoming receive greater than 100 cm of precipitation annually.

Soil/substrate/hydrology: Soils are typically seasonally moist to saturated during spring and early summer after snowmelt, but will dry out later in the growing season. At montane elevations, soils are usually clays or silt loams with an A horizon greater than 10 cm. Some sites may have inclusions of hydric soils in low, depressional areas within this group. At subalpine elevations, soils are derived from a variety of parent materials, and can be acidic or calcareous. The A horizon is typically less than 10 cm, and soils are usually rocky or gravelly with good aeration and drainage, but with a well-developed organic layer. A third setting includes talus or scree slopes, or colluvial fields of rocks and small boulders, where subsurface moisture is provided by melting snow throughout much of the growing season. Soils are developed from colluvium and more recently alluvium are often derived from limestone, sandstone, shale parent materials (Gregory 1983, Youngblood et al. 1985a), or weathered volcanic extrusives such as basalt, pumice and ash or loess deposits. Soil texture is variable and ranges from coarser-textured sandy loams to finer-textured silt loams, clay or clay loams with an average pH of 6.4 (Gregory 1983). Surface rock averages 46%, but varies from 1-90%. Bare ground cover is usually less than 15%.

Dynamics:

DISTRIBUTION

Geographic Range: This group is very widespread in the Rocky Mountains cordillera from New Mexico (where it is uncommon) and Colorado north into Canada, and west into the eastern Cascades and Sierra Nevada. It also occurs in the mountain ranges of Nevada, northern Utah and Wyoming, and has been observed on the Snake River plain, as well as the "island ranges" of central Montana.

Spatial Scale & Pattern [optional]: Small patch, Large patch

Nations: CA, US

States/Provinces: AB, BC, CA?, CO, ID, MT, NM, NV, OR, WA, WY

TNC Ecoregions [optional]: 3:C, 4:C, 7:C, 8:C, 9:C, 11:C, 18:C, 19:C, 20:C, 21:P, 26:C, 68:C

USFS Ecoregions (2007): 341B:C?, 341E:CP, 341G:CC, 342B:CP, 342C:CC, 342D:CC, 342E:C?, 342H:CC, 342J:CC, M313A:PP, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M334A:??, M341A:CC, M341B:CC, M341C:CC, M341D:CP

Omernik Ecoregions:

Federal Lands [optional]: NPS (Great Basin); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate. This is a solid group in its core concept, it's more a question of clarifying exactly how it relates to drier predominantly grass-dominated groups, and also the relationship of specific associations to wet meadow groups.

SYNONYMY

- >> Idaho Fescue - Tufted Hairgrass (308) (Shiflet 1994)
- >> Tall Forb (409) (Shiflet 1994)
- >> Tufted Hairgrass - Sedge (313) (Shiflet 1994) [Forb-rich portions of this SRM type overlap with this group.]

LOWER LEVEL UNITS

Alliances:

- A4165 *Poa secunda* - *Muhlenbergia richardsonis* - *Carex douglasii* Moist Meadow Alliance
- A3951 *Ligusticum* spp. - *Lupinus* spp. - *Delphinium* spp. Montane Mesic Meadow Alliance
- A3950 *Agastache urticifolia* - *Geranium viscosissimum* - *Pteridium aquilinum* Montane Mesic Meadow Alliance
- A4119 *Carex straminiformis* - *Solidago canadensis* Meadow Alliance

- A3364 *Calamagrostis breweri* Mesic Grassland Alliance
- A3949 *Phleum alpinum* - *Elymus trachycaulus* - *Agrostis variabilis* Subalpine Mesic Meadow Alliance
- A1257 *Festuca viridula* - *Carex hoodii* - *Lupinus* spp. Subalpine Mesic Meadow Alliance
- A3948 *Valeriana sitchensis* - *Luzula glabrata* var. *hitchcockii* - *Xerophyllum tenax* Subalpine Mesic Meadow Alliance
- A1294 *Carex filifolia* Mesic Grassland Alliance

AUTHORSHIP

Primary Concept Source: T.N. Shiflet (1994)

Author of Description: M.S. Reid, T. Luna, K.A. Schulz

Acknowledgments:

Version Date: 09/29/2016

Classif Resp Region: West

Internal Author: MSR 3-10, 3-11, mod. KAS 5-15, 11-15, mod. GK 9-16

REFERENCES

References: Buckner 1977, Ellison 1954, Faber-Langendoen et al. 2017a, Fritz 1981, Gregory 1983, Hall 1971, Marr 1977a, Meidinger and Pojar 1991, Potkin and Munn 1989, Shiflet 1994, Starr 1974, Youngblood et al. 1985a

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

G271. Rocky Mountain-North Pacific Subalpine-Montane Mesic Grassland & Meadow

A3950. *Agastache urticifolia* - *Geranium viscosissimum* - *Pteridium aquilinum* Montane Mesic Meadow Alliance

Type Concept Sentence: Plant associations within this montane mesic meadow alliance are characterized by the dominance of *Agastache urticifolia*, *Geranium viscosissimum*, *Heliomeris multiflora*, *Mertensia ciliata*, *Pteridium aquilinum*, or *Wyethia amplexicaulis* and occur in the central Rocky Mountains of Wyoming, Utah and Idaho extending west to ranges in Nevada.

OVERVIEW

Scientific Name: *Agastache urticifolia* - *Geranium viscosissimum* - *Pteridium aquilinum* Montane Mesic Meadow Alliance

Common Name (Translated Scientific Name): Nettleleaf Giant-hyssop - Sticky Purple Geranium - Western Brackenfern Montane Mesic Meadow Alliance

Colloquial Name: Montane Nettleleaf Giant-hyssop - Sticky Purple Geranium - Western Brackenfern Mesic Meadow

Type Concept: The vegetation of this montane mesic meadow alliance is characterized by an often patchy, moderately dense to dense herbaceous layer dominated by perennial forbs. Diagnostic and dominant species are *Agastache urticifolia*, *Geranium viscosissimum*, *Heliomeris multiflora*, *Mertensia ciliata*, *Pteridium aquilinum*, and/or *Wyethia amplexicaulis*. Associated species are diverse and include widespread forbs such as *Achillea millefolium* or *Senecio triangularis*, and mesic graminoids such as *Bromus carinatus*, *Carex microptera*, and *Elymus trachycaulus*. Scattered clumps of the deciduous shrub *Symphoricarpos oreophilus* are common, and occasional *Populus tremuloides* trees may also be present. Plant associations occur in the central Rocky Mountains of Wyoming, Utah and Idaho extending west to ranges in Nevada. Sites vary from gentle to steep slopes with eastern to southwestern aspects, but are most often moderately steep mid to upper slopes. Stands also occur along small streams, benches near seeps, and on moist toeslopes in narrow valley bottoms. Elevations range from 1970-2835 m. Soils are moderately deep to deep, well-drained loams with a thick mollic horizon. The water table ranges to depths of 20 cm. Soils are developed from colluvium and more recently alluvium and are derived from limestone, sandstone or shale parent materials and have clay or clay loam textures.

Classification Comments: This is a poorly documented alliance and may be more extensive than currently known. Subalpine forb meadow communities are not well-studied anywhere in the West. Possible occurrences of *Mertensia ciliata* communities in Colorado and the Centennial Mountains in Montana need to be investigated (Johnston 1987, Padgett et al. 1989).

Internal Comments:

Other Comments:

Similar NVC Types:

- A1257 *Festuca viridula* - *Carex hoodii* - *Lupinus* spp. Subalpine Mesic Meadow Alliance: is dominated or codominated by *Festuca viridula* in the interior Pacific Northwest and central Rocky Mountains.
- A3948 *Valeriana sitchensis* - *Luzula glabrata* var. *hitchcockii* - *Xerophyllum tenax* Subalpine Mesic Meadow Alliance: is typically dominated by *Valeriana sitchensis* or *Xerophyllum tenax* with *Carex geyeri*, *Carex spectabilis*, *Chamerion angustifolium*, *Luzula glabrata* var. *hitchcockii*, and *Veratrum viride* sometimes abundant.

CBR alliances

- A3949 *Phleum alpinum* - *Elymus trachycaulus* - *Agrostis variabilis* Subalpine Mesic Meadow Alliance: is dominated by *Phleum alpinum*, *Elymus trachycaulus*, or *Agrostis variabilis*.
- A3951 *Ligusticum* spp. - *Lupinus* spp. - *Delphinium* spp. Montane Mesic Meadow Alliance: is dominated by *Ligusticum filicinum*, *Ligusticum porteri*, *Ligusticum tenuifolium*, *Lupinus argenteus*, or *Lupinus parviflorus ssp. myrianthus*.

Diagnostic Characteristics: These are high-altitude mesic meadows dominated or codominated by forbs; especially diagnostic and often dominant species include *Agastache urticifolia*, *Geranium viscosissimum*, *Heliomeris multiflora*, *Mertensia ciliata*, *Pteridium aquilinum*, or *Wyethia amplexicaulis*.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a moderately dense to dense (40-100% cover), medium-tall (0.4-0.8 m) herbaceous layer that often occurs in patches. It is dominated by perennial forbs with consistent but low perennial graminoid cover. Scattered cold-deciduous shrubs are often present, and occasional cold-deciduous trees may present in these stands.

Floristics: The vegetation is characterized by an often patchy, moderately dense to dense (40-100% cover) herbaceous layer dominated by perennial forbs. Diagnostic and dominant species are *Agastache urticifolia*, *Geranium viscosissimum*, *Heliomeris multiflora*, *Mertensia ciliata*, *Pteridium aquilinum*, and/or *Wyethia amplexicaulis* (Gregory 1983). Associated species include *Achillea millefolium*, *Bromus carinatus*, *Carex microptera*, *Collomia linearis*, *Delphinium x occidentale*, *Eucephalus engelmannii*, *Elymus trachycaulus*, *Geranium richardsonii*, *Heracleum maximum*, *Hymenoxys hoopesii*, *Lupinus argenteus*, *Poa palustris* (exotic), *Rudbeckia occidentalis*, *Saxifraga odontoloma*, *Senecio triangularis*, and *Senecio serra*. Scattered clumps of the deciduous shrub *Symphoricarpos oreophilus* are common, and occasional *Populus tremuloides* trees may also be present.

ENVIRONMENT & DYNAMICS

Environmental Description: Plant associations within this montane mesic meadow alliance occur in the central Rocky Mountains of Wyoming, Utah and Idaho extending west to ranges in Nevada. Elevations range from 1970-2835 m. Sites vary from gentle to steep (5-70%) slopes with eastern to southwestern aspects, but are most often moderately steep (40%) mid to upper slopes. Stands also occur along small streams, benches near seeps, and on moist toeslopes in narrow valley bottoms. The water table ranges to depths of 20 cm. Soils are moderately deep to deep, well-drained loams with a thick mollic horizon. Soils are developed from colluvium and more recently alluvium and are derived from limestone, sandstone or shale parent materials (Gregory 1983, Youngblood et al. 1985a). Soil texture includes silt loams, clay or clay loams with an average pH of 6.4 (Gregory 1983). Surface rock averages 46%, but varies from 1-90%. Bare ground cover is usually less than 15%.

Dynamics: When disturbed by extensive sheep grazing, this community is converted to a *Rudbeckia occidentalis*- or *Veratrum californicum*-dominated community (Padgett et al. 1989). *Pteridium aquilinum* has been associated with recently disturbed, mesic ground on steep slopes in Grand Tetons National Park.

DISTRIBUTION

Geographic Range: This alliance occurs in the subalpine zone in the central Rocky Mountains of Wyoming, Utah and Idaho extending west to ranges in Nevada.

Nations: US

States/Provinces: ID, NV, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > *Mertensia ciliata* Series (Johnston 1987)

LOWER LEVEL UNITS

Associations:

- CEG001944 *Mertensia ciliata* Meadow
- CEG001937 *Agastache urticifolia* - *Heliomeris multiflora* Meadow
- CEG002544 *Pteridium aquilinum* Meadow
- CEG002536 *Geranium viscosissimum* Meadow
- CEG001947 *Wyethia amplexicaulis* Meadow

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by M. Damm.

Version Date: 2014/03/14

REFERENCES

References: Bissell 1973, Faber-Langendoen et al. 2017b, Gregory 1983, Johnston 1987, Norton et al. 1981, Padgett et al. 1989, Welsh et al. 1987, Youngblood et al. 1985a

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

G271. Rocky Mountain-North Pacific Subalpine-Montane Mesic Grassland & Meadow

A3364. Calamagrostis breweri Mesic Grassland Alliance

Type Concept Sentence: This alliance consists of meadows where *Calamagrostis breweri* or *Calamagrostis muiriana* is the important or dominant grass in the herbaceous layer. This is an alpine and subalpine grassland found in the Sierra Nevada of California at elevations ranging from 1300-1800 m. It occurs on fine-textured soils which are moist for most of the year, often on stream and lake margins.

OVERVIEW

Scientific Name: *Calamagrostis breweri* Mesic Grassland Alliance

Common Name (Translated Scientific Name): Shorthair Reedgrass Mesic Grassland Alliance

Colloquial Name: Shorthair Reedgrass Mesic Grassland

Type Concept: This alliance consists of wet meadows dominated by *Calamagrostis breweri* or *Calamagrostis muiriana*. Other species include *Achillea millefolium* var. *occidentalis* (= *Achillea lanulosa*), *Carex filifolia*, *Deschampsia cespitosa*, *Eriogonum* spp., *Juncus drummondii*, *Juncus mertensianus*, *Oreostemma alpigenum*, *Penstemon heterodoxus*, *Phyllodoce breweri*, *Potentilla* spp., *Ptilagrostis kingii*, *Trisetum spicatum*, and *Vaccinium cespitosum*. Emergent shrubs such as *Kalmia microphylla*, *Salix arctica*, or *Vaccinium cespitosum* may be present at low cover. Herbs are <0.5 m in height, and the canopy cover is intermittent to continuous. This is an alpine and subalpine grassland found in the Sierra Nevada of California at elevations ranging from 1300-1800 m. Habitats are subalpine to alpine seasonally flooded meadows, valley bottoms, flats, and lower slopes which are moist for most of the year, having subsurface moisture.

Classification Comments: Much of the information for this alliance is derived from Sawyer et al. (2009) which follows the treatment of Wilson and Gray (2002), wherein *Calamagrostis breweri* is found north of Carson Pass in the central Sierra Nevada. They differentiated the plants that grow south of Carson Pass as *Calamagrostis muiriana*. The associations listed in Sawyer et al. (2009) under the *Calamagrostis muiriana* Herbaceous Alliance are included here, but currently the USNVC uses *Calamagrostis breweri* in those names. According to Wilson and Gray (2002), the *Calamagrostis muiriana* plants differ in morphology, isozyme patterns, chromosomes number, and ecology from *Calamagrostis breweri* that grows in the northern Sierra Nevada, Klamath Mountains, and Oregon. Unlike *Calamagrostis muiriana*, the northern plants are not community dominants. Under this concept, *Calamagrostis muiriana* associations are restricted to the central and southern Sierra Nevada. Kartesz (1999) does not recognize *Calamagrostis muiriana* but USDA Plants (accessed 20 November 2014) does.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: *Calamagrostis breweri* or *Calamagrostis muiriana* are the indicators, generally dominant, or having >30% relative cover. Shrubs such as *Vaccinium cespitosum* have low to moderate in cover.

VEGETATION

Physiognomy and Structure: This short, alpine or subalpine sod grassland is dominated by graminoids less than 15 cm in height. The herbaceous canopy can be open to continuous. Emergent shrubs (1-2 m) may be present.

Floristics: These wet meadows are dominated by *Calamagrostis breweri* or *Calamagrostis muiriana*. Other species include *Achillea millefolium* var. *occidentalis* (= *Achillea lanulosa*), *Carex filifolia*, *Deschampsia cespitosa*, *Eriogonum* spp., *Juncus drummondii*, *Juncus mertensianus*, *Oreostemma alpigenum*, *Penstemon heterodoxus*, *Phyllodoce breweri*, *Potentilla* spp., *Ptilagrostis kingii*, *Trisetum*

spicatum, and *Vaccinium cespitosum*. Emergent shrubs such as *Kalmia microphylla*, *Salix arctica*, or *Vaccinium cespitosum* may be present at low cover. Herbs are >0.5 m in height, and the canopy cover is intermittent to continuous.

ENVIRONMENT & DYNAMICS

Environmental Description: Habitats are subalpine to alpine seasonally flooded meadows, valley bottoms, flats, and lower slopes. This alliance occurs on fine-textured soils which are moist for most of the year, having subsurface moisture. It is also found on stream and lake margins that maintain the proper soil moisture content. The precipitation regime where this alliance occurs is strongly seasonal, with most precipitation falling in the winter months. Most precipitation in the upper elevational range falls as snow. Summers are very dry. Elevation range is 1300-1800 m. This alliance forms large stands, which often intergrade with other meadow, forest and woodland alliances.

Dynamics: Periodic droughts can reduce the extent of this alliance.

DISTRIBUTION

Geographic Range: This alliance is found in the Sierra Nevada of California.

Nations: US

States/Provinces: CA

TNC Ecoregions [optional]: 12:C

USFS Ecoregions (2007): M261E:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = *Calamagrostis muiriana* (Shorthair reed grass meadows) Alliance (Sawyer et al. 2009) [45.141.00]
- = *Calamagrostis muiriana* Herbaceous Alliance (CNPS 2017) [45.141.00]
- >< Dry Montane Meadow (#45120) (Holland 1986b)
- >< Dry Subalpine or Alpine Meadow (#45220) (Holland 1986b)
- = Shorthair Reed Grass Series (Sawyer and Keeler-Wolf 1995)
- >< Wet Montane Meadow (#45110) (Holland 1986b)
- >< Wet Subalpine or Alpine Meadow (#45210) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEGLO08657 *Calamagrostis breweri* - *Trisetum spicatum* Grassland
- CEGLO08655 *Vaccinium cespitosum* / *Calamagrostis breweri* Dwarf-shrub Grassland
- CEGLO08654 *Calamagrostis breweri* - *Oreostemma alpigenum* Grassland
- CEGLO08656 *Calamagrostis breweri* - *Juncus drummondii* Grassland

AUTHORSHIP

Primary Concept Source: M.S. Reid after Sawyer et al. (2009)

Author of Description: M.S. Reid

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Allen-Diaz 1994, Benedict 1983, Burke 1982, CNPS 2017, Faber-Langendoen et al. 2017b, Fites-Kaufman et al. 2007, Hickman 1993, Holland 1986b, Kartesz 1999, Keeler-Wolf et al. 2003a, Klihoff 1965, Major and Taylor 1977, Potter 2005, Ratliff 1982, Ratliff 1985, Sawyer and Keeler-Wolf 1995, Sawyer and Keeler-Wolf 2007, Sawyer et al. 2009, Taylor 1984, USDA NRCS n.d., Wilson and Gray 2002

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

G271. Rocky Mountain-North Pacific Subalpine-Montane Mesic Grassland & Meadow

A1294. *Carex filifolia* Mesic Grassland Alliance

Type Concept Sentence: This alliance is dominated by *Carex filifolia* in the herbaceous layer. Plants grow in tight clumps that form closed to open turf. This short grassland of dry subalpine and alpine meadows occurs on slopes and ridges from 1500-3700 m elevation in the Sierra Nevada of California and possibly east into the mountain ranges of western Nevada.

OVERVIEW

Scientific Name: *Carex filifolia* Mesic Grassland Alliance

Common Name (Translated Scientific Name): Threadleaf Sedge Mesic Grassland Alliance

Colloquial Name: Threadleaf Sedge Mesic Grassland

Type Concept: This alliance is dominated by *Carex filifolia* in the herbaceous layer. Plants grow in tight clumps that form closed to open turf. Other herbs may include *Achillea millefolium* var. *occidentalis* (= *Achillea lanulosa*), *Antennaria rosea*, *Calamagrostis muiriana*, *Cistanthe monosperma*, *Cistanthe umbellata*, *Deschampsia cespitosa*, *Dicentra uniflora*, *Erigeron algidus* (= *Erigeron petiolaris*), *Juncus mertensianus*, *Lewisia pygmaea*, *Lupinus breweri*, *Oreostemma alpigenum* (= *Aster alpigenus*), *Penstemon heterodoxus*, *Potentilla* spp., *Saxifraga aprica*, *Solidago multiradiata*, and *Trisetum spicatum*. Emergent *Eriogonum nudum* plants may be present at low cover. This alliance forms large stands. Herbs are <0.3 m in height, and the canopy coverage is open to continuous. This short grassland of dry subalpine and alpine meadows occurs on slopes and ridges, and edges of subalpine meadows and basins from 1500-3700 m elevation in the Sierra Nevada of California and possibly east into the mountain ranges of western Nevada. Stands often grow on the upper margins of meadows, or just beyond the zone of seasonal soil saturation if the stand is adjacent to a lake. Soils are well-drained sands or loams. The precipitation regime where this alliance occurs is strongly seasonal, with most precipitation falling in the winter months. Most precipitation in the upper elevational range falls as snow. Summers are very dry.

Classification Comments: This alliance could possibly be merged with *Calamagrostis breweri* Mesic Grassland Alliance (A3364), but occurs on somewhat drier sites, whereas *Calamagrostis breweri* requires subsurface moisture, and is seasonally flooded. In California, this is apparently *Carex filifolia* var. *erostrata* (Hickman 1993, Ball and Reznicek 2002), which in Kartesz (1999) is synonymous with *Carex exserta*. All of the associations in the USNVC for California should be renamed from *Carex filifolia* to *Carex exserta* or else to *Carex filifolia* var. *erostrata*.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Dominated by *Carex filifolia* in the herbaceous layer. *Carex filifolia* $\geq 50\%$ relative cover or is conspicuous ($\geq 1\%$ absolute cover) if other herbaceous species present. *Calamagrostis muiriana* or other short subalpine grasses and sedges are either subdominant or absent.

VEGETATION

Physiognomy and Structure: This short, alpine or subalpine sod grassland is dominated by forbs less than 30 cm in height. The herbaceous canopy can be open to continuous. Emergent shrubs (1-2 m) may be present.

Floristics: This alliance is dominated by *Carex filifolia* in the herbaceous layer. Plants grow in tight clumps that form closed to open turf. Other herbs may include *Achillea millefolium* var. *occidentalis* (= *Achillea lanulosa*), *Antennaria rosea*, *Calamagrostis muiriana*, *Cistanthe monosperma*, *Cistanthe umbellata*, *Deschampsia cespitosa*, *Dicentra uniflora*, *Erigeron algidus* (= *Erigeron petiolaris*), *Juncus mertensianus*, *Lewisia pygmaea*, *Lupinus breweri*, *Oreostemma alpigenum* (= *Aster alpigenus*), *Penstemon heterodoxus*, *Potentilla* spp., *Saxifraga aprica*, *Solidago multiradiata*, and *Trisetum spicatum*. Emergent *Eriogonum nudum* plants may be present at low cover.

ENVIRONMENT & DYNAMICS

Environmental Description: This short grassland of dry subalpine and alpine meadows occurs on slopes and ridges, and edges of subalpine meadows and basins from 1500-3700 m elevation. Stands often grow on the upper margins of meadows, or just beyond the zone of seasonal soil saturation if the stand is adjacent to a lake. Soils are well-drained sands or loams. The precipitation regime where this alliance occurs is strongly seasonal, with most precipitation falling in the winter months. Most precipitation in the upper elevational range falls as snow. Summers are very dry.

Dynamics: No information available.

DISTRIBUTION

Geographic Range: This alliance occurs in the Sierra Nevada of California and possibly east into the mountain ranges of western Nevada.

Nations: US

States/Provinces: CA, NV?

TNC Ecoregions [optional]: 12:C

USFS Ecoregions (2007): M261E:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = *Carex filifolia* (Shorthair sedge turf) Alliance (Sawyer et al. 2009) [45.140.00]
- = *Carex filifolia* Herbaceous Alliance (CNPS 2017) [45.140.00]
- >< Dry Subalpine or Alpine Meadow (#45220) (Holland 1986b)
- = Shorthair sedge series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS

Associations:

- CEGLO08653 *Vaccinium cespitosum* / *Carex filifolia* Dwarf-shrubland
- CEGLO08663 *Carex filifolia* - *Trisetum spicatum* Grassland
- CEGLO08660 *Carex filifolia* - *Cistanthe* spp. Grassland
- CEGLO08662 *Carex filifolia* - *Penstemon heterodoxus* Grassland

AUTHORSHIP

Primary Concept Source: M. Schindel, in Faber-Langendoen et al. (2013)

Author of Description: M.S. Reid

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Allen-Diaz 1994, Ball and Reznicek 2002, Benedict 1983, Bennett 1965, Burke 1982, CNPS 2017, Faber-Langendoen et al. 2017b, Hauser 2006b, Hickman 1993, Holland 1986b, Kartesz 1999, Keeler-Wolf et al. 2003a, Klikoff 1965, Major and Taylor 1977, Paysen et al. 1980, Potter 2005, Ratliff 1979, Ratliff 1982, Ratliff 1985, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Taylor 1984

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

G271. Rocky Mountain-North Pacific Subalpine-Montane Mesic Grassland & Meadow

A4119. *Carex straminiformis* - *Solidago canadensis* Meadow Alliance [Low - Poorly Documented]

Type Concept Sentence:

OVERVIEW

Scientific Name: *Carex straminiformis* - *Solidago canadensis* Meadow Alliance

Common Name (Translated Scientific Name): Shasta Sedge - Canada Goldenrod Meadow Alliance

Colloquial Name: Shasta Sedge - Canada Goldenrod Meadow

Type Concept:

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure:

Floristics:

ENVIRONMENT & DYNAMICS

Environmental Description:

Dynamics:

DISTRIBUTION**Geographic Range:****Nations:** US**States/Provinces:** CA, NV**TNC Ecoregions [optional]:****USFS Ecoregions (2007):****Omernik Ecoregions:****Federal Lands [optional]:****CONFIDENCE LEVEL****USNVC Confidence Level with Comments:** Low - Poorly Documented.**SYNONYMY**

- > *Carex straminiformis* (Mount Shasta sedge meadows) Provisional Alliance (Sawyer et al. 2009) [45.185.00]
- > *Carex straminiformis* Provisional Herbaceous Alliance (CNPS 2017) [45.185.00]
- > *Solidago canadensis* (Canada goldenrod patches) Provisional Alliance (Sawyer et al. 2009) [45.420.00]
- > *Solidago canadensis* Provisional Herbaceous Alliance (CNPS 2017) [45.420.00]

LOWER LEVEL UNITS**Associations:**

- C EGL001793 *Carex straminiformis* Grassland
- C EGL003161 *Solidago canadensis* - *Achillea millefolium* Grassland

AUTHORSHIP**Primary Concept Source:** M.S. Reid**Author of Description:****Acknowledgments:****REFERENCES**

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

G271. Rocky Mountain-North Pacific Subalpine-Montane Mesic Grassland & Meadow

A3951. Ligusticum spp. - Lupinus spp. - Delphinium spp. Montane Mesic Meadow Alliance

Type Concept Sentence: Plant associations within this typically montane mesic meadow alliance are characterized by the dominance of diagnostic species *Ligusticum filicinum*, *Ligusticum porteri*, *Ligusticum tenuifolium*, *Lupinus argenteus*, or *Lupinus parviflorus ssp. myrianthus* and occur in the central Rocky Mountains of Wyoming and Idaho extending south to ranges in Colorado.

OVERVIEW**Scientific Name:** *Ligusticum* spp. - *Lupinus* spp. - *Delphinium* spp. Montane Mesic Meadow Alliance**Common Name (Translated Scientific Name):** Licorice-root species - Lupine species - Larkspur species Montane Mesic Meadow Alliance**Colloquial Name:** Montane Licorice-root - Lupine - Larkspur Mesic Meadow

Type Concept: The vegetation of this montane mesic meadow alliance is characterized by a moderately dense, medium-tall herbaceous layer that is dominated by perennial forbs and composed of diagnostic and dominant species *Ligusticum filicinum*, *Ligusticum porteri*, *Ligusticum tenuifolium*, *Lupinus argenteus*, or *Lupinus parviflorus ssp. myrianthus*. This vegetation has high species richness. Other high frequency taxa include *Delphinium x occidentale*, *Fragaria virginiana*, *Osmorhiza occidentalis*, *Pedicularis bracteosa*, *Senecio crassulus*, *Trollius laxus ssp. albiflorus*, and *Vicia americana*. A few graminoids are frequent such as *Elymus trachycaulus*, *Festuca thurberi*, *Phleum alpinum*, *Poa alpina*, or *Trisetum spicatum*, but have sparse cover. Plant associations occur in the central Rocky Mountains of Wyoming and Idaho extending south to ranges in Colorado. Stands typically occur in montane zones but extend into upper subalpine meadows in swales, depressions and protected areas. Elevation ranges from 2170-3800 m. Sites may be flat to steeply sloped, but all are moist during most of the growing season, and often on lower slopes near snow drifts that are saturated from snowmelt. Aspects are often cooler north- to east-facing. Soils are moderately deep; the upper horizons are well-drained, but stay moist because of a slowly permeable dense clay in the lower horizons.

Classification Comments: One association in this alliance, *Lupinus* spp. - *Poa* spp. Meadow (CEGL001943), is based on standing crop data from just three small plots (5x5 m) on Carter Mountain in northwestern Wyoming (Thilenius and Brown 1987). Cover data and more information on this type from Carter Mountain are needed to show whether it is a distinct association or simply a patch in a larger alpine vegetation type. These stands were also disturbed by past domestic sheep grazing. Also, Johnston (1987) reported that

Bowns and Bagley (1986) described similar stands at 2800 m in southwestern Utah, which are currently outside the range of this alliance.

Internal Comments:

Other Comments:

Similar NVC Types:

- A3950 *Agastache urticifolia* - *Geranium viscosissimum* - *Pteridium aquilinum* Montane Mesic Meadow Alliance: is dominated by species such as *Agastache urticifolia*, *Heliomeris multiflora*, *Geranium viscosissimum*, *Mertensia ciliata*, *Pteridium aquilinum*, or *Wyethia amplexicaulis*.
- A3948 *Valeriana sitchensis* - *Luzula glabrata* var. *hitchcockii* - *Xerophyllum tenax* Subalpine Mesic Meadow Alliance: is typically dominated by *Valeriana sitchensis* or *Xerophyllum tenax* with *Carex geyeri*, *Carex spectabilis*, *Chamerion angustifolium*, *Luzula glabrata* var. *hitchcockii*, and *Veratrum viride* sometimes abundant.
- A3949 *Phleum alpinum* - *Elymus trachycaulus* - *Agrostis variabilis* Subalpine Mesic Meadow Alliance: is dominated by *Phleum alpinum*, *Elymus trachycaulus*, or *Agrostis variabilis*.
- A1257 *Festuca viridula* - *Carex hoodii* - *Lupinus* spp. Subalpine Mesic Meadow Alliance: is dominated or codominated by *Festuca viridula* in the interior Pacific Northwest and central Rocky Mountains.

Diagnostic Characteristics: These are mesic meadows dominated or codominated by forbs; especially diagnostic and often dominant species are *Ligusticum filicinum*, *Ligusticum porteri*, *Ligusticum tenuifolium*, *Lupinus argenteus*, or *Lupinus parviflorus* ssp. *myrianthus*. Other high frequency associated species include *Delphinium x occidentale*, *Fragaria virginiana*, *Osmorhiza occidentalis*, *Pedicularis bracteosa*, *Poa* spp., *Senecio crassulus*, *Trollius laxus* ssp. *albiflorus*, and *Vicia americana*.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a moderately dense to dense (60-100% cover), medium tall (0.5-0.7 m) herbaceous layer that is dominated by perennial forbs. Perennial graminoids are also a consistent component of the vegetation and may form a short herbaceous layer less than 0.5 m tall, but have typically lower cover than the forb layer.

Floristics: This alliance is characterized by a moderately dense, medium-tall herbaceous layer that is dominated by perennial forbs and composed of diagnostic and dominant species *Ligusticum filicinum*, *Ligusticum porteri*, *Ligusticum tenuifolium*, *Lupinus argenteus*, or *Lupinus parviflorus* ssp. *myrianthus*. This vegetation has high species richness with an average of 27 species per plot (Gregory 1983). Other associated species include forbs such as *Achillea millefolium*, *Delphinium x occidentale*, *Eurybia integrifolia*, *Geranium viscosissimum* var. *viscosissimum*, *Helianthella quinquenervis*, *Lathyrus lanszwertii* var. *leucanthus*, *Osmorhiza occidentalis*, *Pedicularis bracteosa*, *Potentilla gracilis*, *Symphotrichum foliaceum*, and *Vicia americana* from lower elevation stands, and at higher elevations, *Arenaria congesta*, *Geranium viscosissimum* var. *incisum*, *Geum rossii*, *Polygonum bistortoides*, *Senecio crassulus*, and *Trollius laxus* ssp. *albiflorus*, sometimes forming an additional short herbaceous layer of cushion plants and short grasses in the upper subalpine/alpine ecotone (Gregory 1983, Thilenius and Brown 1987). A few graminoids are frequent, such as *Bromus carinatus*, *Elymus trachycaulus*, *Festuca idahoensis*, *Festuca thurberi*, *Melica spectabilis*, *Phleum alpinum*, *Poa alpina*, or *Trisetum spicatum*, but have sparse cover.

ENVIRONMENT & DYNAMICS

Environmental Description: Plant associations within this mesic meadow alliance are found in the central Rocky Mountains of Wyoming and Idaho extending south to ranges in Colorado. Sites are typically montane but extend into the upper subalpine to near treeline with elevations ranging from 2170-3800 m. Stands often occur in swales, depressions and protected areas. Sites may be flat to steeply sloped (0-60%), but all are moist during most of the growing season and often on lower slopes near snow drifts that are saturated from snowmelt. Cooler north- to east-facing aspects are prevalent. Soils are variable but are often moderately deep with the upper horizons well-drained, but staying moist because of slowly permeable dense clay in the lower horizons. Soil texture is gravelly loam to silty clay loam. Soil pH is 5.7-6.8. Parent materials may include glacial till, limestone, loess, quartzite, sandstone, siltstone, and shale. Adjacent communities are subalpine forests dominated by *Picea engelmannii* or *Abies lasiocarpa*.

Dynamics: Disturbance by gophers appears to be necessary to maintaining forb dominance in these subalpine meadows. Gregory (1983) reports that the use of herbicides to control *Delphinium x occidentale*, which is poisonous to cattle, may have caused grass species to be more important in these meadows than they would be in untreated situations.

DISTRIBUTION

Geographic Range: This alliance occurs in subalpine zones in the central Rocky Mountains in Wyoming, Utah and Idaho and extends south into the Colorado Rockies.

Nations: US

States/Provinces: CO, ID, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- > *Ligusticum porteri* Series (Johnston 1987)
- > Upland Herb Community Type (Langenheim 1962) [central Colorado?]

LOWER LEVEL UNITS

Associations:

- C EGL003491 *Lupinus latifolius* Meadow
- C EGL001917 *Ligusticum tenuifolium* - *Trollius laxus* ssp. *albiflorus* Meadow
- C EGL001941 *Ligusticum filicinum* - *Delphinium x occidentale* Meadow
- C EGL001915 *Ligusticum porteri* - *Lupinus parviflorus* ssp. *myrianthus* Meadow
- C EGL001916 *Ligusticum porteri* - *Vicia americana* Meadow
- C EGL001942 *Lupinus argenteus* - *Fragaria virginiana* Meadow
- C EGL001943 *Lupinus* spp. - *Poa* spp. Meadow

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Bowns and Bagley 1986, Faber-Langendoen et al. 2017b, Gregory 1983, Hess and Wasser 1982, Johnston 1987, Langenheim 1962, Terwilliger et al. 1979a, Thilenius and Brown 1987

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

G271. Rocky Mountain-North Pacific Subalpine-Montane Mesic Grassland & Meadow

A3949. *Phleum alpinum* - *Elymus trachycaulus* - *Agrostis variabilis* Subalpine Mesic Meadow Alliance

Type Concept Sentence: Plant associations within this upper subalpine to lower alpine mesic meadow alliance are characterized by the dominance of *Phleum alpinum*, *Elymus trachycaulus*, or *Agrostis variabilis* and occur in the central Rocky Mountains of Wyoming, Utah and Idaho extending west to ranges in Nevada.

OVERVIEW

Scientific Name: *Phleum alpinum* - *Elymus trachycaulus* - *Agrostis variabilis* Subalpine Mesic Meadow Alliance

Common Name (Translated Scientific Name): Alpine Timothy - Slender Wheatgrass - Mountain Bentgrass Subalpine Mesic Meadow Alliance

Colloquial Name: Subalpine Alpine Timothy - Slender Wheatgrass - Mountain Bentgrass Mesic Meadow

Type Concept: The vegetation of this upper subalpine to lower alpine mesic meadow alliance is characterized by a mesic herbaceous layer that has moderate to dense cover dominated or codominated by diagnostic perennial grass species *Agrostis variabilis*, *Elymus trachycaulus*, or *Phleum alpinum*. Dominant forb species are *Achillea millefolium* and *Symphyotrichum foliaceum* (= *Aster foliaceus*), with *Antennaria corymbosa*, *Agoseris glauca*, *Epilobium ciliatum* ssp. *glandulosum* (= *Epilobium glandulosum*), and exotic *Taraxacum officinale* frequently present. The ground surface is covered with nonvascular plants such as lichens, liverworts, and mosses forming a cryptogamic crust. Plant associations occur in the central Rocky Mountains including the Yellowstone Plateau, south into the Colorado Plateau west to high ranges in the Great Basin and possibly Sierra Nevada. Elevations range from 2500 to 3900 m. Associations are found in mesic to wet meadows, floodplains, and near seeps and streambanks on medium-textured, mineral soils.

Classification Comments: *Agrostis variabilis* Meadow (CEGL001846) is only known from one location in southern Utah and needs additional survey, description and classification work to understand its expression over its full range. The stands described by Hall (1971) may be the result of disturbance by livestock and may not be an accurate description of "natural" vegetation. Nachlinger (1985) describes *Phleum alpinum* - *Achillea millefolium*-dominated subalpine meadows in the Lake Tahoe region, California and Nevada.

Internal Comments:**Other Comments:****Similar NVC Types:**

- A3950 *Agastache urticifolia* - *Geranium viscosissimum* - *Pteridium aquilinum* Montane Mesic Meadow Alliance: is dominated by mesic species such as *Agastache urticifolia*, *Geranium viscosissimum*, *Heliomeris multiflora*, *Mertensia ciliata*, *Pteridium aquilinum*, or *Wyethia amplexicaulis*.
- A3948 *Valeriana sitchensis* - *Luzula glabrata* var. *hitchcockii* - *Xerophyllum tenax* Subalpine Mesic Meadow Alliance: is typically dominated by *Valeriana sitchensis* or *Xerophyllum tenax* with *Carex geyeri*, *Carex spectabilis*, *Chamerion angustifolium*, *Luzula glabrata* var. *hitchcockii*, and *Veratrum viride* sometimes abundant.
- A3951 *Ligusticum* spp. - *Lupinus* spp. - *Delphinium* spp. Montane Mesic Meadow Alliance: is dominated by *Ligusticum filicinum*, *Ligusticum porteri*, *Ligusticum tenuifolium*, *Lupinus argenteus*, or *Lupinus parviflorus* ssp. *myrianthus*.
- A1257 *Festuca viridula* - *Carex hoodii* - *Lupinus* spp. Subalpine Mesic Meadow Alliance: is dominated or codominated by *Festuca viridula* in the interior Pacific Northwest and central Rocky Mountains.

Diagnostic Characteristics: These are high-altitude mesic meadows dominated by diagnostic mesic graminoid species *Phleum alpinum*, *Elymus trachycaulus*, or *Agrostis variabilis*. Dominant forb species are *Achillea millefolium* and *Symphyotrichum foliaceum*. Associated forb species include *Antennaria corymbosa*, *Antennaria parvifolia*, *Agoseris glauca*, *Cerastium beeringianum*, *Epilobium ciliatum* ssp. *glandulosum*, *Erigeron flagellaris*, *Lupinus lepidus*, *Penstemon procerus*, *Veronica serpyllifolia*, and exotic *Taraxacum officinale* (Hall 1971, Mattson 1984). Associated graminoids include *Blepharoneuron tricholepis*, *Carex engelmannii*, *Carex microptera*, *Deschampsia cespitosa*, *Festuca brachyphylla*, and *Poa* spp.

VEGETATION

Physiognomy and Structure: This alliance is characterized by a moderately dense to dense tufted perennial graminoid layer. The forb layer, typically of rhizomatous perennials, codominates. The ground surface has a cryptogamic crust of lichens, liverworts, and mosses (<0.1 m tall).

Floristics: The vegetation included in this subalpine meadow alliance is characterized by a mesic herbaceous layer that has moderate to dense cover depending on the amount of exposed rock. The herbaceous layer is dominated or codominated by diagnostic perennial grass species *Agrostis variabilis*, *Elymus trachycaulus*, or *Phleum alpinum*. Dominant forb species are *Achillea millefolium* and *Symphyotrichum foliaceum* (= *Aster foliaceus*), with *Antennaria corymbosa*, *Agoseris glauca*, *Epilobium ciliatum* ssp. *glandulosum* (= *Epilobium glandulosum*), and exotic *Taraxacum officinale* frequently present (Hall 1971, Mattson 1984). Associated graminoids include *Blepharoneuron tricholepis*, *Carex engelmannii*, *Carex microptera*, *Deschampsia cespitosa*, *Festuca brachyphylla*, and *Poa* spp. Other associated perennial forb species include *Antennaria parvifolia*, *Cerastium beeringianum*, *Erigeron flagellaris*, *Lupinus lepidus*, *Penstemon procerus*, and *Veronica serpyllifolia*. Annual forbs include *Gentianella amarella* ssp. *acuta* (= *Gentiana amarella*), *Gentianella tenella* (= *Gentiana tenella*), *Polygonum polygaloides* ssp. *confertiflorum* (= *Polygonum watsonii*), and *Veronica peregrina* (Hall 1971, Mattson 1984). The ground surface is covered with nonvascular plants such as lichens, liverworts, and mosses forming a cryptogamic crust.

ENVIRONMENT & DYNAMICS

Environmental Description: Plant associations within this upper subalpine to lower alpine mesic meadow alliance occur in the central Rocky Mountains including the Yellowstone Plateau, south into the Colorado Plateau west to high ranges in the Great Basin and possibly Sierra Nevada. Elevations range from 2500 to 3900 m. Climate is temperate. Summers are warm and winters are cold with freezing temperatures and heavy snow. The precipitation has a bimodal distribution, with about 70% of it occurring from October to April and 30% falling during the summer, often as high-intensity convection storms in the southern extent (Hall 1971). Associations are found in mesic to wet meadows, floodplains, and near seeps and streambanks on medium-textured, mineral soils (Hall 1971, Mattson 1984).

Stands on the Aquarius Plateau are located on gentle slopes (7%) on any aspect, midway between temporarily flooded basins and rock outcrops (Hall 1971). They may also occur on other somewhat mesic sites such as below talus slopes and along streams. Soil is a shallow, acidic (pH 5), nutrient-poor clay loam or loam derived from the basaltic lava that caps the plateau (Hall 1971). The ground surface has a cryptogamic crust of lichens, liverworts, and mosses. Although the soil profile is considered relatively shallow (54 cm), it is the deepest soil associated with the six herbaceous communities described in this meadow (Hall 1971). Water relations appear to be the dominant environmental factor that controls species composition (Hall 1971). This community is classified as dry-mesic (21% soil moisture) which is an intermediate grouping in a soil moisture gradient that ranges from hydric to rocky-xeric (51-5%) (Hall 1971).

Nachlinger (1985) did a detailed soil description on stands in the Sierra Nevada where sites were well-drained, typically occurring on gentle slopes ranging from 4-10° with southeast, south or west aspects. The water table generally is greater than 1 m below the surface (Nachlinger 1985). The A horizon averages 34 cm and is very dark brown to dark gray brown. Structure and texture vary from massive or single grain, loamy sand or sandy loam to massive or weak, angular blocky sandy clay loam, clay loam,

or clay. She also reports an acid pH (4.7) in the A horizon. The B horizon is thick averaging 53 cm. It is most often dark brown sandy clay loam with a strongly acidic pH of 5.4 (Nachlinger 1985).

Adjacent vegetation on a large scale is subalpine forest dominated by species of *Abies*, *Picea*, or *Populus tremuloides*. On a smaller scale adjacent vegetation described by Hall (1971) includes mesic, wet-mesic or hydric meadows dominated by *Danthonia intermedia*, *Deschampsia cespitosa*, or *Carex aquatilis*, respectively. More xeric sites are dominated by *Festuca brachyphylla*.

Dynamics: Many areas in the western U.S. such as the Aquarius Plateau have had a long history of livestock grazing and may have significant deterioration to the vegetation (Hall 1971). Ranges were once heavily overstocked as evidenced by stocking rate records and reports of continuous sod of lush grasses from early inhabitants (Hall 1971). Currently, the Aquarius Plateau shows signs of past erosion and is dominated by relatively short grasses and an abundance of forbs, including the exotic *Taraxacum officinale* (Hall 1971).

DISTRIBUTION

Geographic Range: This alliance occurs in the subalpine zone in the central Rocky Mountains and extends south into the Colorado Plateau at and west to ranges in the Great Basin and possibly Sierra Nevada.

Nations: US

States/Provinces: CA?, NV, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- > *Agrostis variabilis* Herbaceous Vegetation (Hall 1971)
- > *Phleum alpinum* - *Agropyron caninum* habitat type (Mattson 1984)

LOWER LEVEL UNITS

Associations:

- CEGLO01920 *Phleum alpinum* - *Achillea millefolium* Meadow
- CEGLO05427 *Elymus trachycaulus* Meadow
- CEGLO01923 *Phleum alpinum* - *Elymus trachycaulus* Meadow
- CEGLO01846 *Agrostis variabilis* Meadow

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by D. Culver.

Version Date: 2014/03/14

REFERENCES

References: Cronquist et al. 1977, Faber-Langendoen et al. 2017b, Hall 1971, Martin and Hutchins 1980, Mattson 1984, Nachlinger 1985, Sawyer and Keeler-Wolf 1995, Welsh et al. 1987

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

G271. Rocky Mountain-North Pacific Subalpine-Montane Mesic Grassland & Meadow

A4165. *Poa secunda* - *Muhlenbergia richardsonis* - *Carex douglasii* Moist Meadow Alliance [Low - Poorly Documented]

Type Concept Sentence: Moist deep-soil meadows dominated by graminoids *Poa secunda*, *Muhlenbergia richardsonis*, *Poa cusickii*, and/or *Carex douglasii*, found at low to high elevations throughout the interior of the western U.S.

OVERVIEW

Scientific Name: *Poa secunda* - *Muhlenbergia richardsonis* - *Carex douglasii* Moist Meadow Alliance

Common Name (Translated Scientific Name): Sandberg Bluegrass - Mat Muhly - Douglas' Sedge Moist Meadow Alliance

Colloquial Name: Bluegrass - Muhly - Sedge Moist Meadow

Type Concept: These moist meadows are dominated by *Poa secunda*, *Poa cusickii*, *Carex douglasii*, or *Muhlenbergia richardsonis*, usually with a diversity of other graminoids and forbs. They are found on gentle slopes of uplands or drainages, between approximately 10 and 3240 m (30-10,630 feet) elevation. Soils are moist to wet in the spring but dry by the end of the growing season. These meadows are found throughout the interior western United States.

Classification Comments:

Internal Comments: MSR 12-15: these communities are not always alkaline and fit well with Mesic herb meadow group.

Other Comments:

Similar NVC Types:

- A3471 *Deschampsia cespitosa* Serpentine Seep Alliance

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure:

Floristics: The vegetation is characterized by a somewhat open to dense graminoid canopy dominated by the short bunchgrass/graminoid *Poa secunda*, *Poa cusickii*, *Carex douglasii*, or *Muhlenbergia richardsonis*. The herbaceous layer is diverse, with additional graminoids such as *Aristida purpurea*, *Blepharipappus scaber*, *Bromus arvensis* (= *Bromus japonicus*), *Bromus rubens*, *Carex microptera*, *Carex praegracilis*, *Danthonia unispicata*, *Eleocharis palustris*, *Eleocharis quinqueflora* (= *Eleocharis pauciflora*), *Elymus caninus*, *Elymus elymoides*, *Elymus multisetus*, *Hesperostipa comata*, *Hordeum brachyantherum* ssp. *californicum*, *Juncus balticus*, *Koeleria macrantha*, *Leymus simplex*, *Leymus triticoides*, *Pascopyrum smithii*, *Sporobolus cryptandrus*, and *Triteleia hyacinthina*; however, these provide low to moderate cover. Forbs provide moderate cover and include *Achillea millefolium*, *Agoseris glauca*, *Linanthus pungens* (= *Leptodactylon pungens*), *Lomatium bicolor*, *Iris missouriensis*, *Iva axillaris*, *Potentilla gracilis*, *Senecio* sp., and *Trifolium* spp. Shrubs such as *Artemisia arbuscula*, *Artemisia tridentata*, or *Chrysothamnus viscidiflorus* may be present with sparse cover. Introduced species may also be common in some stands, especially *Bromus tectorum*, *Descurainia pinnata*, *Onopordum acanthium*, *Poa pratensis*, and *Sisymbrium altissimum*.

ENVIRONMENT & DYNAMICS

Environmental Description: This widespread grassland association occurs across the intermountain western U.S. Elevation ranges from 10 to 3240 m (32-10,630 feet). Stands occur on relatively flat terrain characterized as valley bottoms with shallow water tables, inactive floodplains, terraces, and dry basins, in swales, on upland gentle slopes and drainage bottoms, often with easterly facing aspects, and sometimes on the dry fringes of wetter meadows. Substrates are deep, well-drained sandy loam and clay loam soils. The soils are moist in spring and tend to be dry by mid-summer, and are often on the dry fringe of wetter areas. This alliance has a wide tolerance of pH conditions and has been documented on serpentine soils, alkaline soils of sand dunes and acidic soils on sandstone and granitic substrates. USFWS wetland Inventory recognizes *Poa secunda* as an FACU.

Dynamics:

DISTRIBUTION

Geographic Range: These meadows are found in the western interior mountains and valleys of the western U.S.

Nations: US

States/Provinces: CA, CO, ID, MT, NV, OR, UT, WA?

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

- > *Carex douglasii* Herbaceous Alliance (Evens et al. 2014)
- > *Carex douglasii* Provisional Herbaceous Alliance (CNPS 2017) [45.169.00]
- > *Muhlenbergia richardsonis* (Mat muhly meadows) Provisional Alliance (Sawyer et al. 2009) [41.277.00]
- > *Poa secunda* (Curly blue grass grassland) Alliance (Sawyer et al. 2009) [41.180.00]
- >> Alkali Meadow (#45310) (Holland 1986b)
- >> Cusick Bluegrass Association (Kovalchik 1987)

- >< Dry Meadow (Volland 1976)
- >< Dry Montane Meadow (#45120) (Holland 1986b)
- >< Dry Subalpine or Alpine Meadow (#45220) (Holland 1986b)
- < Sedge series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS

Associations:

- C EGL001602 *Deschampsia cespitosa* - *Carex douglasii* Moist Meadow
- C EGL005605 *Poa secunda* - *Linanthus pungens* Moist Meadow
- C EGL001768 *Carex douglasii* Moist Meadow
- C EGL001655 *Poa cusickii* Moist Meadow
- C EGL001657 *Poa secunda* Moist Meadow
- C EGL002755 *Poa secunda* - *Muhlenbergia richardsonis* Moist Meadow

AUTHORSHIP

Primary Concept Source: M.S. Reid, in Faber-Langendoen et al. (2015)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2016/09/27

REFERENCES

References: CNPS 2017, Evens et al. 2014, Faber-Langendoen et al. 2017b, Holland 1986b, Kovalchik 1987, Manning 1988, Padgett and Manning 1988, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Smith 1998b, Volland 1976

M493. Western North American Ruderal Grassland & Shrubland

This upland macrogroup contains ruderal grasslands, meadows and shrublands found on human-disturbed sites, and dominated by non-native and generalist native species that occur in temperate areas throughout the western U.S. (Rockies westward) and southwestern Canada.

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

2.B.2.Na.90.a. M493 Western North American Ruderal Grassland & Shrubland

G624. Western North American Interior Ruderal Grassland & Shrubland

Type Concept Sentence: This group includes grasslands dominated by the non-native grass *Elymus repens* and is known from disturbed valley bottoms, alluvial flats, fans and lower valley wall sites in western Colorado and northwestern Montana.

OVERVIEW

Scientific Name: Western North American Interior Ruderal Grassland & Shrubland Group

Common Name (Translated Scientific Name): Western North American Interior Ruderal Grassland & Shrubland Group

Colloquial Name: Western Ruderal Perennial Grassland

Type Concept: This montane, mesic to subhygric herbaceous group has low overall species diversity due to the dominance of *Elymus repens*, an exotic rhizomatous grass. *Elymus repens* is a highly invasive species in mesic areas and tends to exclude other species once established. Overall herbaceous cover ranges from 25-85% with *Elymus repens* clearly dominating with 5-80% cover. This group occurs in western Colorado, northwestern Montana, and southern Idaho. Sites include disturbed valley bottoms, alluvial flats, fans and lower valley wall sites between 1450 and 2300 m in elevation.

Classification Comments:

Similar NVC Types:

- G678 Californian Ruderal Forest
- G819 North American Warm Desert Ruderal Scrub
- G677 North American Warm Desert Ruderal Grassland
- G600 Great Basin-Intermountain Ruderal Dry Shrubland & Grassland

Diagnostic Characteristics:

VEGETATION**Physiognomy and Structure:****Floristics:****ENVIRONMENT & DYNAMICS****Environmental Description:****Dynamics:****DISTRIBUTION****Geographic Range:****Spatial Scale & Pattern [optional]:****Nations:** CA, US**States/Provinces:** CA, CO, KS, MT, ND, NE, NV, SD, UT, WY**TNC Ecoregions [optional]:****USFS Ecoregions (2007):****Omernik Ecoregions:****Federal Lands [optional]:****CONFIDENCE LEVEL****USNVC Confidence Level with Comments:** Moderate.**SYNONYMY****LOWER LEVEL UNITS****Alliances:**

- A4191 *Rumex crispus* - (other FAC & Dryland Forb Species) Ruderal Meadow Alliance
- A2658 *Elymus repens* Ruderal Grassland Alliance
- A3254 *Agropyron cristatum* - *Bromus inermis* - *Poa pratensis* Ruderal Grassland Alliance

AUTHORSHIP**Primary Concept Source:** K.A. Schulz, in Faber-Langendoen et al. (2011)**Author of Description:** G. Kittel**Acknowledgments:****Version Date:** 11/23/2016**Classif Resp Region:** West**Internal Author:** KAS 9-11; GK 11-16**REFERENCES****References:** Faber-Langendoen et al. 2017a

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

G624. Western North American Interior Ruderal Grassland & Shrubland

A3254. *Agropyron cristatum* - *Bromus inermis* - *Poa pratensis* Ruderal Grassland Alliance [Low - Poorly Documented]

Type Concept Sentence: This alliance occurs in disturbed dry to mesic grasslands and meadows found in lowland, montane and subalpine elevations (sea level to 3600 m) throughout the western U.S. and Canada. Vegetation can be a monoculture of a single non-native graminoid species, or a mix of several non-native forbs and graminoids. Graminoids include *Agropyron cristatum* and *Bromus inermis* (which has been purposefully seeded to prevent soil erosion), as well as many introduced forage species, especially in more mesic montane uplands such as *Alopecurus pratensis*, *Dactylis glomerata*, *Phleum pratense*, *Poa pratensis*, and *Psathyrostachys juncea*. Highly invasive and wind- and animal-distributed non-native forb species include *Sisymbrium altissimum*, *Descurainia sophia*, and *Lappula occidentalis*.

OVERVIEW**Scientific Name:** *Agropyron cristatum* - *Bromus inermis* - *Poa pratensis* Ruderal Grassland Alliance**Common Name (Translated Scientific Name):** Crested Wheatgrass - Smooth Brome - Kentucky Bluegrass Ruderal Grassland Alliance**Colloquial Name:** Western Ruderal Perennial Grassland

Type Concept: This alliance occurs in disturbed dry to mesic grasslands and meadows found in lowland, montane and subalpine elevations (sea level to 3600 m) throughout the western U.S. and Canada. Vegetation can be a monoculture of a single non-native graminoid species, or a mix of several non-native forbs and graminoids. Graminoids include *Agropyron cristatum* and *Bromus inermis* (which has been purposefully seeded to prevent soil erosion), as well as many introduced forage species, especially in more mesic montane uplands, such as *Alopecurus pratensis*, *Dactylis glomerata*, *Phleum pratense*, *Poa pratensis*, and *Psathyrostachys juncea* (= *Elymus junceus*). Highly invasive and wind- and animal-distributed non-native forb species include *Sisymbrium altissimum*, *Descurainia sophia*, and *Lappula occidentalis*.

Classification Comments: Successful introductions of non-native forage species have created stands of late-seral grasslands that are difficult to restore to native species.

Internal Comments:

Other Comments:

Similar NVC Types:

- A4148 *Agropyron cristatum* Western Ruderal Perennial Grassland Alliance

Diagnostic Characteristics: Dominant diagnostic species for this alliance are invasive, perennial grass species such as *Agropyron cristatum*, *Alopecurus pratensis*, *Dactylis glomerata*, *Phleum pratense*, *Poa pratensis*, *Psathyrostachys juncea*, and many others.

VEGETATION

Physiognomy and Structure:

Floristics:

ENVIRONMENT & DYNAMICS

Environmental Description:

Dynamics:

DISTRIBUTION

Geographic Range: This alliance occurs in lowland, montane and subalpine elevations (sea level to 3600 m) throughout the western U.S. and Canada.

Nations: CA, US

States/Provinces: CO, KS, MT, ND, NE, NV, SD, SK, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEGLO05266 *Agropyron cristatum* - (*Pascopyrum smithii*, *Hesperostipa comata*) Ruderal Grassland
- CEGLO05264 *Bromus inermis* - (*Pascopyrum smithii*) Ruderal Grassland
- CEGLO05471 *Agropyron cristatum* - *Bromus tectorum* Ruderal Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2013/09/27

REFERENCES

References: Faber-Langendoen et al. 2017b

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

G624. Western North American Interior Ruderal Grassland & Shrubland

A2658. *Elymus repens* Ruderal Grassland Alliance

Type Concept Sentence: This alliance is dominated by the non-native grass *Elymus repens* and is known from disturbed valley bottoms, alluvial flats, fans and lower valley wall sites in western Colorado and northwestern Montana.

OVERVIEW

Scientific Name: *Elymus repens* Ruderal Grassland Alliance

Common Name (Translated Scientific Name): Quackgrass Ruderal Grassland Alliance

Colloquial Name: Ruderal Quackgrass Grassland

Type Concept: This montane, mesic to subhygric herbaceous alliance has low overall species diversity due to the dominance of *Elymus repens* (= *Elytrigia repens* var. *repens*), an exotic rhizomatous grass. *Elymus repens* is a highly invasive species in mesic areas and tends to exclude other species once established. Overall herbaceous cover ranges from 25-85% with *Elymus repens* clearly dominating this association with 5-80% cover. This alliance is known western Colorado, northwestern Montana and southern Idaho. Sites include disturbed valley bottoms, alluvial flats, fans and lower valley wall sites between 1450 and 2300 m in elevation.

Classification Comments:

Internal Comments: GK 11-16: ID added for Minidoka.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Temperate semi-natural sod grasslands of disturbed areas characterized by a near monoculture of *Elymus repens*.

VEGETATION

Physiognomy and Structure: This alliance is characterized by a moderate to dense layer of medium-tall (0.5-1 m) perennial graminoids.

Floristics: This montane, mesic to subhygric herbaceous association has low overall species diversity due to the dominance of *Elymus repens* (= *Elytrigia repens* var. *repens*), an exotic rhizomatous grass. *Elymus repens* is a highly invasive species in mesic areas and tends to exclude other species once established. Overall herbaceous cover ranges from 25-85% with *Elymus repens* clearly dominating this association with 5-80% cover. Other species sometimes present with low cover include *Achillea millefolium*, *Cerastium arvense*, *Carex* spp., *Equisetum laevigatum*, *Iva axillaris*, *Poa palustris*, *Penstemon confertus*, *Symphotrichum laeve* (= *Aster laevis*), and *Taraxacum officinale*.

ENVIRONMENT & DYNAMICS

Environmental Description: It occurs on flat to gently sloping lower slopes, toeslopes and valley bottoms at elevations between 1450 and 1555 m (4750-5100 feet) in Montana and between 1710 and 2285 m (5610-7500 feet) in Colorado. Soils are derived from glacial or fluvial deposits but are variable in soil texture, ranging from moderately well-drained sandy loams to clay loams to poorly drained gravel and rock. Litter dominates the ground surface.

Dynamics: Although characterized as an early-seral dominant (Gross and Werner 1982), *Elymus repens* is a highly invasive species in mesic areas and tends to exclude other species once established. It is tolerant of mildly saline conditions. It hybridizes readily with other wheatgrasses (e.g., *Pascopyrum smithii*, *Pseudoroegneria spicata*) and has fair to good forage value for domestic livestock. Many of the occurrences in the western U.S. can be traced to plantings of *Elymus repens* or hybrids for pasture or hay (Beetle 1955).

DISTRIBUTION

Geographic Range: This alliance is currently known from western Colorado, northwestern Montana, and southern Idaho.

Nations: US

States/Provinces: CO, ID, MT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- C EGL005868 *Elymus repens* Ruderal Grassland

AUTHORSHIP

Primary Concept Source: J. Coles, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2016/11/23

REFERENCES

References: Beetle 1955, Faber-Langendoen et al. 2017b, Gross and Werner 1982

2. Shrub & Herb Vegetation

2.B.2.Na. Western North American Grassland & Shrubland

G624. Western North American Interior Ruderal Grassland & Shrubland

A4191. Rumex crispus - (other FAC & Dryland Forb Species) Ruderal Meadow Alliance [Low - Poorly Documented]

Type Concept Sentence:

OVERVIEW

Scientific Name: *Rumex crispus* - (other FAC & Dryland Forb Species) Ruderal Meadow Alliance

Common Name (Translated Scientific Name): Curly Dock - (and other FAC & Dryland Forb Species) Ruderal Meadow Alliance

Colloquial Name: Ruderal FAC & Dryland Forb Meadow

Type Concept:

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure:

Floristics:

ENVIRONMENT & DYNAMICS

Environmental Description:

Dynamics:

DISTRIBUTION

Geographic Range:

Nations: US

States/Provinces: ID

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY**LOWER LEVEL UNITS****Associations:**

- C EGL005621 *Rumex crispus* Ruderal Grassland

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2015)

Author of Description:

Acknowledgments:

REFERENCES

2.B.2.Nd. Western North American Interior Chaparral

These chaparral shrublands occur between low-elevation desert landscapes and higher subalpine woodlands of the western U.S. and northern Mexico.

M094. Cool Interior Chaparral

These chaparral shrublands occur between low-elevation desert landscapes and higher subalpine woodlands of the Cascades, Sierra Nevada, and interior mountain ranges of the western U.S., generally among montane forests above 1500 m (4550 feet) elevation.

2. Shrub & Herb Vegetation

2.B.2.Nd. Western North American Interior Chaparral

2.B.2.Nd.1.a. M094 Cool Interior Chaparral

G282. Western North American Montane Sclerophyll Scrub

Type Concept Sentence: This western North American group consists of montane chaparral scrublands dominated by a variety of species, including *Arctostaphylos patula*, *Arctostaphylos mewukka*, *Arctostaphylos nevadensis*, *Arctostaphylos viscida*, *Ceanothus cordulatus*, *Ceanothus velutinus*, *Ceanothus integerrimus*, *Ceanothus martinii*, *Chrysolepis sempervirens*, *Holodiscus discolor*, *Prunus emarginata*, *Quercus garryana* var. *fruticosa*, *Quercus sadleriana*, and/or *Quercus vacciniifolia*, generally occurring on ridges and rocky slopes often with southerly aspects throughout the West.

OVERVIEW

Scientific Name: *Arctostaphylos patula* - *Arctostaphylos nevadensis* - *Ceanothus velutinus* Montane Sclerophyll Scrub Group

Common Name (Translated Scientific Name): Greenleaf Manzanita - Pinemat Manzanita - Snowbrush Ceanothus Montane Sclerophyll Scrub Group

Colloquial Name: Greenleaf Manzanita - Pinemat Manzanita Shrubland

Type Concept: This group consists of cool, mostly montane chaparral and sclerophyllous scrublands that occur in the western United States from the Sierra Nevada, Klamath-Siskiyou mountains and southern Cascade Range of California, Oregon and Washington east on the ranges of the Great Basin and plateaus of the Colorado Plateau into the Rocky Mountains extending out to the Black Hills. There are also occurrences extending as far west as the inner Coast Ranges in central California and the Peninsular and Transverse ranges. Stands are typically fairly open-canopied shrublands with open interspaces either bare or supporting patchy grasses and forbs. *Arctostaphylos patula* and *Ceanothus velutinus* are the most widespread dominant/diagnostic species. Other dominant/diagnostic species include *Arctostaphylos mewukka*, *Arctostaphylos nevadensis*, *Arctostaphylos viscida*, *Ceanothus cordulatus*, *Ceanothus integerrimus*, *Ceanothus martinii*, *Chrysolepis sempervirens*, *Holodiscus discolor*, *Prunus emarginata*, *Quercus garryana* var. *fruticosa* (= var. *breweri*) (shrub form), *Quercus sadleriana*, and *Quercus vacciniifolia*. *Cercocarpus ledifolius* is generally absent. Most of the oaks and other chaparral species occur in the western extent. Understory varies with shrub density but is generally sparse. Occasional emergent conifers may be present. Higher elevation stands typically have higher species diversity. Stands in this group are typically montane shrublands found on the slopes of the Sierra Nevada and Cascades and into the western Great Basin, Colorado Plateau and the Black Hills of South Dakota in summer-dry habitats from 800 to 3000 m elevation. Stands in California are found at higher elevations than most other chaparral ranging from 300 to 3300 m elevation. They occur in the northern Coast Ranges, Klamath Mountains, Modoc Plateau, Sierra Nevada and foothills, and southern Cascades of California, Oregon and Washington. Climate is semi-arid to cool temperate. Yearly precipitation and temperature ranges are quite large. Much of the precipitation comes as winter snow at higher elevations, and summer drought-stress is characteristic. These shrublands occur on ridges and rocky slopes often with southerly aspects. Substrates are thin, well-drained skeletal soils with coarser texture loamy or

sandy soils. Parent materials are varied and range from limestone and sandstone to granitics, mafic, and ultramafic substrates. These shrub communities established after stand-replacing fires or clearcut logging in *Pinus ponderosa* or *Pseudotsuga menziesii* forests or pinyon-juniper woodlands, and are seral to forest after several decades. Excessively rocky or droughty, fire-prone sites in the forest may support relatively persistent stands of this group. In the Rocky Mountains, stands are found within a matrix of montane conifer forest and woodland in limited, small-patch occurrences forming post-fire shrublands in areas previously dominated by woodlands. Typical fire regime in this group varies with the amount of organic accumulation. All characteristic species are fire-adapted.

Classification Comments: This cool, mostly montane chaparral and sclerophyllous scrublands group occurs in the western United States and is frequently characterized by dominance of *Arctostaphylos patula* and *Ceanothus velutinus*. Other dominant/diagnostic species include *Arctostaphylos mewukka*, *Arctostaphylos nevadensis*, *Arctostaphylos viscida*, *Ceanothus cordulatus*, *Ceanothus integerrimus*, *Ceanothus martinii*, *Chrysolepis sempervirens*, *Holodiscus discolor*, *Prunus emarginata*, *Quercus garryana* var. *fruticosa* (shrub form), *Quercus sadleriana*, and *Quercus vacciniifolia*. *Cercocarpus ledifolius* is generally absent.

Similar NVC Types:

- G261 Californian Mesic & Pre-montane Chaparral

Diagnostic Characteristics: Open-canopied broad-leaved evergreen shrublands dominated by diagnostic species *Arctostaphylos mewukka*, *Arctostaphylos nevadensis*, *Arctostaphylos patula*, *Arctostaphylos viscida*, *Ceanothus cordulatus*, *Ceanothus integerrimus*, *Ceanothus martinii*, *Ceanothus velutinus*, *Chrysolepis sempervirens*, *Holodiscus discolor*, *Prunus emarginata*, *Quercus garryana* var. *fruticosa* (shrub form), *Quercus sadleriana*, and *Quercus vacciniifolia*. *Cercocarpus ledifolius* is generally absent and herbaceous layer is typically sparse.

VEGETATION

Physiognomy and Structure: Broad-leaved evergreen shrubland with open canopy and little to no undergrowth. Shrubs are typically 1-3 m tall.

Floristics: Stands in this wide-ranging group are typically fairly open-canopied shrublands with open interspaces either bare or supporting patchy grasses and forbs. *Arctostaphylos patula* and *Ceanothus velutinus* are the most widespread dominant/diagnostic species. Other dominant/diagnostic species include *Arctostaphylos mewukka*, *Arctostaphylos nevadensis*, *Arctostaphylos viscida*, *Ceanothus cordulatus*, *Ceanothus integerrimus*, *Ceanothus martinii*, *Chrysolepis sempervirens*, *Holodiscus discolor*, *Prunus emarginata*, *Quercus garryana* var. *fruticosa* (= var. *breweri*) (shrub form), *Quercus sadleriana*, and *Quercus vacciniifolia*. *Cercocarpus ledifolius* is generally absent. Most of the oaks and other chaparral species occur in the western extent. Other shrubs may include *Amelanchier alnifolia*, *Amelanchier utahensis*, *Artemisia tridentata*, *Cercis canadensis* var. *texensis*, *Cercocarpus montanus*, *Garrya fremontii*, *Quercus berberidifolia*, *Prunus subcordata*, *Purshia stansburiana*, *Symphoricarpos* spp., and *Toxicodendron diversilobum*. Emergent conifers may be present, such as *Abies concolor*, *Pinus lambertiana*, *Pinus ponderosa*, *Pinus sabiniana*, *Pseudotsuga menziesii*, and tree oaks such as *Quercus chrysolepis*, *Quercus kelloggii*, or *Quercus wislizeni* may be present at sparse cover. Understory varies with shrub density but is generally sparse with *Elymus glaucus*, *Elymus elymoides*, *Eriogonum nudum*, *Festuca californica*, *Pyrola picta*, and *Stephanomeria lactucina* sometimes present in the herbaceous layer. Higher elevation stands typically have higher species diversity.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands in this group are typically montane shrublands found on the slopes of the Sierra Nevada and Cascades and into the western Great Basin, Colorado Plateau and Black Hills of South Dakota in summer-dry habitats from 800 to 3000 m elevation. Stands in California are found at higher elevations than most other chaparral ranging from 300 to 3300 m elevation. They occur in the northern Coast Ranges, Klamath Mountains, Modoc Plateau, Sierra Nevada and foothills, and southern Cascades of California and southern Oregon. Climate is semi-arid to cool temperate. Yearly precipitation and temperature ranges are quite large. The northern portion of the Sierra Nevada and Klamath-Siskiyou mountains can receive 200 cm of rain per year, while southern stands may receive only 40 cm per year. These sclerophyllous shrubs are adapted to freezing temperatures and cold winters. However, lower elevation stands may never see freezing temperatures, while northern, high-elevation and northern stands may only have a 4-month growing season. Much of the precipitation comes as winter snow, and summer drought-stress is characteristic.

These shrublands occur on ridges and rocky slopes often with southerly aspects. Substrates are thin, well-drained skeletal soils with coarser texture loamy or sandy soils. Parent materials are varied and range from limestone and sandstone to granitics, mafic, and ultramafic substrates. These shrub communities are typically zonal disclimax or, occasionally, edaphic climax brushfields which occur in association with dry needle-leaved evergreen forests or woodlands. They typically established after stand-replacing fires or clear-cut logging in *Pinus ponderosa* or *Pseudotsuga menziesii* forests or pinyon-juniper woodlands, and are seral to forest after several decades. Excessively rocky or droughty, fire-prone sites in the forest may support relatively persistent stands of this group. In the Rocky Mountains, stands are found within a matrix of montane conifer forest and woodland in limited, small-patch

occurrences forming post-fire shrublands in areas previously dominated by woodlands. Typical fire regime in this group varies with the amount of organic accumulation. All characteristic species are fire-adapted.

Dynamics: Stands commonly occur post disturbance after fire or logging along ridges and upper slopes.

DISTRIBUTION

Geographic Range: This chaparral group occurs across much of the western United States from the Sierra Nevada, Klamath-Siskiyou mountains and southern Cascade Range of California, Oregon and Washington east across the ranges of the Great Basin and plateaus of the Colorado Plateau into the Rocky Mountains extending out to the Black Hills. There are occurrences extending as far west as the inner Coast Ranges in central California, the northern Coast Ranges in southeastern Oregon and the Peninsular and Transverse ranges in southern California.

Spatial Scale & Pattern [optional]: Large patch

Nations: CA?, US

States/Provinces: AB?, AZ, BC?, CA, CO, ID, MT, NM, NV, OR, SD, UT, WA?, WY

TNC Ecoregions [optional]: 3:C, 4:C, 7:P, 8:C, 9:C, 11:C, 12:C, 15:P, 18:C, 19:C, 20:P, 21:P

USFS Ecoregions (2007): 313A:??, 341A:CP, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342B:CC, 342C:CC, 342J:CP, M261E:CC, M341A:CC, M341D:CP

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate. This group is very uncertain as a type.

SYNONYMY

- >< Littleleaf Mountain-Mahogany (417) (Shiflet 1994)
- >< Snowbush (420) (Shiflet 1994)

LOWER LEVEL UNITS

Alliances:

- A4117 *Quercus sadleriana* - *Notholithocarpus densiflorus* var. *echinoides* Shrubland Alliance
- A3918 *Prunus emarginata* - *Holodiscus discolor* Shrubland Alliance
- A3919 *Quercus garryana* var. *fruticosa* Shrubland Alliance
- A3916 *Quercus vacciniifolia* - *Chrysolepis sempervirens* Shrubland Alliance
- A3917 *Ceanothus cordulatus* - *Ceanothus integerrimus* Shrubland Alliance
- A0788 *Arctostaphylos patula* - *Arctostaphylos nevadensis* Shrubland Alliance
- A3936 *Ceanothus velutinus* Shrubland Alliance

AUTHORSHIP

Primary Concept Source: T.N. Shiflet (1994)

Author of Description: K.A. Schulz and M.S. Reid

Acknowledgments:

Version Date: 08/06/2015

Classif Resp Region: West

Internal Author: KAS/MSR 3-10, 9-13, mod. KAS 4-15, mod. GK 8-15, 12-15

REFERENCES

References: Barbour and Major 1977, Brown 1982a, Faber-Langendoen et al. 2017a, Sawyer et al. 2009, Shiflet 1994

2. Shrub & Herb Vegetation

2.B.2.Nd. Western North American Interior Chaparral

G282. Western North American Montane Sclerophyll Scrub

A0788. *Arctostaphylos patula* - *Arctostaphylos nevadensis* Shrubland Alliance

Type Concept Sentence: This alliance consists of shrublands strongly dominated by *Arctostaphylos patula* or *Arctostaphylos nevadensis*. They are often monotypic stands with few other shrubs. These montane shrublands occur on the eastern slope of the Sierra Nevada and into the western Great Basin and Colorado Plateau and are found mostly on steep, usually south-facing slopes, where soils are rocky and well-drained.

OVERVIEW

Scientific Name: *Arctostaphylos patula* - *Arctostaphylos nevadensis* Shrubland Alliance

Common Name (Translated Scientific Name): Greenleaf Manzanita - Pinemat Manzanita Shrubland Alliance

Colloquial Name: Greenleaf Manzanita - Pinemat Manzanita Shrubland

Type Concept: This alliance consists of shrublands strongly dominated by *Arctostaphylos patula* or *Arctostaphylos nevadensis*. They are often monotypic stands with few other shrubs. Common shrub associates include *Arctostaphylos nevadensis*, *Ceanothus cordulatus*, *Ceanothus velutinus*, *Cercocarpus montanus*, *Chrysolepis sempervirens* (= *Castanopsis sempervirens*), and *Ribes* spp. Eastward, steppe species such as *Artemisia tridentata*, *Purshia tridentata*, and *Cercocarpus ledifolius* become common associates. Herbaceous vegetation is typically sparse and poorly described across the range of this alliance. Reported associates in northern California include *Elymus elymoides*, *Pyrola picta*, and *Stephanomeria lactucina*. This alliance occurs on the eastern slope of the Sierra Nevada and into the western Great Basin and Colorado Plateau. Stands occur on steep, usually south-facing slopes, where soils are rocky and well-drained from 800 to 3300 m in elevation. Much of the annual precipitation comes as winter snow, and summer drought stress is characteristic. These shrublands typically establish after stand-replacing fires and will succeed to forests after several decades. Excessively rocky or droughty, fire-prone sites within forested areas may support relatively persistent stands of this alliance. They are an important component of the Sierra Nevada/southern Cascade montane chaparral and may form large inclusions in dry pine forests following disturbance.

Classification Comments: This alliance may prove to be more widespread than currently known. More information/inventory is needed to confirm that shrublands of *Arctostaphylos nevadensis* also belong in this alliance. In California, many of the other alliances defined in Western North American Montane Sclerophyll Scrub Group (G282) occur adjacent to stands of this alliance.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Shrublands dominated or with a significant component of *Arctostaphylos patula* or *Arctostaphylos nevadensis*.

VEGETATION

Physiognomy and Structure: These are dense brushfields of sclerophyllous shrubs up to 2 m in height. Needle-leaved evergreen trees are often associated with these communities and may form a sparse emergent layer (20-35 m tall). Herbaceous vegetation is typically sparse and composed of scattered xerophytic graminoids and forbs.

Floristics: These shrublands are strongly dominated by *Arctostaphylos patula* or *Arctostaphylos nevadensis* and may be almost monotypic. They are an important component of the Sierra Nevada/southern Cascade montane chaparral and may form large inclusions in dry pine forests following disturbance. Common shrub associates include *Arctostaphylos nevadensis*, *Ceanothus cordulatus*, *Ceanothus velutinus*, *Cercocarpus montanus*, *Chrysolepis sempervirens* (= *Castanopsis sempervirens*), and *Ribes* spp. Eastward, steppe species such as *Artemisia tridentata*, *Purshia tridentata*, and *Cercocarpus ledifolius* become common associates. Herbaceous vegetation is typically sparse and poorly described across the range of this alliance. Reported associates in northern California include *Elymus elymoides*, *Pyrola picta*, and *Stephanomeria lactucina*.

ENVIRONMENT & DYNAMICS

Environmental Description: These are montane shrublands found on the eastern slope of the Sierra Nevada and into the western Great Basin and Colorado Plateau in summer-dry habitats from 800 to 3000 m elevation. Much of the precipitation comes as winter snow, but summer drought-stress is characteristic. These shrublands are mostly found on steep, usually south-facing slopes, where soils are rocky and well-drained. These are typically zonal disclimax or, occasionally, edaphic climax brushfields which occur in association with dry needle-leaved evergreen forests or woodlands. These shrublands are typically established after stand-replacing fires or clearcut logging in *Pinus ponderosa* or *Pseudotsuga menziesii* forest, and are seral to forest after several decades. Excessively rocky or droughty, fire-prone sites in the forest may support relatively persistent stands of this alliance.

Dynamics: *Arctostaphylos patula* is a rapidly colonizing, light-intolerant species which is disturbance-dependent in most environmental settings where it occurs (Mozingo 1987). Fire has also been shown to enhance germination of *Arctostaphylos* seeds. These communities often form dense patches in disturbed conifer forests which are strongly dominant and may inhibit conifer re-establishment and early growth (Conard and Radosevich 1982).

DISTRIBUTION

Geographic Range: These shrublands are reported from the eastern slope of the Sierra Nevada in Nevada and California and from the Colorado Plateau in southwestern Utah and western Colorado. *Arctostaphylos patula* is reported to form dense shrublands from southern Oregon and east across the Great Basin in montane habitats to Montana, northwestern Colorado, and northern Arizona (Mozingo 1987). The alliance likely occurs in these areas as well.

CBR alliances

Nations: US

States/Provinces: AZ, CA, CO, NV, OR?, UT, WA?

TNC Ecoregions [optional]: 6:C, 9:C, 11:C, 12:C, 18:C, 19:C, 20:C

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: BLM (Uncompahgre Plateau); NPS (Bryce Canyon, Cedar Breaks, Colorado, Dinosaur, Grand Canyon, Great Basin, Yosemite, Zion)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > *Arctostaphylos patula* (Green leaf manzanita chaparral) Alliance (Sawyer et al. 2009) [37.303.00]

LOWER LEVEL UNITS

Associations:

- CEGLO05820 *Arctostaphylos patula* Sierran Chaparral Shrubland
- CEGLO02694 *Arctostaphylos patula* - *Artemisia tridentata* (*ssp. vaseyana*, *ssp. wyomingensis*) Shrubland
- CEGLO05422 *Arctostaphylos patula* / *Ceanothus martinii* Shrubland
- CEGLO02696 *Arctostaphylos patula* Shrubland
- CEGLO00957 *Arctostaphylos patula* / *Ceanothus velutinus* - *Ceanothus prostratus* Shrubland

AUTHORSHIP

Primary Concept Source: M.S. Reid and D. Sarr, in Faber-Langendoen et al. (2013)

Author of Description: M.S. Reid, D. Sarr, K.A. Schulz

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Barbour and Major 1977, Conard and Radosevich 1982, Faber-Langendoen et al. 2017b, Mozingo 1987, Reid et al. 1999, Sawyer et al. 2009, Townsend 1966

2. Shrub & Herb Vegetation

2.B.2.Nd. Western North American Interior Chaparral

G282. Western North American Montane Sclerophyll Scrub

A3917. *Ceanothus cordulatus* - *Ceanothus integerrimus* Shrubland Alliance

Type Concept Sentence: This alliance consists of shrublands dominated by either *Ceanothus cordulatus* or *Ceanothus integerrimus*, with other montane chaparral shrubs. This alliance occurs in cismontane California and mountains of southern Oregon. Stands occur on well-drained soils and are best developed on dry, exposed sites such as along ridges and upper slopes, between 300 and 2100 m elevation.

OVERVIEW

Scientific Name: *Ceanothus cordulatus* - *Ceanothus integerrimus* Shrubland Alliance

Common Name (Translated Scientific Name): Mountain Whitethorn - Deerbrush Shrubland Alliance

Colloquial Name: Californian Montane Whitethorn - Deerbrush Chaparral

Type Concept: This chaparral shrubland alliance is dominated by either *Ceanothus cordulatus* or *Ceanothus integerrimus*, with other montane chaparral shrubs, including *Arctostaphylos manzanita*, *Arctostaphylos patula*, *Arctostaphylos viscida*, *Ceanothus cuneatus*, *Ceanothus sanguineus* (in Oregon), *Ceanothus velutinus*, *Chrysolepis sempervirens*, *Holodiscus discolor*, *Notholithocarpus densiflorus* (= *Lithocarpus densiflorus*), *Prunus emarginata*, *Quercus berberidifolia*, *Quercus chrysolepis*, *Quercus vacciniifolia*, and *Symphoricarpos mollis*. Emergent trees may be present and can include *Pseudotsuga menziesii*, *Arbutus menziesii*, and *Quercus wislizeni*. The herbaceous layer is sparse and typically includes *Elymus glaucus*. These are generally short-lived shrublands (on the order of decades), succeeding to conifer woodlands or forest. Stands establish from seed banks post-fire or after other disturbance such as logging; too frequent fires can deplete the seed bank. This chaparral shrubland of cismontane California and mountains of southern Oregon is found between 300 and 2100 m elevation. This is a region with strong seasonal precipitation patterns: long, dry summers and cool, moist winters. Precipitation varies from 30 cm per year in the southern portions of the range to 200 cm per year in the northern. Stands occur on well-drained soils and are best developed on dry, exposed sites such as along ridges and upper slopes.

Classification Comments: While one of these dominants is evergreen and the other is semi-deciduous or deciduous, they share many floristic characteristics, dynamics, and environmental setting, so they are placed in a single alliance.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure: This sclerophyllous, temperate, broad-leaved evergreen shrubland forms a continuous to intermittent shrub canopy with a sparse herbaceous layer. Emergent conifers (10-15 m tall) may be present.

Floristics: This chaparral shrubland alliance is dominated by either *Ceanothus cordulatus* or *Ceanothus integerrimus*, with other montane chaparral shrubs, including *Arctostaphylos manzanita*, *Arctostaphylos patula*, *Arctostaphylos viscida*, *Ceanothus cuneatus*, *Ceanothus sanguineus* (in Oregon), *Ceanothus velutinus*, *Chrysolepis sempervirens*, *Holodiscus discolor*, *Notholithocarpus densiflorus* (= *Lithocarpus densiflorus*), *Prunus emarginata*, *Quercus berberidifolia*, *Quercus chrysolepis*, *Quercus vacciniifolia*, and *Symphoricarpos mollis*. Emergent trees may be present and can include *Pseudotsuga menziesii*, *Arbutus menziesii*, and *Quercus wislizeni*. The herbaceous layer is sparse and typically includes *Elymus glaucus*.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance occurs along ridges and upper slopes between 900 and 2900 m in elevation. Stands occur on well-drained soils and are best developed on dry, exposed sites. This alliance grows in a climate with long, dry summers and wet winters. Average yearly precipitation totals vary from roughly 62 cm in the northern end of the range to 30 cm in the southern extremes.

Dynamics: This alliance is not normally self-perpetuating. It is transitional to other forest vegetation types, and requires disturbances such as logging and fire to provide openings within suitable habitat.

DISTRIBUTION

Geographic Range: This alliance occurs from Oregon to southern California. Stands are found in the Klamath Mountains, Coast and Cascade ranges, Sierra Nevada, and Transverse and Peninsular ranges.

Nations: US

States/Provinces: CA, OR

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > *Ceanothus cordulatus* (Mountain white thorn chaparral) Alliance (Sawyer et al. 2009) [37.209.00]
- > *Ceanothus integerrimus* (Deer brush chaparral) Alliance (Sawyer et al. 2009) [37.206.00]
- > *Ceanothus integerrimus* Shrubland Alliance (Keeler-Wolf et al. 2012)
- = Deer Brush Chaparral (#37531) (Holland 1986b)
- = Whitethorn Chaparral (#37532) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEGLO05821 *Ceanothus cordulatus* / Sparse Understory Sierran Shrubland
- CEGLO03023 *Ceanothus cordulatus* Shrubland
- CEGLO03027 *Ceanothus integerrimus* Shrubland
- CEGLO05818 *Ceanothus integerrimus* - *Arctostaphylos viscida* - (*Arctostaphylos mewukka*) Shrubland

AUTHORSHIP

Primary Concept Source: M.S. Reid, in Faber-Langendoen et al. (2013)

Author of Description: M.S. Reid

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Faber-Langendoen et al. 2017b, Holland 1986b, Keeler-Wolf et al. 2012, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009

2. Shrub & Herb Vegetation

2.B.2.Nd. Western North American Interior Chaparral

G282. Western North American Montane Sclerophyll Scrub

A3936. Ceanothus velutinus Shrubland Alliance

Type Concept Sentence: This alliance consists of shrublands where *Ceanothus velutinus* is the major dominant. Mature stands have a uniform layer of tall shrubs 1-2 m in height. It occurs on montane slopes in the western U.S., including the Black Hills of South Dakota.

OVERVIEW

Scientific Name: *Ceanothus velutinus* Shrubland Alliance

Common Name (Translated Scientific Name): Snowbrush Ceanothus Shrubland Alliance

Colloquial Name: Snowbrush Ceanothus Chaparral

Type Concept: This alliance consists of stands dominated by *Ceanothus velutinus*. The vegetation in mature stands is dominated by a uniform layer of tall shrubs 1-2 m in height. There may be a few scattered *Amelanchier* sp., *Artemisia tridentata*, *Cercocarpus* spp., *Mahonia repens*, *Prunus virginiana*, *Rosa* spp., *Spiraea betulifolia*, and /or *Symphoricarpos* spp. In California, associated species can include *Arctostaphylos patula*, *Arctostaphylos viscida*, *Ceanothus cordulatus*, *Ceanothus cuneatus*, *Chrysolepis sempervirens*, *Holodiscus discolor*, *Prunus emarginata*, *Quercus sadleriana*, *Quercus vacciniifolia*, and *Symphoricarpos mollis*. This alliance occurs throughout the western U.S., including the Black Hills of South Dakota. Typical occurrences are an acre or two in size and are somewhat isolated, as they are usually part of a mosaic of post-burn vegetation types. Sites range from moderate to steep (14-73% slope) and tend to prefer cooler north or east aspects. Parent materials are variable, and soils are well-drained, rocky and generally coarse in texture.

Classification Comments: *Ceanothus velutinus* grows throughout much of the western U.S., where it is associated with many forest types from South Dakota to the Pacific coast. Stands develop along mountain slopes after disturbances such as fire or logging. The two varieties, the inland var. *velutinus* with velvety leaves and the coastal, taller var. *hookeri*, have similar ecologies (Fross and Wilken 2006), so we include both in the alliance. Most of the major habitat typing studies in the western U.S. do not characterize seral types, so it should not be any surprise that this type is poorly described and sampled. The alliance concept remains somewhat tentative and needs review as more data become available. This type is likely to be widespread in the Rocky Mountains of Colorado, Wyoming and Montana, west into areas of the Sierra Nevada, Great Basin mountains, and the Cascades. Communities of *Ceanothus fendleri* should probably be included in this group and alliance.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Shrublands dominated by *Ceanothus velutinus*.

VEGETATION

Physiognomy and Structure:

Floristics: This alliance consists of stands dominated by *Ceanothus velutinus*. There may be a few scattered *Amelanchier* sp., *Artemisia tridentata*, *Cercocarpus* spp., *Mahonia repens*, *Prunus virginiana*, *Rosa* spp., *Spiraea betulifolia*, and /or *Symphoricarpos* spp. In California, associated species can include *Arctostaphylos patula*, *Arctostaphylos viscida*, *Ceanothus cordulatus*, *Ceanothus cuneatus*, *Chrysolepis sempervirens*, *Holodiscus discolor*, *Prunus emarginata*, *Quercus sadleriana*, *Quercus vacciniifolia*, and *Symphoricarpos mollis*. A variety of herbaceous species may be present and may occur in the looser "openings" in the shrub layer, but *Ceanothus velutinus* can form a dense canopy and shade out the ground layer.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands of this alliance occur on dry hillsides, often with thin soil.

Dynamics: Most stands are known to respond to fire by prolific reseedling, in some cases germinating from soils after many years post-fire. It is considered an early-seral shrubland for this reason. *Ceanothus velutinus* is a slow-growing shrub; it may take 20 years following fire before the shrub will dominate a stand.

DISTRIBUTION

Geographic Range: This alliance occurs in the western U.S., possibly into Alberta and British Columbia, and is currently known from South Dakota (Black Hills) west to California. It has not been reported from Washington, Oregon, Nevada, Idaho, Montana, or Utah but probably occurs in those states.

Nations: CA?, US

States/Provinces: AB?, BC?, CA, CO, SD, WY

TNC Ecoregions [optional]: 4:C, 5:C, 11:C, 12:C

USFS Ecoregions (2007): 263A:CC, 341D:CC, 342B:CC, M261A:CC, M261B:CC, M261D:CC, M261E:CC, M261G:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = *Ceanothus velutinus* (Tobacco brush or snow bush chaparral) Alliance (Sawyer et al. 2009) [37.210.00]
- = *Ceanothus velutinus* Shrubland Alliance (CNPS 2017) [37.210.00]
- >< Mixed Montane Chaparral (#37510) (Holland 1986b)
- >< Tobacco Brush Chaparral (#37533) (Holland 1986b)
- = Tobacco brush series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS**Associations:**

- CEG003144 *Ceanothus velutinus* - *Prunus emarginata* - *Artemisia tridentata* Shrubland
- CEG002167 *Ceanothus velutinus* Shrubland

AUTHORSHIP

Primary Concept Source: M.S. Reid, in Faber-Langendoen et al. (2013)

Author of Description: M.S. Reid

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Anderson 2001a, Bolsinger 1989, CNPS 2017, Cheng 2004, Conard and Radosevich 1982, Faber-Langendoen et al. 1996, Faber-Langendoen et al. 2017b, Fross and Wilken 2006, Hanes 1977, Holland 1986b, Keeler-Wolf et al. 2003a, Riser and Fry 1994, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Winward 1994

2. Shrub & Herb Vegetation

2.B.2.Nd. Western North American Interior Chaparral

G282. Western North American Montane Sclerophyll Scrub

A3918. *Prunus emarginata* - *Holodiscus discolor* Shrubland Alliance

Type Concept Sentence: This alliance consists of shrublands dominated by *Prunus emarginata* or *Holodiscus discolor*. It is widespread at montane to subalpine altitudes of California generally found between 700 and 2800 m elevation, but more common at higher elevations. It occurs on ridges, montane slopes, rocky chutes, moraines, and talus. Soils are skeletal and may be rocky, loamy, or sandy.

OVERVIEW

Scientific Name: *Prunus emarginata* - *Holodiscus discolor* Shrubland Alliance

Common Name (Translated Scientific Name): Bitter Cherry - Oceanspray Shrubland Alliance

Colloquial Name: Californian Montane Bitter Cherry - Oceanspray Shrubland

Type Concept: This alliance consists of shrublands where *Prunus emarginata* or *Holodiscus discolor* characteristically are dominant or the important species in the canopy. Other shrubs may include *Achnatherum occidentale* (= *Stipa occidentalis*), *Amelanchier alnifolia*, *Arctostaphylos patula*, *Artemisia tridentata*, *Ceanothus cordulatus*, *Ceanothus cuneatus*, *Ceanothus integerrimus*, *Ceanothus velutinus*, *Cercocarpus ledifolius*, *Chrysolepis sempervirens* (= *Castanopsis sempervirens*), *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Eriogonum nudum*, *Garrya fremontii*, *Keckiella corymbosa*, *Mimulus suksdorfii*, *Prunus andersonii*, *Quercus sadleriana*, *Quercus vaccinifolia*, *Ribes* spp., *Symphoricarpos mollis*, and *Symphoricarpos rotundifolius*. Emergent conifers may be present. This is a widespread montane to subalpine shrubland alliance of California, occurring on ridges, montane slopes, rocky chutes, moraines, and talus. It is generally found between 700 and 2800 m elevation, but more common at higher elevations. Stands occur on concave or northerly facing slopes, or in rocky areas that accumulate more surface run-off than surrounding areas, or with

rock outcrops and steep talus where shrubs establish in rock crevices and other openings between rocks. Soils are skeletal and may be rocky, loamy, or sandy. Unlike most chaparral types, this alliance can form self-perpetuating stands, which can be of continuous shrub cover or have an intermittent canopy.

Classification Comments: This alliance is a tentative combination of two Sawyer et al. (2009) alliances, based on dominance of these two deciduous species combined with the additional floristic component of the montane chaparrals, such as the *Ceanothus* and *Arctostaphylos* taxa. Although it probably works as an alliance, it may belong in a different group altogether.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure: This temperate cold-deciduous shrubland forms an intermittent canopy. Emergent conifers may be present. The herbaceous layer is sparse.

Floristics: This alliance consists of shrublands where *Prunus emarginata* or *Holodiscus discolor* characteristically are dominant or the important species in the canopy. Other shrubs may include *Achnatherum occidentale* (= *Stipa occidentalis*), *Amelanchier alnifolia*, *Arctostaphylos patula*, *Artemisia tridentata*, *Ceanothus cordulatus*, *Ceanothus cuneatus*, *Ceanothus integerrimus*, *Ceanothus velutinus*, *Cercocarpus ledifolius*, *Chrysolepis sempervirens* (= *Castanopsis sempervirens*), *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Eriogonum nudum*, *Garrya fremontii*, *Keckiella corymbosa*, *Mimulus suksdorfii*, *Prunus andersonii*, *Quercus sadleriana*, *Quercus vacciniifolia*, *Ribes* spp., *Symphoricarpos mollis*, and *Symphoricarpos rotundifolius*. Emergent conifers may be present.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands of this montane to subalpine shrubland alliance occur on ridges and slopes with thin soils. Soils are skeletal and may be rocky, loamy, or sandy. Stands are found between 700 and 2800 m elevation. The widespread range of this alliance includes a large variety of habitats, and yearly precipitation and temperature ranges are quite large. The northern portion of the range can receive 200 cm of rain per year, while southern stands may receive only 40 cm per year. Lower elevation, southern stands may never see freezing temperatures, while northern, high-elevation stands may only have a five-month growing season. Unlike most chaparral types, this alliance forms self-perpetuating stands.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance of the mountains of California occurs in the northern and central Coast Ranges, the Klamath Mountains, south through the Cascades and Sierra Nevada, into the Peninsular and Transverse ranges. It may also occur in adjacent areas of southern Oregon.

Nations: US

States/Provinces: CA, OR?

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > *Holodiscus discolor* (Ocean spray brush) Alliance (Sawyer et al. 2009) [39.100.00]
- > *Prunus emarginata* (Bitter cherry thickets) Provisional Alliance (Sawyer et al. 2009) [37.900.00]
- > *Holodiscus* Series (Sawyer and Keeler-Wolf 1995)
- >< Mixed Montane Chaparral (#37510) (Holland 1986b)
- >< Northern North Slope Chaparral (#37E10) (Holland 1986b)
- >< Tobacco Brush Series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS

Associations:

- C EGL005822 *Prunus emarginata* Sierran Chaparral Shrubland
- C EGL003129 *Holodiscus discolor* / *Sedum obtusatum* ssp. *boreale* - *Cryptogramma acrostichoides* Shrubland
- C EGL003130 *Holodiscus discolor* - *Sambucus racemosa* Shrubland

AUTHORSHIP

Primary Concept Source: M.S. Reid after Sawyer et al. (2009)

Author of Description: M.S. Reid

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Faber-Langendoen et al. 2017b, Hickman 1993, Holland 1986b, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009

2. Shrub & Herb Vegetation

2.B.2.Nd. Western North American Interior Chaparral

G282. Western North American Montane Sclerophyll Scrub

A3919. *Quercus garryana* var. *fruticosa* Shrubland Alliance [Low - Poorly Documented]

Type Concept Sentence: This alliance consists of the shrub forms of *Quercus garryana* where they are dominant or codominant with several other shrub species such as *Amelanchier*, *Arctostaphylos*, *Ceanothus*, *Cercocarpus*, *Fraxinus*, *Prunus*, and/or shrubby forms of *Quercus*. It occurs in the northern Coast Ranges, Klamath Mountains, Modoc Plateau, Sierra Nevada and foothills, and southern Cascades of California, and is likely to occur in Oregon.

OVERVIEW

Scientific Name: *Quercus garryana* var. *fruticosa* Shrubland Alliance

Common Name (Translated Scientific Name): Oregon White Oak Shrubland Alliance

Colloquial Name: Californian Montane Oregon White Oak Shrubland

Type Concept: This alliance consists of stands of the shrub form of *Quercus garryana* var. *fruticosa* where it is dominant or codominant with *Amelanchier utahensis*, *Arctostaphylos nevadensis*, *Arctostaphylos patula*, *Ceanothus cordulatus*, *Ceanothus cuneatus*, *Ceanothus integerrimus*, *Ceanothus velutinus*, *Cercis canadensis* var. *texensis* (= *Cercis occidentalis*), *Cercocarpus montanus*, *Clematis lasiantha*, *Fraxinus dipetala*, *Prunus emarginata*, *Prunus subcordata*, *Quercus berberidifolia*, *Quercus vacciniifolia*, and *Toxicodendron diversilobum*. Emergent *Quercus chrysolepis*, *Quercus kelloggii*, *Quercus wislizeni*, or *Pinus sabiniana* trees may be present at sparse cover. Shrubs are <5 m in height, and the canopy is intermittent to continuous. The herbaceous layer is usually open and grassy. This alliance occurs in the northern Coast Ranges, Klamath Mountains, Modoc Plateau, Sierra Nevada and foothills, and southern Cascades of California, and is likely to occur in Oregon. Habitats are ridges and upper slopes, and may be steep and rocky. Elevation is 450-1800 m. Since most stands are on thin soils, they tend to be invaded slowly by conifers, if at all.

Classification Comments: This concept follows the *Quercus garryana* var. *fruticosa* shrubland alliance of Sawyer et al. (2009). This alliance is tentative; although it probably works as an alliance, it may belong in a different group altogether. The dominant taxa are deciduous oaks, although the overall floristics contain elements of montane chaparrals, such as the *Ceanothus* and *Arctostaphylos* species, as well as evergreen oaks such as *Quercus vacciniifolia*.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure: This temperate or cold-deciduous shrubland forms an intermittent to continuous canopy less than 5 m in height. Emergent trees (15-20 m tall) may be present. The herbaceous layer is variable; it may be dominated by graminoids.

Floristics: Stands dominated by *Quercus garryana* var. *fruticosa* (= var. *breweri*) or *Quercus garryana* var. *garryana*. Other codominant shrubs include *Amelanchier utahensis*, *Arctostaphylos nevadensis*, *Arctostaphylos patula*, *Ceanothus cordulatus*, *Ceanothus cuneatus*, *Ceanothus integerrimus*, *Ceanothus velutinus*, *Cercis canadensis* var. *texensis* (= *Cercis occidentalis*), *Cercocarpus montanus*, *Clematis lasiantha*, *Fraxinus dipetala*, *Prunus emarginata*, *Prunus subcordata*, *Quercus berberidifolia*, *Quercus vacciniifolia*, and *Toxicodendron diversilobum*. Emergent *Quercus chrysolepis*, *Quercus kelloggii*, *Quercus wislizeni*, or *Pinus sabiniana* trees may be present at sparse cover. *Festuca californica* may be present in the herbaceous layer.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands of this California shrubland alliance are found at higher elevations than most other chaparrals. Elevations range from 450 to 1800 m. Sites tend to be cooler and moister due to these higher elevations. Annual precipitation is quite seasonal, with the bulk falling between November and April. Yearly precipitation totals vary from 60 cm in the south to over 120 cm in the north. Summers are very warm and dry; winters are cool and moist. Stands are usually found on upper slopes; often these are steep. Soils are thin.

Dynamics: This alliance is much more fire-resistant than other chaparrals. This is possibly due to its fidelity to moister sites.

DISTRIBUTION

Geographic Range: This alliance occurs in the northern Coast Ranges, Klamath Mountains, Modoc Plateau, Sierra Nevada and foothills, and southern Cascades of California, and is likely to occur in Oregon.

Nations: US

States/Provinces: CA, OR?

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

- = *Quercus garryana* (Brewer oak scrub) Alliance (Sawyer et al. 2009) [37.411.00]
- = *Quercus garryana* var. *breweri* Shrubland Alliance (Keeler-Wolf et al. 2012)
- = *Quercus garryana* (*shrub*) Shrubland Alliance (CNPS 2017) [37.411.00]
- = Brewer Oak Series (Sawyer and Keeler-Wolf 1995)
- = Shin Oak Brush (#37541) (Holland 1986b)

LOWER LEVEL UNITS**Associations:**

- C EGL003091 *Quercus garryana* var. *fruticosa* Shrubland [Placeholder]

AUTHORSHIP

Primary Concept Source: M.S. Reid after Sawyer et al. (2009)

Author of Description: M.S. Reid

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: CNPS 2017, Faber-Langendoen et al. 2017b, Hickman 1993, Holland 1986b, Keeler-Wolf et al. 2012, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009

2. Shrub & Herb Vegetation

2.B.2.Nd. Western North American Interior Chaparral

G282. Western North American Montane Sclerophyll Scrub

A4117. *Quercus sadleriana* - *Notholithocarpus densiflorus* var. *echinoides* Shrubland Alliance [Low - Poorly Documented]

Type Concept Sentence: This alliance consists of shrublands dominated by *Quercus sadleriana* and/or *Notholithocarpus densiflorus* var. *echinoides*. It is found in the Klamath-Siskiyou mountains of southern Oregon and California, as well as along the foothills of the central Sierra Nevada. Stands commonly occur after disturbance from fire or logging along ridges and upper slopes between 600 and 3300 m elevation.

OVERVIEW

Scientific Name: *Quercus sadleriana* - *Notholithocarpus densiflorus* var. *echinoides* Shrubland Alliance

Common Name (Translated Scientific Name): Deer Oak - Tanoak Shrubland Alliance

Colloquial Name: Californian Disturbance-Driven Montane Scrub Oak Chaparral

Type Concept: This alliance consists of shrublands dominated by *Quercus sadleriana* and/or *Notholithocarpus densiflorus* var. *echinoides* (= *Lithocarpus densiflorus* var. *echinoides*). Other shrubs may include *Arctostaphylos nevadensis*, *Arctostaphylos patula*,

Ceanothus cordulatus, *Ceanothus cuneatus*, *Ceanothus velutinus*, *Holodiscus discolor*, *Prunus emarginata*, and *Symphoricarpos mollis*. Emergent conifers such as *Abies concolor*, *Pinus lambertiana*, *Pinus ponderosa*, or *Pseudotsuga menziesii* may be present at low cover. The herbaceous layer is sparse. This alliance is found in the Klamath-Siskiyou mountains of southern Oregon and California, as well as along the foothills of the central Sierra Nevada. Topography and substrates are varied but tend towards skeletal, thin, rocky soils derived from granitics, mafic, and ultramafic. Most stands establish after fire or in areas with a history of logging. Climate has long, dry summers and wet winters. Average yearly precipitation totals vary from roughly 200 cm in the northern end of the range to 40 cm in the southern Sierra Nevada.

Classification Comments: This alliance includes two Sawyer et al. (2009) alliances because they occur in similar ecological settings, and respond to disturbance in similar ways.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Dominance of *Quercus sadleriana* or *Notholithocarpus densiflorus* var. *echinoides*, singularly or mixed with other montane chaparral shrubs such as *Arctostaphylos nevadensis*, *Arctostaphylos patula*, *Ceanothus cordulatus*, *Ceanothus cuneatus*, *Ceanothus velutinus*, *Holodiscus discolor*, *Prunus emarginata*, and *Symphoricarpos mollis*.

VEGETATION

Physiognomy and Structure: This hemi-sclerophyllous, temperate, broad-leaved evergreen shrubland forms an intermittent to continuous canopy up to 2 m in height. Emergent conifers (10-15 m tall) may be present. The herbaceous layer is sparse.

Floristics: This shrubland of montane and subalpine zones in northern California and Oregon is dominated by *Quercus sadleriana* or *Notholithocarpus densiflorus* var. *echinoides* (= *Lithocarpus densiflorus* var. *echinoides*), singularly or mixed with other montane chaparral shrubs such as *Arctostaphylos nevadensis*, *Arctostaphylos patula*, *Ceanothus cordulatus*, *Ceanothus cuneatus*, *Ceanothus velutinus*, *Holodiscus discolor*, *Prunus emarginata*, and *Symphoricarpos mollis*. Emergent conifers may be present. The herbaceous layer is sparse.

ENVIRONMENT & DYNAMICS

Environmental Description: Habitat is on rocky exposed ridges and steep slopes of all aspects at montane and subalpine (600-2200 m) elevations. The climatic regime where this alliance grows is largely Mediterranean, though not as strongly as in more southerly parts of California. Winters are cool and very wet, with annual precipitation totals often in excess of 200 cm. Average yearly precipitation totals vary from roughly 200 cm in the northern end of the range to 40 cm in the southern Sierra Nevada. Summers are warm and fairly dry.

Dynamics: This alliance is probably not self-perpetuating. Most stands are established after fire or logging and are transitional to forest.

DISTRIBUTION

Geographic Range: This alliance occurs from the Klamath Mountains of Oregon to southern California. Stands are also found in the Coast Ranges, Sierra Nevada, and Transverse and Peninsular ranges.

Nations: US

States/Provinces: CA, OR

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

- > *Lithocarpus densiflorus* var. *echinoides* (Shrub tanoak chaparral) Alliance (Sawyer et al. 2009) [73.110.00]
- > *Quercus sadleriana* (Sadler oak or deer oak brush fields) Alliance (Sawyer et al. 2009) [37.412.00]

LOWER LEVEL UNITS

Associations:

- CEG003093 *Quercus sadleriana* Shrubland [Placeholder]

AUTHORSHIP

Primary Concept Source: M.S. Reid after Sawyer et al. (2009)

Author of Description: M.S. Reid

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Faber-Langendoen et al. 2017b, Holland 1986b, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009

2. Shrub & Herb Vegetation

2.B.2.Nd. Western North American Interior Chaparral

G282. Western North American Montane Sclerophyll Scrub

A3916. *Quercus vacciniifolia* - *Chrysolepis sempervirens* Shrubland Alliance

Type Concept Sentence: This alliance consists of shrublands dominated by *Quercus vacciniifolia* and/or *Chrysolepis sempervirens*.

This alliance occurs from Oregon to the southern Sierra Nevada of California along ridges and upper slopes between 700 and 3300 m in elevation.

OVERVIEW

Scientific Name: *Quercus vacciniifolia* - *Chrysolepis sempervirens* Shrubland Alliance

Common Name (Translated Scientific Name): Huckleberry Oak - Bush Chinquapin Shrubland Alliance

Colloquial Name: Californian Montane Scrub Oak Chaparral

Type Concept: This alliance consists of shrublands dominated by *Quercus vacciniifolia* and/or *Chrysolepis sempervirens* occurring either in mixed stands together or as the sole dominant. Other shrubs may include *Amelanchier alnifolia*, *Arctostaphylos nevadensis*, *Arctostaphylos patula*, *Ceanothus cordulatus*, *Ceanothus cuneatus*, *Ceanothus velutinus*, *Garrya fremontii*, *Holodiscus discolor*, *Prunus emarginata*, and *Symphoricarpos mollis*. Emergent conifers such as *Abies concolor*, *Abies magnifica*, *Pinus jeffreyi*, *Pinus lambertiana*, *Pinus monticola*, *Pinus ponderosa*, or *Pseudotsuga menziesii* may be present at low cover. The herbaceous layer is sparse. Stands occur in the northern Coast Ranges, Klamath-Siskiyou mountains and throughout much of the Sierra Nevada. Topography and substrates are varied but tend towards skeletal, thin, rocky soils derived from granitics, mafic, and ultramafic. They occur on dry rocky and nutrient-poor soils at montane to subalpine elevations (700-3300 m). Climate has long, dry summers and wet winters. Average yearly precipitation totals vary from roughly 200 cm in the northern end of the range to 40 cm in the southern Sierra Nevada.

Classification Comments: This alliance includes two Sawyer et al. (2009) alliances because they occur in similar ecological settings, have very similar floristics and can occur as mixed stands together. The dominants are evergreen, often referred to as "montane scrub oak chaparral."

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Dominance of *Quercus vacciniifolia* and *Chrysolepis sempervirens*, singularly or mixed with other montane chaparral shrubs such as *Arctostaphylos nevadensis*, *Arctostaphylos patula*, *Ceanothus cordulatus*, *Ceanothus cuneatus*, *Ceanothus velutinus*, *Garrya fremontii*, *Holodiscus discolor*, *Prunus emarginata*, and *Symphoricarpos mollis*.

VEGETATION

Physiognomy and Structure: This sclerophyllous, temperate, broad-leaved evergreen shrubland forms a continuous to intermittent shrub canopy with a sparse herbaceous layer. Emergent conifers (10-15 m tall) may be present.

Floristics: *Chrysolepis sempervirens* (= *Castanopsis sempervirens*) and/or *Quercus vacciniifolia* is the sole or dominant plant in the shrub canopy. Other shrubs may include *Amelanchier alnifolia*, *Arctostaphylos nevadensis*, *Arctostaphylos patula*, *Ceanothus cordulatus*, *Ceanothus velutinus*, *Chrysolepis sempervirens* (= *Castanopsis sempervirens*), *Garrya fremontii*, *Prunus emarginata*, *Quercus sadleriana*, *Quercus vacciniifolia*, and *Symphoricarpos mollis*. Emergent conifers may be present. The herbaceous layer is sparse.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance occurs along ridges and upper slopes between 700 and 3300 m elevation. Stands are normally found on thin, rocky soils. This alliance grows in a climate with long, dry summers and wet winters. Average yearly precipitation totals vary from roughly 62 cm in the northern end of the range to 30 cm in the southern extremes.

Dynamics: Stands of this alliance are self-perpetuating on shallow soils. Stands on deeper soils are usually the result of disturbance and are transitional to forests.

DISTRIBUTION

Geographic Range: This alliance of montane slopes and ridges occurs from Oregon to the southern Sierra Nevada of California. Stands are found in the Coast and Cascade ranges, Klamath Mountains, and south into the Sierra Nevada.

Nations: US

States/Provinces: CA, OR

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > *Chrysolepis sempervirens* (Bush chinquapin chaparral) Alliance (Sawyer et al. 2009) [37.700.00]
- > *Quercus vaccinifolia* Shrubland Alliance (Keeler-Wolf et al. 2012)
- > *Quercus vacciniifolia* (Huckleberry oak chaparral) Alliance (Sawyer et al. 2009) [37.414.00]
- = Bush Chinquapin Chaparral (#37550) (Holland 1986b)
- = Huckleberry Oak Chaparral (#37542) (Holland 1986b)
- >< Mixed Montane Chaparral (#37510) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEGLO03039 *Chrysolepis sempervirens* Shrubland
- CEGLO08697 *Quercus vacciniifolia* - *Arctostaphylos patula* Shrubland
- CEGLO08696 *Quercus vacciniifolia* - *Chrysolepis sempervirens* Shrubland
- CEGLO08695 *Chrysolepis sempervirens* / Sparse Understory Sierran Shrubland

AUTHORSHIP

Primary Concept Source: M.S. Reid after Sawyer et al. (2009)

Author of Description: M.S. Reid

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Faber-Langendoen et al. 2017b, Holland 1986b, Keeler-Wolf et al. 2012, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009

M091. Warm Interior Chaparral

This macrogroup includes all the interior chaparral in the southwestern U.S. and northern Mexico and is composed of a very diverse list of diagnostic, mostly evergreen shrubs such as *Arctostaphylos pungens*, *Ceanothus greggii*, *Garrya wrightii*, and *Quercus turbinella* which dominate large areas on foothills, xeric mountain slopes and canyons.

2. Shrub & Herb Vegetation

2.B.2.Nd. Western North American Interior Chaparral

2.B.2.Nd.2.a. M091 Warm Interior Chaparral

G280. Eastern Madrean Chaparral

Type Concept Sentence: This chaparral group occurs in the Madrean Oriental in northern Mexico and desert mountains across Trans-Pecos Texas and is characterized by a moderate to dense shrub canopy dominated by evergreen shrub oak species *Quercus intricata*, *Quercus laceyi*, *Quercus pringlei*, *Quercus pungens*, *Quercus vaseyana*, and other chaparral species, such as *Acacia roemeriana*, *Ceanothus greggii*, *Cercocarpus montanus*, *Fallugia paradoxa*, *Fendlera rigida*, *Fraxinus greggii*, *Garrya ovata*, *Garrya wrightii*, *Juniperus pinchotii*, *Purshia mexicana*, *Rhus virens* var. *choriophylla*, *Salvia lycioides*, *Salvia regla*, *Salvia roemeriana*, and *Sophora secundiflora* that occur on foothills, mountain slopes and canyons.

OVERVIEW

Scientific Name: *Quercus intricata* - *Quercus laceyi* - *Quercus pungens* Chaparral Group

Common Name (Translated Scientific Name): Dwarf Oak - Lacey Oak - Pungent Oak Chaparral Group

Colloquial Name: Pinchot's Juniper Chaparral

Type Concept: This chaparral group is found in mid-elevation sites in the Madrean Oriental in northern Mexico and desert mountains across Trans-Pecos Texas extending to the Guadalupe Mountains. It is characterized by a moderate to dense shrub canopy dominated by evergreen shrub oak species, such as *Quercus intricata*, *Quercus laceyi*, *Quercus pringlei*, *Quercus pungens*, and *Quercus vaseyana*, and several chaparral species, such as *Acacia roemeriana*, *Ceanothus greggii*, *Cercocarpus montanus*, *Dasyllirion leiophyllum*, *Fallugia paradoxa*, and *Garrya wrightii*. Other Madrean species characteristic of this group include *Acacia roemeriana*, *Fendlera rigida* (= *Fendlera linearis*), *Fraxinus greggii*, *Garrya ovata*, *Juniperus pinchotii*, *Purshia mexicana*, *Rhus virens* var. *choriophylla* (= *Rhus choriophylla*), *Salvia lycioides* (= *Salvia ramosissima*), *Salvia regla*, *Salvia roemeriana*, and *Sophora secundiflora*. Stands occur on foothills, mountain slopes and canyons in drier habitats below the encinal and pine woodlands. Sites are often associated with more xeric and coarse-textured substrates such as limestone, basalt or alluvium, especially in higher-elevation transition areas with more mesic woodlands. In the Trans-Pecos of Texas, disjunct *Quercus gambelii* may occur as a significant component of this shrubland. Most chaparral species are fire-adapted, resprouting vigorously after burning or producing fire-resistant seeds. Stands occurring within montane woodlands are seral and a result of recent fires. Grass cover may be significant. Dominant grasses often include *Bouteloua curtipendula*, *Bouteloua hirsuta*, and *Muhlenbergia emersleyi*.

Classification Comments: Similar Western Madrean Chaparral Group (G281) has floristics mostly derived from the Sierra Madre Occidentale, whereas floristics of this group are derived from the Sierra Madre Oriental. However, this group is not matorral (thornscrub) as it is typically dominated by shrubby evergreen oaks and chaparral species, not thornscrub species. More survey is needed to determine if *Quercus turbinella*, common in Western Madrean Chaparral Group (G281), also occurs in this group.

Similar NVC Types:

- G281 Western Madrean Chaparral

Diagnostic Characteristics: This upland shrubland is characterized by Sierra Madre Oriental shrub indicator species that may be present to dominate. These diagnostic species include shrubby evergreen oaks such as *Quercus intricata*, *Quercus invaginata*, *Quercus laceyi*, *Quercus pringlei*, *Quercus pungens*, and *Quercus vaseyana*, and many other species such as *Acacia roemeriana*, *Arbutus xalapensis*, *Fendlera rigida*, *Fraxinus greggii*, *Garrya ovata*, *Purshia mexicana*, *Rhus virens* var. *choriophylla*, *Salvia lycioides*, *Salvia roemeriana*, *Salvia regla* and *Sophora secundiflora*. Widespread shrub species such as *Arctostaphylos pungens*, *Ceanothus greggii*, *Cercocarpus montanus*, *Dasyllirion leiophyllum*, *Fallugia paradoxa*, *Garrya wrightii*, and *Quercus gambelii* may dominate or codominate, but are not diagnostic. Stands dominated by shrubby evergreen oaks such as *Quercus emoryi* and *Quercus grisea* are included in Madrean Encinal Group (G201).

VEGETATION

Physiognomy and Structure: This upland shrubland is typically dominated by a moderate to dense evergreen sclerophyllous shrub canopy usually less than 3 m tall. Herbaceous layers may be present and are typically dominated by perennial graminoids.

Floristics: Vegetation is characterized by a moderate to dense sclerophyllous shrub canopy, usually less than 3 m tall, dominated by evergreen shrub oak species, such as *Quercus intricata*, *Quercus invaginata*, *Quercus laceyi*, *Quercus pringlei*, *Quercus pungens*, and *Quercus vaseyana*, and several widespread chaparral species, such as *Arctostaphylos pungens*, *Ceanothus greggii*, *Cercocarpus montanus*, *Dasyllirion leiophyllum*, *Fallugia paradoxa*, and *Garrya wrightii*. Other Madrean species characteristic of this group include *Acacia roemeriana*, *Arbutus xalapensis* (= *Arbutus texana*), *Fraxinus greggii*, *Fendlera rigida* (= *Fendlera linearis*), *Garrya ovata*, *Juniperus pinchotii*, *Purshia mexicana*, *Rhus virens* var. *choriophylla* (= *Rhus choriophylla*), *Salvia lycioides* (= *Salvia ramosissima*), *Salvia roemeriana*, and *Salvia regla*. In the Trans-Pecos of Texas, disjunct *Quercus gambelii* may occur as a significant component of this shrubland. The widespread shrub species such as *Arctostaphylos pungens*, *Ceanothus greggii*, *Cercocarpus montanus*, *Dasyllirion leiophyllum*, *Fallugia paradoxa*, *Garrya wrightii*, and *Quercus gambelii* may dominate or codominate, but are not diagnostic. Most chaparral species are fire-adapted, resprouting vigorously after burning or producing fire-resistant seeds. Stands occurring within montane woodlands are seral and a result of recent fires. Grass cover may be significant. Dominant grasses often include *Bouteloua curtipendula*, *Bouteloua hirsuta*, and *Muhlenbergia emersleyi*.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands often dominate along the mid-elevation transition zone from the Chihuahuan Desert into mountains (1700-2500 m). It occurs on foothills, mountain slopes and canyons in drier habitats below the encinal and pine woodlands, and is often associated with more xeric and coarse-textured substrates such as limestone, basalt or alluvium, especially in transition areas with more mesic woodlands.

Dynamics:

DISTRIBUTION

Geographic Range: This group is found in the Madrean Oriental in northern Mexico, in mountains across Trans-Pecos Texas, such as the Chisos and Davis mountains, and extends into southeastern New Mexico in the Guadalupe Mountains. Stands often dominate along the mid-elevation transition from the Chihuahuan Desert into mountains (1700-2500 m elevation).

Spatial Scale & Pattern [optional]: Large patch

Nations: MX, US

States/Provinces: MXCH, MXCO, NM, TX

TNC Ecoregions [optional]: 21:P, 22:P, 24:P

USFS Ecoregions (2007): 315A:PP, 321A:CC, M313B:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = "Coahuilan" Chaparral (Brown 1982a)

LOWER LEVEL UNITS

Alliances:

- A3972 *Sophora secundiflora* - *Acacia roemeriana* - *Cercocarpus montanus* var. *paucidentatus* Chaparral Alliance
- A0505 *Juniperus pinchotii* Chaparral Alliance
- A3971 *Quercus pungens* - *Quercus intricata* - *Quercus vaseyana* Chaparral Alliance

AUTHORSHIP

Primary Concept Source: D.E. Brown (1982a)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 11/05/2015

Classif Resp Region: West

Internal Author: KAS 1-10, 9-13, 11-15

REFERENCES

References: Brown 1982a, Brown et al. 1979, Dick-Peddie 1993, Faber-Langendoen et al. 2017a, Muldavin et al. 1994a, Muldavin et al. 2000b, Muldavin et al. 2003a, Shiflet 1994

2. Shrub & Herb Vegetation

2.B.2.Nd. Western North American Interior Chaparral

G280. Eastern Madrean Chaparral

G281. Western Madrean Chaparral

Type Concept Sentence: This interior chaparral group is found across the southwestern U.S. from central New Mexico and southern Utah west to California and is characterized by a moderate to dense evergreen shrub layer dominated by sclerophyllous shrubs, especially *Adenostoma sparsifolium*, *Arctostaphylos pungens*, *Ceanothus greggii*, *Cercocarpus montanus*, *Garrya wrightii*, *Mortonia utahensis*, *Quercus cornelius-mulleri*, *Quercus john-tuckeri*, and *Quercus turbinella*, that occurs in foothills, xeric mountain slopes and canyons.

OVERVIEW

Scientific Name: *Quercus turbinella* - *Ceanothus greggii* - *Arctostaphylos pungens* Chaparral Group

Common Name (Translated Scientific Name): Sonoran Scrub Oak - Desert Ceanothus - Mexican Manzanita Chaparral Group

Colloquial Name: Manzanita - Ceanothus Chaparral

Type Concept: This interior chaparral group is found across the southwestern U.S. from central New Mexico and southern Utah west to California. The moderate to dense evergreen shrub layer is dominated by sclerophyllous shrubs, especially *Ceanothus greggii* and *Quercus turbinella*. Other common shrubs from the eastern portion of its range (Arizona and New Mexico) include *Arctostaphylos pringlei* (higher elevations), *Arctostaphylos pungens*, *Cercocarpus montanus*, *Garrya wrightii*, *Purshia stansburiana*, *Quercus toumeyii*, and *Rhus trilobata*. In desert chaparral stands in the western extent *Arctostaphylos patula* (not dominant), *Arctostaphylos glauca*, *Cercocarpus montanus* var. *glaber* (= *Cercocarpus betuloides*), *Garrya flavescens*, *Juniperus californica*, *Nolina parryi*, *Quercus john-*

tuckeri, *Quercus cornelius-mulleri*, *Quercus berberidifolia*, and *Rhus ovata* characterize this shrubland. Scattered remnant pinyon and juniper trees may be present; however, in the western Mojave, *Juniperus californica* sometimes forms an open, shrubby tree layer with the evergreen oaks and other shrubs. Stands occur prominently across central Arizona (Mogollon Rim) and western New Mexico, south into mountains in the northwestern Chihuahuan region and Madrea Occidentale in northern Mexico, and north into extreme southwestern Utah and southern Nevada. It also occurs in mountains in the Sonora and western Mojave deserts, and extends from northeast Kern County, California, and south into Baja Norte, Mexico. Stands are found on foothills, xeric mountain slopes and canyons in hotter and drier habitats and often dominate along the mid-elevation transition zone between desert scrub and montane woodlands (1000-2200 m). Sites are often steep and rocky. Parent materials are varied and include basalt, diabases, gneiss, schist, shales, slates, sandstones and, more commonly, limestone and coarse-textured granitic substrates. Occasional desert scrub species may be present in drier, rockier, more open transition sites. Most chaparral species are fire-adapted, sprouting vigorously after burning or producing abundant fire-resistant seeds. Stands occurring within montane woodlands are seral and a result of recent fires.

The similar Eastern Madrea Chaparral Group (G280) has floristics mostly derived from the Sierra Madre Oriental, whereas floristics of this group are derived from the Sierra Madre Occidentale. However, this group is not matorral (thornscrub) as it is typically dominated by shrubby evergreen oaks and chaparral species, not thornscrub species. More survey is needed to determine if *Quercus turbinella*, common in this group, also codominates in Eastern Madrea Chaparral Group (G280).

Classification Comments: The similar Eastern Madrea Chaparral Group (G280) has floristics mostly derived from the Sierra Madre Oriental, whereas floristics of this group are derived from the Sierra Madre Occidentale. For now, this group includes warm-desert interior chaparrals found in the western Mojave and western Sonoran regions of southern California, but review may suggest splitting it into two groups. Relatively little is known of the "Mogollon Rim" or "Arizona" chaparral types (Carmichael et al. 1978, Brown 1982), so that it's hard to ascertain the floristic patterns adequately. While the main oaks are different in California, the important associated species are more widely distributed, from California east into New Mexico.

Similar NVC Types:

- G261 Californian Mesic & Pre-montane Chaparral
- G280 Eastern Madrea Chaparral

Diagnostic Characteristics: This upland shrubland is characterized by Sierra Madre Occidentale evergreen sclerophyllous indicator species that may be present to dominant. These diagnostic species include evergreen shrubby oaks such as *Quercus turbinella*, *Quercus toumeyi* and, in western Mojave stands, *Quercus cornelius-mulleri* and *Quercus john-tuckeri*, as well as many other diagnostic species, including *Arctostaphylos glauca*, *Arctostaphylos pringlei*, *Cercocarpus montanus* var. *glaber*, *Cercocarpus montanus* var. *paucidentatus*, *Ceanothus greggii*, *Garrya flavescens*, *Garrya wrightii*, and *Rhus ovata*. Additional characteristic species include *Arctostaphylos patula*, *Juniperus californica*, *Nolina parryi*, and *Rhus trilobata*.

VEGETATION

Physiognomy and Structure: This upland shrubland is typically dominated by a moderate to dense evergreen sclerophyllous shrub canopy usually less than 3 m tall. Herbaceous layers may be present and are typically dominated by perennial graminoids.

Floristics: The vegetation is characterized by a moderate to dense evergreen shrub layer dominated by sclerophyllous shrubs such as *Quercus turbinella* and *Ceanothus greggii*. Other common shrubs from the eastern portion of its range (Arizona and New Mexico) include *Cercocarpus montanus* var. *paucidentatus*, *Garrya wrightii*, *Purshia stansburiana*, *Quercus toumeyi*, *Rhus trilobata* with *Arctostaphylos pringlei* and *Arctostaphylos pungens* at higher elevations. In desert chaparral stands in the western extent, *Adenostoma sparsifolium*, *Arctostaphylos glauca*, *Cercocarpus montanus* var. *glaber* (= *Cercocarpus betuloides*), *Fremontodendron californicum*, *Garrya flavescens*, *Juniperus californica*, *Quercus berberidifolia*, *Quercus cornelius-mulleri*, *Quercus john-tuckeri*, *Rhus virens* var. *choriophylla*, and *Rhus ovata* characterize this shrubland. Scattered remnant pinyon and juniper trees may be present; however, in the western Mojave, *Juniperus californica* sometimes forms an open, shrubby tree layer over the evergreen oaks and other shrubs. Occasional desert scrub species may be present in drier, rockier, more open transition sites. The herbaceous layer is generally composed of grasses, such as *Bouteloua curtipendula*, *Bouteloua hirsuta*, *Bothriochloa barbinodis*, *Eragrostis intermedia*, *Lycurus phleoides*, *Muhlenbergia emersleyi*, *Muhlenbergia pauciflora*, and several species of *Aristida*, which are largely restricted to rocky, protected areas because of past heavy livestock grazing (Brown 1982a).

ENVIRONMENT & DYNAMICS

Environmental Description: Stands are found on foothills, xeric mountain slopes and canyons in hotter and drier habitats and often dominate along the mid-elevation (1000-2200 m) transition zone between desert scrub and montane woodlands (encinal, pine-oak, and ponderosa pine). Sites are variable but often steep and rocky. Sometimes this group occurs in thickets along upper canyon watercourses and northerly upland slopes within the pinyon-juniper woodland zone. **Climate:** This is a group of warm semi-desert regions in the southwestern U.S. The climate is hot and may have a somewhat bi-modal precipitation regime with spring rains and

warm-season monsoonal rains as well. Frosts occur in winter, and even sometime snows, which will melt rapidly.

Soil/substrate/hydrology: Parent materials are varied and include basalt, diabases, gneiss, schist, shales, slates, sandstones and, more commonly, limestone and coarse-textured granitic substrates.

Dynamics: Many of the communities in this group are dominated by fire-adapted shrubs. *Quercus cornelius-mulleri* sprouts vigorously from root crowns after fire. Since *Quercus cornelius-mulleri* chaparral occurs in areas of lower rainfall and sparser vegetation cover, it typically has less frequent fire and slower recovery rates than typical cismontane chaparral types elsewhere in California. *Quercus turbinella* in Arizona and New Mexico is a fire-type; it sprouts vigorously from the root crown and rhizomes. Typical fire intervals in Arizona exceed 74 years (Reid et al. 1999, Tirmenstein 1999d). Plants in the New York Mountains of California are treelike, suggesting that fires have been absent for perhaps greater than 100 years. Instead, flooding has initiated stem breakage and sprouting of some canyon bottom stands.

DISTRIBUTION

Geographic Range: This group occurs prominently across central Arizona (Mogollon Rim) and western New Mexico, south into mountains in the northwestern Chihuahuan region and Madrean Occidentale in northern Mexico. It also occurs in mountains in the Sonora and western Mojave deserts, extends from northeast Kern County, California, into Baja Norte, Mexico, and often dominates along the mid-elevation (1000-2200 m) transition zone between desert scrub and montane woodlands.

Spatial Scale & Pattern [optional]: Large patch

Nations: MX, US

States/Provinces: AZ, CA, MXBC, MXSO, NM, NV, TX, UT

TNC Ecoregions [optional]: 17:C, 19:C, 21:C, 22:C, 23:C, 24:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313C:CC, 313D:CC, 315A:CC, 315H:CC, 321A:CC, 322A:CC, 322B:CC, 322C:CC, 341A:CP, 341F:CC, M261E:CC, M313A:CC, M341C:??

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low. This group may be too broad and floristically diverse. Review comments will help to understand its diversity.

SYNONYMY

- = "Arizona" Chaparral (Brown 1982a)
- = Arizona Chaparral (503) (Shiflet 1994)

LOWER LEVEL UNITS

Alliances:

- A3791 *Cercocarpus montanus* Madrean Montane Chaparral Alliance
- A3790 *Arctostaphylos pungens* - *Arctostaphylos pringlei* - *Ceanothus greggii* Chaparral Alliance
- A0793 *Quercus turbinella* Chaparral Alliance
- A3793 *Quercus john-tuckeri* - *Quercus cornelius-mulleri* - *Fremontodendron californicum* Chaparral Alliance
- A3792 *Cercocarpus montanus* - *Eriogonum fasciculatum* - *Adenostoma sparsifolium* Western Mojave Desert Chaparral Alliance

AUTHORSHIP

Primary Concept Source: D.E. Brown (1982a)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 11/05/2015

Classif Resp Region: West

Internal Author: KAS 1-10, 4-15, 11-15

REFERENCES

References: Barbour and Major 1988, Brown 1982a, Brown et al. 1979, Cable 1975a, Carmichael et al. 1978, DeBano 1999, Dick-Peddie 1993, Faber-Langendoen et al. 2017a, Holland and Keil 1995, MacMahon 1988, Muldavin et al. 1994a, Muldavin et al. 2000b, Reid et al. 1999, Shiflet 1994, Stout et al. 2013, Thomas et al. 2004, Tirmenstein 1999d

2. Shrub & Herb Vegetation

2.B.2.Nd. Western North American Interior Chaparral

G281. Western Madrean Chaparral

A3790. *Arctostaphylos pungens* - *Arctostaphylos pringlei* - *Ceanothus greggii* Chaparral Alliance

Type Concept Sentence: This alliance includes evergreen shrublands dominated or codominated by *Arctostaphylos pungens*, *Arctostaphylos pringlei*, *Ceanothus greggii*, and *Mortonia utahensis*. This chaparral occurs from Nevada to New Mexico on dry mountain slopes ranging from 980-2470 m elevation depending on aspect.

OVERVIEW

Scientific Name: *Arctostaphylos pungens* - *Arctostaphylos pringlei* - *Ceanothus greggii* Chaparral Alliance

Common Name (Translated Scientific Name): Pointleaf Manzanita - Pringle's Manzanita - Desert *Ceanothus* Chaparral Alliance

Colloquial Name: Manzanita - *Ceanothus* Chaparral

Type Concept: Stands of this alliance have a moderately dense canopy dominated or codominated by the sclerophyllous evergreen shrubs *Arctostaphylos pungens*, *Arctostaphylos pringlei*, *Ceanothus greggii*, *Mortonia scabrella*, or *Mortonia utahensis*. Other characteristic shrubs include *Amelanchier utahensis*, *Cercocarpus montanus* var. *paucidentatus*, *Dasyllirion wheeleri*, *Ephedra viridis*, *Garrya flavescens*, *Mahonia fremontii* (= *Berberis fremontii*), and *Robinia neomexicana*. Scattered oaks such as *Quercus arizonica*, *Quercus pungens*, or *Quercus turbinella* may be present, but not codominant. Herbaceous cover is typically low (<15% cover). Common grasses include *Bouteloua curtipendula*, *Bouteloua eriopoda*, and *Muhlenbergia emersleyi*. Frequent forbs include *Astrolepis sinuata*, *Bahia absinthifolia*, and *Macroptilium gibbosifolium*. This alliance occurs in southeastern Nevada, southwestern Utah, Arizona, and southwestern New Mexico. This chaparral occurs on dry mountain slopes ranging from 980-2470 m elevation depending on aspect. The climate is arid to semi-arid with temperatures rarely falling below freezing. Annual precipitation has a bimodal distribution with about a third to two-thirds of the highly variable annual precipitation occurring in July through September during the late summer monsoon, and most of the rest falling during the winter months. Mean annual precipitation is approximately 40 cm. Soils are gravelly with rocks. Parent material includes limestone, rhyolite, granite and quartzite. Adjacent vegetation includes desert grasslands dominated by *Elionurus barbiculmis*, *Heteropogon contortus*, and *Bouteloua* spp. at lower elevations and desert scrub stands dominated by *Acacia neovernicosa* or *Parthenium incanum*.

Classification Comments: Alliances are based in part by fire adaptations of dominant species. For example *Arctostaphylos pungens*, *Arctostaphylos pringlei*, and *Ceanothus greggii* primarily reproduce from seeds that require heat scarification to germinate in contrast to *Quercus turbinella* which strongly sprouts after being burned so it becomes the predominant species over obligate with repeated fires or fire suppression. *Mortonia sempervirens* and *Mortonia utahensis* occur on rocky slopes that rarely burn. Stands describe by Carmichael et al. (1978) in Arizona need to be included in the range of this alliance.

Internal Comments: mjr 12-14: CA added for MOJN.

Other Comments:

Similar NVC Types: Other alliances within Eastern Madrean Chaparral Group (G280), Western Madrean Chaparral Group (G281), and Western North American Montane Sclerophyll Scrub Group (G282) may have some shared associated species with this alliance.

Diagnostic Characteristics: This alliance is characterized by dominance of *Arctostaphylos pungens*, *Arctostaphylos pringlei*, *Ceanothus greggii*, *Mortonia scabrella*, or *Mortonia utahensis* in the shrub canopy. Oaks such as *Quercus turbinella* are absent or have relatively low cover (i.e., not codominant). Herbaceous cover is typically low (<15% cover).

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a moderately dense to dense cover dominated by sclerophyllous and microphyllous, evergreen broad-leaved shrubs ranging from 0.5-3 m tall. Scattered needle-leaved and broad-leaved evergreen trees, 2-5 m tall, are often present. The herbaceous layer is typically sparse and dominated by perennial graminoids, with annual forbs and grasses present seasonally.

Floristics: Stands have a moderately dense canopy dominated or codominated by the sclerophyllous evergreen shrubs *Arctostaphylos pungens*, *Arctostaphylos pringlei*, *Ceanothus greggii*, *Mortonia scabrella*, or *Mortonia utahensis*. Other characteristic shrubs include *Amelanchier utahensis*, *Cercocarpus montanus* var. *paucidentatus*, *Dasyllirion wheeleri*, *Ephedra viridis*, *Garrya flavescens*, *Mahonia fremontii* (= *Berberis fremontii*), *Nolina microcarpa*, *Rhus virens* var. *choriophylla*, and *Robinia neomexicana*. Scattered oaks such as *Quercus arizonica*, *Quercus pungens*, or *Quercus turbinella* may be present, but not codominant. Herbaceous cover is typically low (<15% cover). Common grasses include *Achnatherum eminens* (= *Stipa eminens*), *Aristida purpurea* var. *nealleyi* (= *Aristida glauca*), *Bouteloua curtipendula*, *Bouteloua eriopoda*, *Muhlenbergia emersleyi*, and *Tridens muticus*. Frequent forbs include *Astrolepis sinuata*, *Bahia absinthifolia*, *Calochortus flexuosus*, *Castilleja* sp., *Delphinium parishii*, *Eriogonum wrightii*, *Lomatium foeniculaceum* ssp. *macdougallii*, and *Macroptilium gibbosifolium*.

ENVIRONMENT & DYNAMICS

Environmental Description: Shrublands included in this alliance occur in foothill to montane elevations from southeastern Nevada across southern Utah, Arizona and southeastern New Mexico often growing on cooler north- and east-facing slopes. Elevation ranges from 1050-2300 m depending on aspect. Climate is generally semi-arid with warm summers and cool winters. Annual precipitation has a bimodal distribution with a third to two-thirds of the approximately 40 cm mean annual precipitation falling during the summer and early fall. The winter precipitation has high year-to-year variation. Soils are gravelly with rocks. Parent material includes limestone, rhyolite, granite and quartzite.

Dynamics: *Arctostaphylos pungens* is a fire-adapted species that reproduces prolifically from heat-scarified seeds after fires (Carmichael et al. 1978). Armstrong (1969) considers these shrublands a fire disclimax. Prior to a fire, the *Arctostaphylos pungens* shrubland he described was a *Pinus monophylla* / *Juniperus osteosperma* woodland because of the numerous stumps present. He believed the lack of tree regeneration was caused by the low rainfall and re-occurring fires. Bourgeron et al. (1993b) suggest that this a seral phase of *Pinus discolor* / *Quercus hypoleucoides* woodland.

DISTRIBUTION

Geographic Range: Shrublands included in this alliance occur on mountain slopes and high plateaus from the Virgin Mountains in southeastern Nevada, across the Colorado Plateau in Utah south along the Mogollon Rim and the Sky Island ranges of southeastern Arizona and southwestern New Mexico. It likely occurs in adjacent Chihuahua and Sonora, Mexico.

Nations: MX?, US

States/Provinces: AZ, CA, MXCH?, MXSO?, NM, NV, UT

TNC Ecoregions [optional]: 11:C

USFS Ecoregions (2007): 341Fe:CCC, 341Ff:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > *Ceanothus greggii* (Cup leaf ceanothus chaparral) Alliance (Sawyer et al. 2009) [37.212.00]
- > *Ceanothus greggii* Shrubland Alliance (Evens et al. 2014)
- ? Chihuahuan Desertscrub, mesic phase (Wentworth 1982)
- >< Pointleaf Manzanita Plant Association (Carmichael et al. 1978)

LOWER LEVEL UNITS**Associations:**

- CEPP005938 *Ceanothus greggii* var. *vestitus* Shrubland
- CEGLO00958 *Arctostaphylos pungens* Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Armstrong 1969, Bourgeron et al. 1993b, Carmichael et al. 1978, Evens et al. 2014, Faber-Langendoen et al. 2017b, Keeler-Wolf et al. 1998a, Sawyer et al. 2009, VegCAMP and AIS 2013, Wentworth 1982

2. Shrub & Herb Vegetation

2.B.2.Nd. Western North American Interior Chaparral

G281. Western Madrean Chaparral

A3792. *Cercocarpus montanus* - *Eriogonum fasciculatum* - *Adenostoma sparsifolium* Western Mojave Desert Chaparral Alliance [Low - Poorly Documented]

Type Concept Sentence: Stands are characterized by the co-importance of *Cercocarpus montanus* var. *glaber* and *Eriogonum fasciculatum*. This shrubland of California's southern mountains and the western margins of the Mojave and Colorado deserts and Baja California occurs in a wide variety of habitats.

OVERVIEW

Scientific Name: *Cercocarpus montanus* - *Eriogonum fasciculatum* - *Adenostoma sparsifolium* Western Mojave Desert Chaparral Alliance

Common Name (Translated Scientific Name): Alderleaf Mountain-mahogany - Eastern Mojave Buckwheat - Redshank Western Mojave Desert Chaparral Alliance

Colloquial Name: Western Mojave Desert Chaparral

Type Concept: Stands are characterized by the co-importance of *Cercocarpus montanus* var. *glaber* and *Eriogonum fasciculatum*. *Adenostoma sparsifolium* also may dominate. Other shrubs may include *Adenostoma fasciculatum*, *Ceanothus megacarpus*, *Fremontodendron californicum*, *Garrya flavescens*, *Prunus ilicifolia* ssp. *ilicifolia*, *Quercus dumosa*, *Salvia apiana*, and *Hesperoyucca whipplei* (= *Yucca whipplei*). The herbaceous layer is sparse. This shrubland of California's southern mountains and the western margins of the Mojave and Colorado deserts and Baja California, occurs in a wide variety of habitats. Elevations range from 300-2000 m. Stands are found on all slopes. Soils are usually derived from alluvium, and may be deep, shallow or, on steep slopes, completely absent.

Classification Comments: The placement of this alliance in the USNVC group level needs review.

Internal Comments:

Other Comments:

Similar NVC Types: Other alliances within Eastern Madrean Chaparral Group (G280), Western Madrean Chaparral Group (G281), and Western North American Montane Sclerophyll Scrub Group (G282) may have some shared associated species with this alliance.

Diagnostic Characteristics: Dominance of *Cercocarpus montanus* var. *glaber*, *Eriogonum fasciculatum*, or *Adenostoma sparsifolium* is diagnostic of this chaparral alliance.

VEGETATION

Physiognomy and Structure: This sclerophyllous, broad-leaved and microphyllous, evergreen, extremely xeromorphic shrubland forms a continuous canopy less than 4 m in height. The herbaceous layer is sparse.

Floristics: Stands are characterized by the co-importance of *Cercocarpus montanus* var. *glaber* and *Eriogonum fasciculatum*. *Adenostoma sparsifolium* also may dominate. Other shrubs may include *Adenostoma fasciculatum*, *Ceanothus megacarpus*, *Fremontodendron californicum*, *Garrya flavescens*, *Prunus ilicifolia* ssp. *ilicifolia*, *Quercus dumosa*, *Salvia apiana*, and *Hesperoyucca whipplei* (= *Yucca whipplei*). The herbaceous layer is sparse.

ENVIRONMENT & DYNAMICS

Environmental Description: This shrubland of California's southern mountains and the western margins of the Mojave and Colorado deserts and Baja California occurs in a wide variety of habitats. Elevations range from 300-2000 m. Stands are found on all slopes. Soils are usually derived from alluvium, and may be deep, shallow or, on steep slopes, completely absent. This alliance is probably winter-dormant due to cold temperatures. Precipitation totals are low, ranging from 25 to 50 cm per year. Summers are dry and winters are relatively cool and moist.

Dynamics: This alliance is less fire-prone than other types of chaparral due to lower fuel loads. Plants are dormant much of the year due to intense heat in the late summer and fall, and cold in the winter. Stands are often found on previously burned sites.

DISTRIBUTION

Geographic Range: This alliance occurs in California's inner, southern Coast Ranges, the Transverse and Peninsular ranges, and west to the margins of the Mojave and Colorado deserts.

Nations: MX?, US

States/Provinces: CA, MXBC?

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

- >< *Adenostoma sparsifolium* (Redshank chaparral) Alliance (Sawyer et al. 2009) [37.501.00]

- >< *Cercocarpus montanus* (Birch leaf mountain mahogany chaparral) Alliance (Sawyer et al. 2009) [76.100.00]
- >< *Eriogonum fasciculatum* (California buckwheat scrub) Alliance (Sawyer et al. 2009) [32.040.00]
- >< Flannel Bush Chaparral (#37J00) (Holland 1986b)
- >< Red Shank Chaparral (#37300) (Holland 1986b)
- >< Semi-Desert Chaparral (#37400) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEGLO03003 *Adenostoma sparsifolium* Shrubland [Placeholder]
- CEGLO03036 *Cercocarpus montanus* var. *glaber* - *Eriogonum fasciculatum* Shrubland [Placeholder]

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by M. Schindel.

Version Date: 2014/12/18

REFERENCES

References: Faber-Langendoen et al. 2017b, Hickman 1993, Holland 1986b, Marion 1943, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009

2. Shrub & Herb Vegetation

2.B.2.Nd. Western North American Interior Chaparral

G281. Western Madrean Chaparral

A3791. *Cercocarpus montanus* Madrean Montane Chaparral Alliance

Type Concept Sentence: This alliance includes shrublands dominated by *Cercocarpus montanus* in the Chihuahuan Desert of New Mexico, Arizona, and northern Mexico. Stands occur from foothill to lower montane elevational zones in desert mountain ranges and along the Mogollon Rim.

OVERVIEW

Scientific Name: *Cercocarpus montanus* Madrean Montane Chaparral Alliance

Common Name (Translated Scientific Name): Alderleaf Mountain-mahogany Madrean Montane Chaparral Alliance

Colloquial Name: Madrean Montane Alderleaf Mountain-mahogany Chaparral

Type Concept: This alliance includes shrublands dominated by *Cercocarpus montanus* in the Chihuahuan Desert of New Mexico, Arizona, and northern Mexico. Vegetation is characterized by an open to moderately dense shrub canopy dominated or codominated by *Cercocarpus montanus* with other shrubs common in interior chaparral such as *Ericameria laricifolia*, *Garrya flavescens*, *Mimosa aculeaticarpa* var. *biuncifera*, *Rhus virens* var. *choriophylla*, *Robinia neomexicana*, and stem succulents such as *Agave parryi*, *Dasyllirion wheeleri*, *Nolina microcarpa*, *Opuntia engelmannii*, *Cylindropuntia imbricata* (= *Opuntia imbricata*), and *Yucca baccata*. Chaparral species *Arctostaphylos pungens*, *Arctostaphylos pringlei*, *Ceanothus greggii*, and *Quercus turbinella* are absent or present with low cover (not codominant). Scattered trees may also be present with low cover, including *Pinus edulis*, *Juniperus monosperma*, and *Juniperus osteosperma*. Open stands may have an abundant herbaceous layer characterized by Madrean perennial grasses such as *Muhlenbergia pauciflora* and *Muhlenbergia emersleyi*, although many other herbaceous species may be present to abundant. Shrublands included in this alliance are found on breaks and foothill, mountain and canyon slopes throughout much of the southwestern U.S. Elevations range from 1500-2500 m. Sites are variable but are generally xeric and rocky with moderate to very steep slopes. Substrate is typically thin, well-drained, poorly developed lithic soils with abundant rock outcrops. Parent material is variable and includes alluvium, colluvium and residuum from igneous, metamorphic or sedimentary rocks.

Classification Comments: *Cercocarpus montanus* is a wide-ranging species. This alliance is associated with warm semi-desert interior chaparral stands, not the more temperate foothill to montane zones in the Rocky Mountains. The varieties of *Cercocarpus montanus* typical in this alliance are *Cercocarpus montanus* var. *paucidentatus*, *Cercocarpus montanus* var. *montanus*, and *Cercocarpus montanus* var. *glaber* (western). *Rhus virens* var. *choriophylla* / *Cercocarpus montanus* var. *paucidentatus* Shrubland (CEGL001123) was moved from Eastern Madrean Chaparral Group (G280) to this alliance because it was sampled in the Mule Mountains of southeastern Arizona and is more typical of Western Madrean Chaparral Group (G281) in the Sierra Occidentale and Mogollon Rim. This alliance (A3791) is included in G281 as a best fit. However, the alliance is widespread, occurring in central and southeastern Arizona, extending east across southern New Mexico to the Organ, Oscura, Mockingbird, San Andres, San Augustine and Sacramento mountains. One association described from the San Andres and Oscura mountains, i.e., *Cercocarpus montanus* / *Muhlenbergia pauciflora* Shrubland (CEGL001089), is included in this alliance although it was also described from the Guadalupe Mountains of Texas and New Mexico, which is the northwestern extent of Eastern Madrean Chaparral Group (G280). More classification review is

needed to better understand the transition zone between Eastern Madrean Chaparral Group (G280) and Western Madrean Chaparral Group (G281). Additionally, there are several other *Cercocarpus montanus* plant associations described in Muldavin et al. (2000b, 2003) that need to be reviewed for inclusion in this alliance.

Internal Comments:

Other Comments:

Similar NVC Types: Other alliances within Eastern Madrean Chaparral Group (G280), Western Madrean Chaparral Group (G281), and Western North American Montane Sclerophyll Scrub Group (G282) may have some shared associated species with this alliance.

- A3733 *Cercocarpus montanus* - *Quercus x pauciloba* Shrubland Alliance

Diagnostic Characteristics: This alliance is characterized by dominance or codominance of diagnostic species *Cercocarpus montanus* with shrubs common in chaparral such as *Garrya flavescens*, *Rhus virens* var. *choriophylla*, and *Robinia neomexicana*. *Arctostaphylos pungens*, *Arctostaphylos pringlei*, *Ceanothus greggii*, and *Quercus turbinella* are absent or present with low cover (not codominant). Open stands may have an abundant herbaceous layer characterized by perennial grasses such as *Muhlenbergia emersleyi*, *Muhlenbergia pauciflora*, and *Muhlenbergia setifolia*, although many other herbaceous species may be present to abundant.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a moderately sparse to moderately dense cover of broad-leaved deciduous/evergreen shrubs 2 m tall. The sparse to moderately dense herbaceous layer is usually less than 1 m tall and dominated by graminoids. Some stands have herbaceous layers dominated by perennial forbs, but generally forb cover is sparse. Annuals are seasonally present.

Floristics: This alliance includes shrublands dominated by *Cercocarpus montanus* in the Chihuahuan Desert. Vegetation is characterized by an open to moderately dense shrub canopy dominated or codominated by *Agave parryi* and *Cercocarpus montanus* with other shrubs common in interior chaparral such as *Ericameria laricifolia*, *Garrya flavescens*, *Mimosa aculeaticarpa* var. *biuncifera*, *Rhus virens* var. *choriophylla*, *Robinia neomexicana*, and stem succulents such as *Agave parryi*, *Dasyllirion wheeleri*, *Nolina microcarpa*, *Opuntia engelmannii*, *Cylindropuntia imbricata* (= *Opuntia imbricata*), and *Yucca baccata*. Chaparral species *Arctostaphylos pungens*, *Arctostaphylos pringlei*, *Ceanothus greggii*, and *Quercus turbinella* are absent or present with low cover (not codominant). Scattered trees may also be present with low cover, including *Pinus edulis*, *Juniperus monosperma*, and *Juniperus deppeana*. Open stands may have an abundant herbaceous layer characterized by Madrean perennial grasses such as *Bothriochloa barbinodis*, *Bouteloua eriopoda*, *Muhlenbergia emersleyi*, *Muhlenbergia pauciflora*, *Muhlenbergia setifolia*, *Muhlenbergia tenuifolia*, and *Schizachyrium cirratum*, although many other herbaceous species may be present to abundant, including *Bouteloua curtipendula*, *Bouteloua gracilis*, *Eragrostis intermedia*, *Hesperostipa neomexicana*, and *Schizachyrium cirratum* (Muldavin et al. 2000b). Forbs may be diverse and include *Artemisia carruthii*, *Artemisia ludoviciana*, *Eriogonum jamesii*, *Eriogonum wrightii*, *Hedeoma plicata*, *Heliomeris longifolia*, *Heliomeris multiflora*, *Mirabilis multiflora*, *Mirabilis oxybaphoides*, and *Viguiera dentata*.

ENVIRONMENT & DYNAMICS

Environmental Description: Shrublands included in this alliance are found on breaks and foothill, mountain and canyon slopes throughout much of the southwestern U.S. Elevations range from 1500-2500 m. Climate is semi-arid. Summers are hot and winters are mild. Mean annual precipitation is approximately 24 cm with precipitation occurring bimodally during the winter and late summer with a droughty period in late spring/early summer. The late summer rain often occurs as high-intensity thunderstorms. Sites are variable but are generally xeric and rocky with moderate to very steep slopes. Stands are usually found on southerly aspects. Substrate is typically thin, well-drained, poorly developed lithic soils with abundant rock outcrops. Soils textures are variable and range from sandy loam to clay. Parent material includes alluvium, colluvium and residuum from igneous, metamorphic or sedimentary rocks such as granite, gneiss, limestone, quartz monzonite, rhyolite, sandstone, schist and shale.

Dynamics: Ecological factors that control shrub densities such as fire and drought need more investigation. Unlike other species of *Cercocarpus*, *Cercocarpus montanus* is a fire-resistant species because it can resprout from the base after a fire has killed the top (Cronquist et al. 1997). In the southern portion of its range *Cercocarpus montanus* functions as an evergreen shrub by retaining leaves during mild winters and losing them during cold winters (Dick-Peddie 1993).

DISTRIBUTION

Geographic Range: These shrublands occur from Utah to Texas in breaks, canyons, foothills and mesas, mountains in the southern Colorado Plateau, Chihuahuan Desert and Mogollon Rim south into Mexico especially on desert mountain ranges.

Nations: MX, US

States/Provinces: AZ, NM, TX, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:
Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Cercocarpus montanus* (Mountain Mahogany) Series (Muldavin et al. 1998b)
- = *Cercocarpus montanus* Shrubland Alliance (Wood et al. 1998)
- = *Cercocarpus montanus* Shrubland Alliance (Bourgeron et al. 1995a)
- = *Cercocarpus montanus* Shrubland Alliance (Muldavin et al. 1998a)
- = *Cercocarpus montanus* Shrubland Alliance (Muldavin et al. 2000b)
- = *Cercocarpus montanus* Shrubland Alliance (Muldavin et al. 2003a)
- = *Cercocarpus montanus* Shrubland Alliance (Muldavin 1994)
- ? Mountain Mahogany-Mixed Shrub Series (Dick-Peddie 1993) [included within the Montane Scrubland Vegetation Type]
- ? Mountain mahogany Series (133.34) (Brown 1982a) [included within Interior Chaparral]

LOWER LEVEL UNITS

Associations:

- C EGL001123 *Rhus virens* var. *choriophylla* / *Cercocarpus montanus* var. *paucidentatus* Shrubland
- C EGL001089 *Cercocarpus montanus* / *Muhlenbergia pauciflora* Shrubland
- C EGL001500 *Cercocarpus montanus* / *Muhlenbergia emersleyi* Scrub
- C EGL001088 *Cercocarpus montanus* / *Garrya flavescens* Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Bourgeron et al. 1993b, Bourgeron et al. 1995a, Brown 1982a, Cronquist et al. 1997, Diamond 1993, Dick-Peddie 1993, Faber-Langendoen et al. 2017b, Muldavin 1994, Muldavin and Mehlhop 1992, Muldavin et al. 1998a, Muldavin et al. 1998b, Muldavin et al. 2000b, Muldavin et al. 2003a, Nixon 1977, Wood et al. 1998

2. Shrub & Herb Vegetation

2.B.2.Nd. Western North American Interior Chaparral

G281. Western Madrean Chaparral

A3793. *Quercus john-tuckeri* - *Quercus cornelius-mulleri* - *Fremontodendron californicum* Chaparral Alliance

Type Concept Sentence: This chaparral alliance is characterized by evergreen scrub oak species and other sclerophyllous shrubs with dominant diagnostic species such as *Ceanothus greggii*, *Fremontodendron californicum*, *Juniperus californica*, *Quercus cornelius-mulleri*, or *Quercus john-tuckeri*. It occurs from arid, interior southern California and adjacent Mojave and Colorado deserts to the east.

OVERVIEW

Scientific Name: *Quercus john-tuckeri* - *Quercus cornelius-mulleri* - *Fremontodendron californicum* Chaparral Alliance

Common Name (Translated Scientific Name): Tucker Oak - Muller Oak - California Flannelbush Chaparral Alliance

Colloquial Name: Tucker Oak - Muller Oak - California Flannelbush Chaparral

Type Concept: This chaparral alliance is characterized by evergreen scrub oak species and other sclerophyllous shrubs. Dominant diagnostic species include *Ceanothus greggii*, *Fremontodendron californicum*, *Juniperus californica*, *Quercus cornelius-mulleri*, or *Quercus john-tuckeri*. Many other chaparral species may be present. Some emergent trees may be present, but they are not common. This vegetation type generally intergrades with other chaparral types or pinyon-juniper woodlands. This alliance occurs from arid, interior southern California and adjacent Mojave and Colorado deserts to the east. Stands occur primarily on upper slopes and ridgetops with shallow, well-drained soils. The elevation ranges from 300-1700 m, and yearly precipitation totals are generally less than 30 cm. Droughts are common.

Classification Comments: Placement of this alliance in the USNVC needs further review. The southern California associations in the western interior chaparral group are problematic. If primarily western Mojave then perhaps Mojave mid-elevation scrub groups, but they also occur in cismontane California, so likely could be included in one of the many California chaparral groups. The three

component old alliances have a similar range and habitats. *Ceanothus greggii* is a widespread chaparral shrub the may codominant with chaparral from other groups.

Internal Comments: KAS 11-14: Julie Evens requests moving this alliance to G261 "This *Quercus john-tuckeri* alliance is more closely related to *Quercus berberidifolia* and *Q. douglasii* (in which it hybridizes with both of these species) and also to other chaparral oaks like *Quercus wislizeni* shrub oaks. It is found on mesic slopes and in the lower montane zone just like QUBE in the inner Coast Range of California including Fresno to San Luis Obispo Cos, and just reaches into the western Mojave."

Other Comments:

Similar NVC Types: Other alliances within Eastern Madrean Chaparral Group (G280), Western Madrean Chaparral Group (G281), and Western North American Montane Sclerophyll Scrub Group (G282) may have some shared associated species with this alliance.

Diagnostic Characteristics: Shrublands dominated by diagnostic species *Ceanothus greggii*, *Fremontodendron californicum*, *Juniperus californica*, *Quercus cornelius-mulleri*, or *Quercus john-tuckeri*.

VEGETATION

Physiognomy and Structure: This broad-leaved evergreen shrubland is characterized by an intermittent canopy of shrubs less than 3 m in height. Occasional emergent trees (5-10 m tall) may be present. The herbaceous layer is sparse.

Floristics: This chaparral alliance is characterized by evergreen scrub oak species and other sclerophyllous shrubs. Dominant diagnostic species include *Ceanothus greggii*, *Fremontodendron californicum*, *Juniperus californica*, *Quercus cornelius-mulleri*, and *Quercus john-tuckeri*. Many other shrub species may be present to codominant such as *Adenostoma fasciculatum*, *Adenostoma sparsifolium*, *Arctostaphylos glauca*, *Ceanothus cuneatus*, *Cercocarpus montanus*, *Coleogyne ramosissima*, *Ericameria linearifolia*, *Eriogonum fasciculatum*, and *Garrya flavescens*. Emergent trees such as *Quercus chrysolepis*, *Quercus douglasii*, *Pinus coulteri*, *Pinus monophylla*, *Pinus quadrifolia* and *Pinus sabiniana* may be occasionally present. The herbaceous layer is sparse.

ENVIRONMENT & DYNAMICS

Environmental Description: This chaparral alliance occurs from arid, interior southern California and adjacent Mojave and Colorado deserts to the east. Stands occur primarily on upper slopes and ridgetops with shallow, well-drained soils. The elevation ranges from 300-1700 m, and yearly precipitation totals are generally less than 30 cm. Droughts are common. This vegetation type generally intergrades with other chaparral types or pinyon-juniper woodlands.

Dynamics: This chaparral alliance occurs in drier and colder regions than other types. This alliance is found often on recently burned sites. It is not as prone to fire as other chaparral vegetation types due to lighter fuel loads. *Quercus cornelius-mulleri* or *Quercus john-tuckeri* vigorously sprouts from root crowns after fire (Sawyer et al. 2009).

DISTRIBUTION

Geographic Range: This alliance occurs in the western Mojave and Colorado deserts and throughout the interior of southern California. It may also be found in Baja California, Mexico.

Nations: MX?, US

States/Provinces: CA, MXBC?

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: BLM (Carrizo Plain); NPS (Joshua Tree)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- > *Ceanothus greggii* (Cup leaf ceanothus chaparral) Alliance (Sawyer et al. 2009) [37.212.00]
- > *Quercus cornelius-mulleri* (Muller oak chaparral) Alliance (Sawyer et al. 2009) [37.415.00]
- > *Quercus cornelius-mulleri* Shrubland Alliance (Evens et al. 2012)
- > *Quercus john-tuckeri* (Tucker oak chaparral) Alliance (Sawyer et al. 2009) [37.418.00]
- ? Semi-Desert Chaparral (#37400) (Holland 1986b)
- ? Semi-desert chaparral (Cheatham and Haller 1975)

LOWER LEVEL UNITS

Associations:

- CEG003026 *Ceanothus greggii* - *Fremontodendron californicum* Shrubland [Placeholder]

- CEGLO02727 *Quercus john-tuckeri* - *Juniperus californica* Shrubland
- CEGLO02726 *Quercus cornelius-mulleri* Shrubland [Placeholder]

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by M. Schindel.

Version Date: 2014/12/18

REFERENCES

References: Cheatham and Haller 1975, Evens et al. 2012, Faber-Langendoen et al. 2017b, Holland 1986b, Keeler-Wolf 1997, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Stout et al. 2013

2. Shrub & Herb Vegetation

2.B.2.Nd. Western North American Interior Chaparral

G281. Western Madrean Chaparral

A0793. *Quercus turbinella* Chaparral Alliance

Type Concept Sentence: This alliance includes evergreen shrublands dominated or codominated by *Quercus turbinella* that typically forms thickets with other shrubs. *Quercus turbinella* shrublands are typically found on steep, rocky slopes, often sheltered slopes in limestone canyons, in the mountains of Nevada, Arizona, New Mexico, and western Texas.

OVERVIEW

Scientific Name: *Quercus turbinella* Chaparral Alliance

Common Name (Translated Scientific Name): Sonoran Scrub Oak Chaparral Alliance

Colloquial Name: Sonoran Scrub Oak Chaparral

Type Concept: This alliance includes evergreen shrublands dominated or codominated by *Quercus turbinella* that typically forms thickets with other shrubs. Important shrub associates can include *Arctostaphylos* spp., *Ceanothus greggii*, *Cercocarpus montanus*, *Coleogyne ramosissima*, *Ephedra viridis*, *Fraxinus greggii*, *Garrya wrightii*, *Juniperus osteosperma*, *Rhus virens*, *Rhus trilobata*, *Rhus microphylla*, and a shrub form of *Quercus grisea*. Ground cover is typically sparse with scattered grasses, forbs and ferns. Some typical herbaceous components include *Aristida* spp., *Astrolepis sinuata* (= *Notholaena sinuata*), *Bouteloua curtipendula*, *Bouteloua eriopoda*, and *Notholaena standleyi*. Shrublands in this alliance are small in extent and occur in a matrix of succulent desert scrub and semi-desert grassland. *Quercus turbinella* shrublands are typically found on steep, rocky slopes, often sheltered slopes in limestone canyons, in the mountains of Nevada, Arizona, New Mexico, and western Texas.

Classification Comments: *Quercus turbinella* is a widespread interior chaparral species whose distribution is centered in Arizona. Therefore, this alliance is included in Western Madrean Chaparral Group (G281), but stands extend west into the Mojave and Great Basin and east into western Texas. Alliances are based in part by the fire adaptations of dominant species; for example, *Quercus turbinella* strongly sprouts after being burned so it becomes the predominant species with repeated fires or fire suppression over species such as *Arctostaphylos pungens*, *Arctostaphylos pringlei*, and *Ceanothus greggii* that primarily reproduce from seeds that require heat scarification to germinate (Carmichael et al. 1978).

Internal Comments: mjr 3-16: *Quercus turbinella* does not occur in WY (removed). mjr 12-14: CA added for MOJN.

Other Comments:

Similar NVC Types: Some stands in alliances in Eastern Madrean Chaparral Group (G280) may be codominated by *Quercus turbinella* but will have diagnostic species from that group present. Other alliances within Eastern Madrean Chaparral Group (G280), Western Madrean Chaparral Group (G281), and Western North American Montane Sclerophyll Scrub Group (G282) may have some shared associated species with this alliance.

- A3971 *Quercus pungens* - *Quercus intricata* - *Quercus vaseyana* Chaparral Alliance: may be codominated by *Quercus turbinella*, but will have diagnostic species from Eastern Madrean Chaparral Group (G280) present.

Diagnostic Characteristics: This alliance is characterized by dominance of *Quercus turbinella* or codominance with a variety of other species such as *Amelanchier utahensis*, *Arctostaphylos pungens*, *Artemisia tridentata*, *Cercocarpus montanus*, *Coleogyne ramosissima*, *Ephedra viridis*, *Fraxinus anomala*, *Garrya flavescens*, *Juniperus osteosperma*, *Ptelea trifoliata*, or *Rhus trilobata*. The herbaceous layer is usually sparse because of shading from shrubs, but open stands may have an herbaceous layer dominated by grasses such as *Bouteloua curtipendula* and *Bouteloua eriopoda*.

VEGETATION

Physiognomy and Structure: Vegetation in this shrubland alliance is dominated by a moderately dense cover of broad-leaved evergreen shrubs typically about 2 m tall, but can reach 5 m. The graminoid layer is sparse to moderately dense and dominated by medium-tall, warm-season bunchgrasses. The forb layer is generally sparse but may have high species diversity. Cacti or rosette shrub succulents are commonly present.

Floristics: This alliance includes evergreen shrublands dominated or codominated by *Quercus turbinella* that typically forms thickets with other shrubs. Important shrub associates can include *Arctostaphylos* spp., *Ceanothus greggii*, *Cercocarpus montanus*, *Coleogyne ramosissima*, *Ephedra viridis*, *Fraxinus greggii*, *Garrya wrightii*, *Juniperus osteosperma*, *Rhus virens*, *Rhus trilobata*, *Rhus microphylla*, and a shrub form of *Quercus grisea*. Cacti or rosette shrub succulents such as *Agave palmeri*, *Dasyllirion wheeleri*, *Nolina microcarpa*, *Opuntia* spp., and *Yucca baccata* are commonly present. The herbaceous layer is sparse to moderately dense, ranging from 5-40% cover. Perennial grasses are the most abundant species, particularly *Aristida* spp., *Bouteloua curtipendula*, *Bouteloua eriopoda*, *Eragrostis* spp., *Leptochloa dubia*, and *Muhlenbergia* spp. Many forb and fern species can occur, but have little cover. Common forbs include *Artemisia ludoviciana*, *Croton fruticulosus*, *Datura* spp., and *Eriogonum wrightii*. Ferns include species of *Cheilanthes*, *Pellaea*, and *Astroblepis*. Annual grasses and forbs are seasonally present and often include the exotic species *Bromus rubens* and *Bromus tectorum*.

ENVIRONMENT & DYNAMICS

Environmental Description: Shrublands included in this alliance occur in the foothills and lower slopes of isolated desert mountain ranges and canyons from Nevada to western Texas, but distribution is centered in Arizona below the Mogollon Rim. Elevations range from 850-1800 m. Climate is semi-arid. From one-half to two-thirds of the 40-65 cm mean annual precipitation occurs during July-September as the result of convectional thunderstorms. The balance occurs during winter as occasional rains. Late spring and early summer are typically dry. Summers are hot and winters can have periods of cold weather and occasional snows. Stands occur on nearly level to steep (to 80%), rocky slopes on all aspects. Soils are typically deep, coarse-textured, and poorly developed. Textures vary from cobbly and gravelly loamy sand to gravelly loam. Parent materials are varied and include weathered granite, schist, diabase, sandstone, shale, limestone, slate, gneiss, quartzite, monzonite and basalt. Occasionally stands occur on fine-textured soil that may be too warm for *Juniperus* (Carmichael et al. 1987). Leaf litter occasionally accumulates 2-8 cm deep (Warren and Treadwell 1980). Litter layers affect soil development, rates of erosion, and fire regimes and behavior (Kemp 1965). Vegetation at higher elevations is often woodlands dominated by species of *Quercus*, *Pinus*, or *Juniperus*. At lower elevations there is desert scrub dominated by species of *Acacia*, *Mimosa*, *Prosopis*, or *Encelia*.

Dynamics: Most of the species in these chaparral stands have some adaptation to fire. The root systems are well-developed and draw moisture from a large volume of soil allowing for rapid sprouting after fire. Non-sprouting species, such as species of *Ceanothus* and *Arctostaphylos*, require fire to scarify the numerous seeds in the seed bank before they will germinate (Carmichael et al. 1978). Recovery after fire can occur in as little as 5-11 years, and some stands are fire-induced climax and need fire to maintain them (Carmichael et al. 1978). Altered fire regimes, fuelwood harvest, and grazing by livestock have significant impacts on the quality of sites. More study is needed to understand and manage these shrublands.

DISTRIBUTION

Geographic Range: The distribution of shrublands included in this alliance is centered in Arizona below the Mogollon Rim, extending north and west into Utah, Nevada, and east into southern New Mexico, western Texas. It also likely occurs in northern Mexico.

Nations: MX?, US

States/Provinces: AZ, CA, NM, NV, TX, UT

TNC Ecoregions [optional]: 17:C

USFS Ecoregions (2007): 322Al:CCC, 322Am:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Lake Mead, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Quercus turbinella* (Sonoran live oak scrub) Alliance (Sawyer et al. 2009) [71.095.00]
- = *Quercus turbinella* Series (Muldavin et al. 1994a) [includes the *Quercus turbinella*/*Bouteloua curtipendula* Plant Association within the Broadleaf Evergreen Interior Chaparral Group]
- = *Quercus turbinella* Shrubland Alliance (Evens et al. 2014)
- = *Quercus turbinella* Shrubland Alliance (CNPS 2017) [71.095.00]
- < Mojavean Piñon Woodland (#72210) (Holland 1986b)
- < Scrub Oak Mahogany Series - 133.31 (Brown et al. 1979)

- < Singleleaf pinyon series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS

Associations:

- CEG000977 *Quercus turbinella* - *Garrya flavescens* - *Arctostaphylos pungens* Shrubland
- CEG000980 *Quercus turbinella* - *Ephedra viridis* Shrubland
- CEG000979 *Quercus turbinella* - *Cercocarpus montanus* Shrubland
- CEG000978 *Quercus turbinella* / *Bouteloua eriopoda* Shrubland
- CEG002950 *Quercus turbinella* - (*Amelanchier utahensis*) Colluvial Shrubland
- CEPP006752 *Quercus turbinella* - *Juniperus californica* - *Eriogonum* spp. Shrubland
- CEG000981 *Quercus turbinella* - *Juniperus osteosperma* Shrubland
- CEG005160 *Quercus turbinella* - *Ptelea trifoliata* - *Fraxinus anomala* Mesic Shrubland
- CEG005168 *Quercus turbinella* - (*Rhus trilobata*, *Artemisia tridentata*) Shrubland
- CEPP006751 *Quercus turbinella* - *Baccharis sergiloides* Shrubland
- CEG000982 *Quercus turbinella* - *Coleogyne ramosissima* Shrubland

AUTHORSHIP

Primary Concept Source: E. Muldavin, P. Mehlhop, and E. DeBruin (1994a)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Brown 1978, Brown 1982a, Brown et al. 1979, CNPS 2017, Carmichael et al. 1978, Diamond 1993, Dick-Peddie 1993, Evens 2000, Evens et al. 2014, Faber-Langendoen et al. 2017b, Holland 1986b, Kemp 1965, Muldavin and Mehlhop 1992, Muldavin et al. 1994a, Nixon 2002, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, TPWD 1990a, Thomas et al. 2004, Tirmenstein 1999d, Warren and Treadwell 1980, Warren et al. 1982, Wells 1960

2.C. Shrub & Herb Wetland

Shrub & Herb Wetland includes open bogs, fens, fresh and saltwater marshes, wet meadows and wet shrublands. The vegetation occurs from tropical to polar regions.

2.C.2. Temperate to Polar Bog & Fen

Temperate to Polar Bog & Fen includes temperate bogs and fens dominated by *Sphagnum* or brown mosses with ericaceous shrubs, graminoids, and low scrub tree growth forms, across the mid-latitudes of the Northern Hemisphere from 23° to 70°N, but is much less common in the southern mid-latitudes.

2.C.2.Na. North American Bog & Fen

This division includes open and treed bogs and fens throughout much of North America from the boreal zone in Canada south to northern California, montane areas in the western United States, the northern Great Plains, and much of the midwestern and northeastern United States and southeastern Canada.

M877. North American Boreal & Subboreal Alkaline Fen

This alkaline fen macrogroup occurs on peatlands across the boreal regions of North America, extending south into subboreal regions of the Rocky Mountains, Great Lakes, and northeastern and north-central U.S. *Sphagnum* peatmoss and ericaceous shrubs are patchy to absent and brown mosses, broad-leaved non-ericaceous shrubs, and thin-leaved graminoids are common.

2. Shrub & Herb Vegetation

2.C.2.Na. North American Bog & Fen

2.C.2.Na.2.c. M877 North American Boreal & Subboreal Alkaline Fen

G516. Rocky Mountain Alkaline Fen

Type Concept Sentence: This group occurs throughout the Rocky Mountains from Colorado north into Canada, where it is confined to fens with groundwater discharge, soil chemistry (neutral to alkaline), and peat accumulation of at least 40 cm. Vegetation is dominated by graminoids and low shrubs and includes *Carex buxbaumii*, *Carex cusickii*, *Carex limosa*, *Carex saxatilis*, *Carex utriculata*, *Kobresia myosuroides*, and *Kobresia simpliciuscula*. Shrubs include *Betula glandulosa* and several *Salix* spp.

OVERVIEW

Scientific Name: *Kobresia myosuroides* - *Carex buxbaumii* Alkaline Fen Group

Common Name (Translated Scientific Name): Bellardi Bog Sedge - Buxbaum's Sedge Alkaline Fen Group

Colloquial Name: Dwarf Birch Alkaline Shrub Fen

Type Concept: This group occurs infrequently throughout the Rocky Mountains from Colorado north into Canada. It is confined to specific environments defined by groundwater discharge, soil chemistry (neutral to alkaline), and peat accumulation of at least 40 cm. Vegetation is dominated by graminoids and low shrubs and includes *Carex buxbaumii*, *Carex cusickii*, *Carex limosa*, *Carex saxatilis*, *Carex utriculata*, *Kobresia myosuroides*, and *Kobresia simpliciuscula*. Shrubs include *Betula glandulosa* and several *Salix* spp. Fens form at low points in the landscape or on slopes where groundwater intercepts the soil surface. Groundwater inflows maintain a fairly constant water level year-round, with water at or near the surface most of the time. Constant high water levels and cold winter temperatures lead to accumulation of organic material. In addition to peat accumulation and perennially saturated soils, soil chemistry is alkaline to neutral with nutrients high in base cations. Nitrogen (N) and potassium (K) are usually still limiting plant growth in rich fens. Rich fens are strongly influenced by geology and occur where limestone, dolostone, marble or where glacially-derived materials are calcareous. The surrounding landscape may be ringed with other wetland systems, e.g., riparian shrublands, or a variety of upland systems from grasslands to forests.

Classification Comments: This group contains alkaline and neutral fens. Acidic and poor fens are classified in Rocky Mountain Acidic Fen Group (G515). Some associations occur across the pH gradient, making placement into either an acidic group or neutral-alkaline group problematic. It may prove more useful to have all fens in one group and use the alliance level to tease out poor versus rich fens. Alkaline fens in Alaska are placed into either Western North American Boreal Alkaline Fen Group (G361) or North Pacific Alkaline Open Fen Group (G285).

Similar NVC Types:

- G361 Western North American Boreal Alkaline Fen
- G285 North Pacific Alkaline Open Fen: covers calcareous and other alkaline fens but with Pacific Northwest species such as *Myrica gale*.
- G284 North Pacific Acidic Open Bog & Fen: covers poor fens in the Pacific Northwest with species such as *Callitropsis nootkatensis*, *Pinus contorta* var. *contorta*, *Picea sitchensis*, and *Tsuga heterophylla*.
- G515 Rocky Mountain Acidic Fen: includes wet peatlands that have deep peat and are therefore less influenced by groundwater, or occur in non-calcareous bedrock; mineral influences are much less and pH of soil water is more neutral than in the alkaline fens.

Diagnostic Characteristics: Saturated year-round organic soils with >40 cm peat, bathed in mineral-rich groundwater discharge (pH neutral to alkaline) and dominated by wetland indicator plants, and the ground cover is dominated by *Sphagnum* mosses.

VEGETATION

Physiognomy and Structure: Wet peatlands with heavy moss ground cover, low-statured graminoid species, short and dwarf-shrubs that often occur in a mosaic of these types all adjacent to each other.

Floristics: Vegetation is dominated by graminoids and low shrubs and includes *Carex buxbaumii*, *Carex cusickii*, *Carex limosa*, *Carex saxatilis*, *Carex utriculata*, *Kobresia myosuroides*, and *Kobresia simpliciuscula*. Shrubs include *Betula glandulosa* and several *Salix* spp. Rare plants found in calcareous fens include *Salix candida*, *Salix myrtillofolia*, *Salix serissima*, *Primula egalikensis*, *Eriophorum altaicum* var. *neogaeum*, *Carex viridula*, *Carex tenuiflora*, *Carex leptalea*, *Trichophorum pumilum*, and *Sisyrinchium pallidum* (Cooper 1986b, Windell et al. 1986, Cooper and Sanderson 1997, Steen and Coupe 1997).

ENVIRONMENT & DYNAMICS

Environmental Description: It is confined to specific environments defined by groundwater discharge, soil chemistry, and peat accumulation of at least 40 cm. Fens form at low points in the landscape or on slopes where groundwater intercepts the soil surface. Groundwater inflows maintain a fairly constant water level year-round, with water at or near the surface most of the time. Constant high water levels and cold winter temperatures lead to accumulation of organic material. In addition to peat accumulation and perennially saturated soils, soil chemistry is alkaline to neutral and nutrients high in base cations. Nitrogen (N) and potassium (K) are usually still limiting plant growth in rich fens. Rich fens are strongly influenced by geology and occur where limestone, dolostone, marble or where glacially-derived materials are calcareous (Cooper 1986b, Windell et al. 1986, Cooper and Sanderson 1997, Steen and Coupe 1997, Bedford and Godwin 2003).

Dynamics: Mountain fens act as natural filters cleaning ground and surface water. Fens also act as sponges by absorbing heavy precipitation, slowly releasing it downstream, minimizing erosion and recharging groundwater systems (Windell et al. 1986). The

persistent groundwater and cold temperatures allow organic matter to accumulate (forming peat) which allows classification of wetlands within this group as fens. Fens produce peat that accumulates at the rate of 20 to 30 cm (8-11 inches) per 1000 years, making peatlands a repository of 10,000 years of post glacial history (Windell et al. 1986).

DISTRIBUTION

Geographic Range: This group occurs infrequently throughout the mountains of the interior west, the Sky Islands of Arizona and high mountains and plateaus of Nevada and Utah, and the Rocky Mountains of Utah, Colorado, Wyoming, Montana, Idaho, the Black Hills of South Dakota, and north into Canada.

Spatial Scale & Pattern [optional]: Small patch

Nations: CA, US

States/Provinces: AB, AZ, BC, CA, CO, ID, MT, NV, OR, SD, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Alliances:

- A3436 *Kobresia myosuroides* - *Kobresia simpliciuscula* Alkaline Graminoid Fen Alliance
- A3434 *Betula nana* Alkaline Shrub Fen Alliance
- A3435 *Carex limosa* - *Carex buxbaumii* - *Triglochin maritima* Alkaline Graminoid Fen Alliance

AUTHORSHIP

Primary Concept Source: J. Rocchio, D. Cooper, B. Bedford, in Faber-Langendoen et al. (2011)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 11/23/2015

Classif Resp Region: West

Internal Author: GK 11-10, 5-13, 11-15, mod. MSR 3-17

REFERENCES

References: Bedford and Godwin 2003, Cooper 1986b, Cooper and Sanderson 1997, Faber-Langendoen et al. 2017a, Rondeau 2001, Steen and Coupé 1997, Windell et al. 1986

2. Shrub & Herb Vegetation

2.C.2.Na. North American Bog & Fen

G516. Rocky Mountain Alkaline Fen

A3434. *Betula nana* Alkaline Shrub Fen Alliance

Type Concept Sentence: This alliance covers shrub-dominated neutral to alkaline pH fens (organic soil wetlands) found at elevations of 1500-3350 m (5000-11,000 feet) within the Rocky Mountains. *Betula nana* is an indicator for the shrubby growth form on these fens; however, other shrub species may be dominant. There is usually herbaceous cover, and dense mosses cover the ground.

OVERVIEW

Scientific Name: *Betula nana* Alkaline Shrub Fen Alliance

Common Name (Translated Scientific Name): Dwarf Birch Alkaline Shrub Fen Alliance

Colloquial Name: Dwarf Birch Alkaline Shrub Fen

Type Concept: This alliance consists of shrubby wetlands dominated by several different shrub species, often represented by *Betula nana*. These wetlands are neutral to alkaline pH fens found at elevations of 1500-3350 m (5000-11,000 feet) within the Rocky Mountains. *Betula nana* is an indicator for the shrubby growth form on these fens; however, other shrub species may be dominant. There is usually herbaceous cover, and dense mosses cover the ground.

Classification Comments: Fens are neutral to alkaline pH, with shrubby growth.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Shrub cover is at least 25% over the shorter canopy of herbaceous growth.

VEGETATION

Physiognomy and Structure: The shrub layer is dominated by a broad-leaved deciduous, low, spreading erect shrub mostly 1-3 m tall. The canopy cover is sparse to moderate while the herbaceous layer cover is high. The fern layer is prominent, with up to 80% cover.

Floristics: Vegetation types within this alliance are described as seasonally flooded, cold-deciduous shrublands. *Betula glandulosa* dominates the canopy. Other shrubs present include *Alnus incana*, *Cornus sericea*, *Dasiphora fruticosa* ssp. *floribunda* (= *Pentaphylloides floribunda*), *Rhamnus alnifolia*, *Salix planifolia*, *Salix monticola*, and *Salix wolfii*. The herbaceous undergrowth is found on small hummocks and is usually dominated by a dense mixture of mesic forbs and mesic graminoids. Mesic graminoids include *Calamagrostis canadensis*, *Calamagrostis stricta*, *Carex aquatilis*, *Carex utriculata*, *Carex livida*, and *Deschampsia cespitosa*. Forb cover is sparse and may include *Caltha leptosepala*, *Epilobium ciliatum*, *Ligusticum filicinum*, *Ranunculus sceleratus*, *Sparganium natans* (= *Sparganium minimum*), and *Thalictrum alpinum*. Fern allies present may include *Equisetum laevigatum*.

ENVIRONMENT & DYNAMICS

Environmental Description: Elevations range from 900 to 3000 m in the Rocky Mountains. Communities occur on peat soils in seeps, swales, and wet alluvial terraces adjacent to low-gradient meandering streams. They are found in areas where soils are saturated from seeps and springs. Soils are Histosols saturated all year. Quaking mats are typical of many stands.

Dynamics: As peatland hummocks develop (become more pronounced), they may become more heavily dominated by *Salix* species (Wendell et al. 1986, as cited in Kittel et al. 1999b). Due to cold temperatures and a short growing season, this process may take several decades to occur (Phillips 1977).

DISTRIBUTION

Geographic Range: Stands of this alliance are found in the Rocky Mountains of Idaho, Montana, Wyoming, and Colorado. These are likely to occur in Alberta and British Columbia as well.

Nations: CA?, US

States/Provinces: AB?, BC?, CO, ID, MT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Betula glandulosa* Series (Johnston 1987)

LOWER LEVEL UNITS

Associations:

- CEGLO01188 *Salix candida* / *Carex utriculata* Shrub Fen
- CEGLO02899 *Betula glandulosa* / *Sphagnum* spp. Shrub Fen
- CEGLO02700 *Betula glandulosa* / *Carex lasiocarpa* Shrub Fen
- CEGLO00229 *Salix farriae* / *Eleocharis quinqueflora* Shrub Fen

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Carsey et al. 2003a, Carsey et al. 2003b, Faber-Langendoen et al. 2017b, Hansen et al. 1991, Hansen et al. 1995, Hitchcock et al. 1964, Johnston 1987, Kartesz 1994a, Kettler and McMullen 1996, Kittel et al. 1995, Kittel et al. 1999a, Kittel et al. 1999b, Komarkova 1986, Phillips 1977, Sanderson and Kettler 1996

2. Shrub & Herb Vegetation

2.C.2.Na. North American Bog & Fen

G516. Rocky Mountain Alkaline Fen

A3435. *Carex limosa* - *Carex buxbaumii* - *Triglochin maritima* Alkaline Graminoid Fen Alliance

Type Concept Sentence: This alliance covers neutral to alkaline herbaceous fens dominated by one or more *Carex* species. Some well-documented species include *Carex buxbaumii*, *Carex cusickii*, *Carex limosa*, and *Carex saxatilis*. *Carex aquatilis* and *Carex utriculata* may be present as well. This alliance occurs in the Rocky Mountains. Fens are seasonally or permanently saturated wetlands with an organic substrate that is at least 30 cm thick.

OVERVIEW

Scientific Name: *Carex limosa* - *Carex buxbaumii* - *Triglochin maritima* Alkaline Graminoid Fen Alliance

Common Name (Translated Scientific Name): Mud Sedge - Buxbaum's Sedge - Seaside Arrow-grass Alkaline Graminoid Fen Alliance

Colloquial Name: Rocky Mountain Alkaline Sedge Graminoid Fen

Type Concept: This alliance consists of neutral to alkaline herbaceous fens dominated by one or more *Carex* species. Some well-documented species include *Carex buxbaumii*, *Carex cusickii*, *Carex limosa*, and *Carex saxatilis*. *Carex aquatilis* and *Carex utriculata* may be present as well. Additional species may include *Caltha leptosepala*, *Deschampsia cespitosa*, *Drosera* spp., *Eleocharis quinqueflora*, *Eriophorum* spp., *Menyanthes trifoliata*, *Pedicularis groenlandica*, and *Trichophorum cespitosum* (= *Scirpus cespitosus*). The source and quality of groundwater determine the nutrient content and pH of these fens, which most often occur as basin or depressional wetlands, but can also occur as slope and alluvial wetlands in terms of their hydrogeomorphic setting. These fens are seasonally or permanently saturated wetlands with an organic substrate that is at least 30 cm thick, and occur in the Rocky Mountains.

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: These are herbaceous-dominated, neutral to alkaline pH fens with herbaceous cover as the dominant vegetation, usually with a high moss ground cover, but this may be submerged under water during part of the year.

VEGETATION

Physiognomy and Structure: This alliance is characterized by turf-forming, perennial graminoids. The graminoid stratum is dominated by one or two sedge species. The forb layer is typically present.

Floristics: Dominant species are *Carex buxbaumii*, *Carex cusickii*, *Carex limosa*, and *Carex saxatilis*, either singly or in various mixes. Common co-associates are *Carex aquatilis*, *Carex canescens*, *Carex lasiocarpa*, *Carex livida*, *Carex utriculata*, and *Deschampsia cespitosa*. Forbs are often present and can have high cover, but stands are usually dominated by their graminoid components. Forb species include *Caltha leptosepala*, *Drosera linearis*, *Ligusticum tenuifolium*, *Menyanthes trifoliata*, *Pedicularis groenlandica*, and *Pedicularis groenlandica*. Other species present may include *Scheuchzeria palustris*. A dense layer of *Sphagnum* spp. or other moss genera is typically the ground cover.

ENVIRONMENT & DYNAMICS

Environmental Description: Fens occur from 2400-3900 m in elevation and are located in narrow to broad mountain valleys, on organic substrates, with smooth to concave surface topography. Soils are commonly Histosols consisting of deep, fibric peat and are persistently saturated with standing water in the spring. Saturated conditions retard plant decomposition and favor organic matter accumulation.

Dynamics:**DISTRIBUTION**

Geographic Range: This alliance is found in the mountains of Utah, Idaho, Montana, Wyoming, Colorado and New Mexico, and likely extends into Alberta and British Columbia, Canada.

Nations: CA?, US

States/Provinces: AB?, BC?, CO, ID, MT, NM, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Carex buxbaumii*-*Carex aquatilis* (Mattson 1984)
- ? *Carex buxbaumii*-*Carex saxatilis* (Tuhy 1981)

LOWER LEVEL UNITS

Associations:

- CEG001806 *Carex buxbaumii* Fen
- CEG002549 *Carex diandra* Wet Meadow Fen
- CEG002922 *Carex utriculata* Perched Wetland Fen
- CEG000230 *Carex cusickii* Fen
- CEG001811 *Carex limosa* Fen
- CEG001769 *Carex saxatilis* Fen
- CEG001995 *Triglochin maritima* Fen
- CEG001877 *Carex microglochin* Fen

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Cronquist et al. 1977, Cronquist et al. 1997, Faber-Langendoen et al. 2017b, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Hermann 1970, Kettler and McMullen 1996, Lewis 1970, Mattson 1984, Moseley et al. 1991, Moseley et al. 1994, Padgett et al. 1989, Pierce 1986, Pierce and Johnson 1986, Sanderson and Kettler 1996, Sawyer and Keeler-Wolf 1995, Tuhy 1981

2. Shrub & Herb Vegetation

2.C.2.Na. North American Bog & Fen

G516. Rocky Mountain Alkaline Fen

A3436. Kobresia myosuroides - Kobresia simpliciuscula Alkaline Graminoid Fen Alliance

Type Concept Sentence: This Rocky Mountain alliance contains strongly alkaline fens dominated by herbaceous species; indicators include *Kobresia myosuroides* and *Kobresia simpliciuscula*, the later indicating extremely rich conditions. The water chemistry is distinct in that it contains high levels of calcium and magnesium.

OVERVIEW

Scientific Name: *Kobresia myosuroides* - *Kobresia simpliciuscula* Alkaline Graminoid Fen Alliance

Common Name (Translated Scientific Name): Simple Bog Sedge - Bellardi Bog Sedge Alkaline Graminoid Fen Alliance

Colloquial Name: Bog Sedge Alkaline Graminoid Fen

Type Concept: This alliance consists of strongly alkaline fens dominated by herbaceous species; indicators include *Kobresia myosuroides* and *Kobresia simpliciuscula*, the later indicating extremely rich conditions. Other species present may include *Carex aquatilis*, *Carex simulata*, *Eleocharis quinqueflora*, *Juncus arcticus*, *Ptilagrostis porteri* (= *Ptilagrostis mongholica* ssp. *porteri*), *Salix brachycarpa*, *Salix candida*, *Thalictrum alpinum*, and *Trichophorum pumilum* (= *Scirpus pumilus*). The water chemistry is distinct in that it contains high levels of calcium and magnesium. It is documented to occur in the Rocky Mountains of Colorado, but is likely to occur in Wyoming, Montana, Idaho, Utah, New Mexico, Alberta and British Columbia

Classification Comments: Shrub cover, if present, is <25%.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Alkaline pH herbaceous-dominated fens with *Kobresia myosuroides* or *Kobresia simpliciuscula* present to dominant.

VEGETATION

Physiognomy and Structure: Low cold-deciduous shrub cover of at least 25%.

Floristics: Indicators of this alliance include *Kobresia myosuroides* and *Kobresia simpliciuscula*, the later indicating extremely rich conditions. Other species present may include *Carex aquatilis*, *Carex simulata*, *Eleocharis quinqueflora*, *Juncus arcticus*, *Ptilagrostis porteri* (= *Ptilagrostis mongholica* ssp. *porteri*), *Salix brachycarpa*, *Salix candida*, *Thalictrum alpinum*, and *Trichophorum pumilum* (= *Scirpus pumilus*).

ENVIRONMENT & DYNAMICS

Environmental Description: The water chemistry is distinct in that it contains high levels of calcium and magnesium.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is documented to occur in the Rocky Mountains of Colorado, but is likely to occur in Wyoming, Montana, Idaho, Utah, New Mexico, Alberta and British Columbia.

Nations: CA?, US

States/Provinces: AB?, BC?, CO, ID?, MT?, NM?, UT?, WY?

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- C EGL002900 *Kobresia myosuroides* - *Thalictrum alpinum* Fen
- C EGL005661 *Glaux maritima* - *Poa secunda* Rich Fen
- C EGL002901 *Kobresia simpliciuscula* - *Trichophorum pumilum* Fen

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Cooper n.d., Faber-Langendoen et al. 2017b

2.C.4. Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland

Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland includes wet riparian and swamp shrublands, wet meadows, wet prairies, and shallow and deep emergent marshes. The vegetation comprises seasonal green emergent, hydrophytic shrubs and herbs with at least 10% cover, on mucky, inundated or saturated soils across the mid-latitudes of the Northern and Southern hemispheres from 23° to 70°.

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

This division contains marshes, wet meadows and shrublands, singly and in mosaics, along riparian corridors, around vernal pools, depressions, seeps and springs on mineral soils or shallow organic layers over mineral substrates in temperate (and possibly southern boreal) latitudes of western North America.

M888. Arid West Interior Freshwater Marsh

These arid west freshwater marshes are found at all elevations below alpine throughout the interior basins and mountains of western North America, with dominant species such *Carex pellita*, *Carex praegracilis*, *Eleocharis palustris*, *Juncus arcticus ssp. littoralis*, *Paspalum distichum*, *Schoenoplectus americanus*, *Schoenoplectus pungens*, *Typha domingensis*, *Typha latifolia*, and species of *Bidens*, *Cicuta*, *Cyperus*, *Mimulus*, and *Phalaris*.

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

2.C.4.Nb.1.a. M888 Arid West Interior Freshwater Marsh

G531. Arid West Interior Freshwater Marsh

Type Concept Sentence: These arid west freshwater marshes are found at all elevations below alpine throughout the western interior basins and mountains of western North America, with dominant species such as *Carex pellita*, *Carex praegracilis*, *Eleocharis palustris*, *Juncus arcticus ssp. littoralis*, *Paspalum distichum*, *Schoenoplectus americanus*, *Schoenoplectus pungens*, *Typha domingensis*, *Typha latifolia*, and species of *Bidens*, *Cicuta*, *Cyperus*, *Mimulus*, and *Phalaris*.

OVERVIEW

Scientific Name: *Schoenoplectus* spp. - *Typha* spp. Interior Freshwater Marsh Group

Common Name (Translated Scientific Name): Clubrush species - Cattail species Interior Freshwater Marsh Group

Colloquial Name: Common Spikerush - Pale Spikerush Marsh

Type Concept: These arid west freshwater marshes are found at all elevations below timberline throughout the western interior basins and mountains of western North America. Vegetation is characterized by a lush, dense herbaceous layer with low diversity, sometimes occurring as a monoculture. Structure varies from emergent forbs which barely reach the water surface to tall graminoids that reach as tall as 4 m high. Dominant species include *Carex pellita* (= *Carex lanuginosa*), *Carex praegracilis*, *Eleocharis palustris*, *Juncus arcticus ssp. littoralis* (= *Juncus balticus*), *Paspalum distichum*, *Schoenoplectus americanus*, *Schoenoplectus pungens*, *Typha domingensis*, *Typha latifolia*, and species of *Bidens*, *Cicuta*, *Cyperus*, *Mimulus*, and *Phalaris*. This group includes shallow freshwater to brackish waterbodies found in bottomlands along drainages, in river floodplain depressions, cienegas, oxbow lakes, below seeps, frequently flooded gravel bars, low-lying sidebars, in-fill side channels, small ponds, stockponds, ditches and slow-moving streams, perennial streams in valleys and mountain foothills, as well as in small depressions gouged into basalt by Pleistocene floods, channeled scablands of the Columbia Plateau and within dune fields in the intermountain western U.S. These wetlands are mostly small-patch, confined to limited areas in suitable floodplain or basin topography. They are mostly semipermanently flooded, but some marshes have seasonal hydrologic flooding. Water is on or above the surface for most of the growing season. A consistent source of freshwater is essential to the function of these communities. Soils are muck or mineral or muck over a mineral soil, and water is high-nutrient. It is often found along the borders of ponds, lakes or reservoirs that have more open water. Some occurrences are interdunal wetlands in wind deflation areas, where sands are scoured down to the water table. The water table may be perched over an impermeable layer of caliche or clay or, in the case of the Great Sand Dunes of Colorado, a geologic dike that creates a closed basin that traps water.

Classification Comments: This group does not include oceanic saline-influenced tidal areas (coastal saline marshes and brackish marshes) which belong to Temperate Pacific Salt Marsh Group (G499). Marshes in saline waters located at the edge of the Great Salt Lake are included in North American Desert Alkaline-Saline Marsh & Playa Group (G538).

Similar NVC Types:

- G521 Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh
- G524 Western North American Ruderal Marsh, Wet Meadow & Shrubland
- G538 North American Desert Alkaline-Saline Marsh & Playa
- G544 Western North American Temperate Freshwater Aquatic Vegetation

Diagnostic Characteristics: Temperate continental, permanently saturated to seasonally flooded wetlands, often with standing water for much of the year, dominated by emergent graminoid herbaceous vegetation. Characteristic dominant species include *Typha* spp., *Schoenoplectus* spp., *Eleocharis palustris*, *Carex praegracilis*, *Carex pellita*, and *Cyperus* spp.

VEGETATION

Physiognomy and Structure: Vegetation is characterized by a lush, dense to open emergent herbaceous layer. The emergent vegetation is characterized by graminoids, annual or perennial forbs or a mixture of all three. Heights varies from low forbs that barely breaking the water surface to tall graminoids up to 4 m high. Sites are permanently or seasonally inundated which prevents the establishment of woody species. Ponds typically have concentric rings or zones of vegetation.

Floristics: These arid west interior marshes are dominated by emergent herbaceous species, mostly graminoids (*Carex*, *Scirpus* and/or *Schoenoplectus*, *Eleocharis*, *Juncus*, *Typha*,) but also some forbs. Stands vary in diversity, with some stands occurring as a monoculture of one of the dominant genera. Dominant species include *Carex pellita* (= *Carex lanuginosa*), *Carex praegracilis*, *Eleocharis palustris*, *Juncus arcticus* ssp. *littoralis* (= *Juncus balticus*), *Paspalum distichum*, *Schoenoplectus americanus*, *Schoenoplectus pungens*, *Typha domingensis*, *Typha latifolia*, and species of *Bidens*, *Cicuta*, *Cyperus*, *Mimulus*, and *Phalaris*.

ENVIRONMENT & DYNAMICS

Environmental Description: *Climate:* Temperate Continental climate. Environmental settings include bottomlands along drainages, in river floodplain depressions, cienegas, oxbow lakes, below seeps, frequently flooded gravel bars, low-lying sidebars, infilled side channels, small ponds, stockponds, ditches and slow-moving streams, perennial streams in valleys and mountain foothills. Elevations range from 890 to 1560 m (2930-5120 feet). *Soil/substrate/hydrology:* Substrates are variable but are generally fine-textured, alkaline, alluvial soil, coarse loam, sandy loam, sand, silt or peat. Hydrologic regimes vary from seasonal inundation followed by complete soil desiccation to year-round standing water. Water may be poorly oxygenated and nitrogen-rich. They are mostly semipermanently flooded, but some marshes have seasonal hydrologic flooding. Water is at or above the surface for most of the growing season. A consistent source of freshwater is essential to the function of these systems. Soils are muck or mineral or muck over a mineral soil, and water is high-nutrient. Environmental information compiled from Bowers (1982, 1984, 1986), Banner et al. (1986, 1993), Lloyd et al. (1990), MacKinnon et al. (1990), Cooper and Severn (1992), Viereck et al. (1992), Shiflet (1994), Holland and Keil (1995), Shephard (1995), Steen and Coupe (1997), Hammond (1998), Pineada et al. (1999), Boggs (2000), Pineda (2000), Rondeau (2001), Brand and Sanderson (2002), and Chappell and Christy (2004).

Dynamics: Sites are depressions, ponds, springs, and riparian areas that are heavily inundated for at least part of the growing season which impedes the establishment of woody species. Isolated marshes in dune systems are subject to changes in size and location of the wet swales as the sand dunes shift, due to active dune migration. Dune "blowouts" and subsequent stabilization through succession are characteristic processes of the active dunes which surround the interdunal swales.

DISTRIBUTION

Geographic Range: This group is found throughout the temperate western North America interior (Columbia Basin, Great Basin, Colorado Plateau, and higher intermountain basins of western North America). It is also known to occur in dune fields across the intermountain western U.S., including the Great Sand Dunes in southern Colorado and the Pink Coral Dunes in Utah, and may also occur in dune fields in northeastern Arizona and the Great Basin, as well as in southwestern Wyoming in the Killpecker Dunes and Ferris Dunes, and southern Idaho.

Spatial Scale & Pattern [optional]: Small patch

Nations: CA, MX, US

States/Provinces: AZ, BC, CA, CO, ID, KS, NM, NV, OK, OR, SD, TX, UT, WA, WY

TNC Ecoregions [optional]: 1:C, 2:C, 3:C, 4:C, 6:C, 10:C, 11:C, 12:C, 13:C, 14:C, 15:C, 16:C, 19:C, 20:C, 22:C, 23:C, 24:C, 28:C, 68:C, 69:C, 70:C, 81:C

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- < III.A.3.d - Fresh sedge marsh (Viereck et al. 1992)
- < III.B.3.a - Fresh herb marsh (Viereck et al. 1992)
- < Wetlands (217) (Shiflet 1994)

LOWER LEVEL UNITS

Alliances:

- A3891 *Eleocharis palustris* - *Eleocharis macrostachya* Marsh Alliance
- A3894 *Paspalum distichum* Marsh Alliance
- A3895 *Schoenoplectus americanus* - *Schoenoplectus acutus* - *Schoenoplectus californicus* Marsh Alliance
- A3896 *Typha domingensis* - *Typha latifolia* - *Phragmites australis* ssp. *americanus* Western Marsh Alliance
- A3892 *Equisetum fluviatile* - *Equisetum x ferrissii* Marsh Alliance

AUTHORSHIP

Primary Concept Source: C. Chappell, R. Crawford, K.A. Schulz, in D. Faber-Langendoen et al. (2011)

Author of Description: M.E. Hall, G. Kittel and J. Christy

Acknowledgments: J. Christy

Version Date: 12/02/2015

Classif Resp Region: West

Internal Author: MEH 10-10, mod. GK 9-13, 12-15

REFERENCES

References: Banner et al. 1986, Banner et al. 1993, Bezanson 2000, Boggs 2000, Bowers 1982, Bowers 1984, Bowers 1986, Brand and Sanderson 2002, Brown 1982a, Carr 1991, Carr 2004, Chappell and Christy 2004, Comer et al. 2003, Cooper and Severn 1992, Crowe et al. 2004, Dick-Peddie 1993, El-Hage and Moulton 1998, Faber-Langendoen et al. 2017a, Hammond 1998, Hendrickson and Minckley 1984, Holland and Keil 1995, Jahrsdoerfer and Leslie 1988, Lloyd et al. 1990, MacKinnon et al. 1990, Muldavin et al. 1994b, Muldavin et al. 2000a, Muldavin et al. 2000b, Pineda 2000, Pineda et al. 1999, Rodriguez et al. 2017, Rondeau 2001, Shephard 1995, Shiflet 1994, Steen and Coupé 1997, Szaro 1989, TPWD 1989d, Ungar 1965, Ungar 1972, Viereck et al. 1992

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G531. Arid West Interior Freshwater Marsh

A3891. *Eleocharis palustris* - *Eleocharis macrostachya* Marsh Alliance

Type Concept Sentence: This herbaceous wetland alliance is dominated or codominated by *Eleocharis palustris* and/or *Eleocharis macrostachya*, and occurs in shallow, mostly still water throughout much of the western United States and into northern Mexico, from sea level to upper montane altitudes. Stands occur on a variety of landforms, including lake margins, stream terraces, floodplains, gravel bars, and around springs or wet basins (cienegas).

OVERVIEW

Scientific Name: *Eleocharis palustris* - *Eleocharis macrostachya* Marsh Alliance

Common Name (Translated Scientific Name): Common Spikerush - Pale Spikerush Marsh Alliance

Colloquial Name: Common Spikerush - Pale Spikerush Marsh

Type Concept: This herbaceous wetland alliance is characterized by an herbaceous layer that is dominated or codominated by *Eleocharis palustris* and/or *Eleocharis macrostachya*. Associates include *Carex praegracilis*, *Deschampsia cespitosa*, *Distichlis spicata*, *Juncus arcticus* ssp. *littoralis* (= *Juncus balticus*), *Muhlenbergia asperifolia*, *Panicum virgatum*, *Phalaris arundinacea* (= *Phalaroides arundinacea*), and *Spartina pectinata*. Forb cover is also variable and may include *Berula erecta*, *Caltha leptosepala*, *Iris missouriensis*, *Lemna* spp., *Mentha arvensis*, *Pedicularis groenlandica*, *Potamogeton* spp., *Ranunculus cymbalaria*, *Rhodiola integrifolia*, *Nasturtium officinale* (= *Rorippa nasturtium-aquaticum*), *Rumex crispus*, and *Sparganium angustifolium*. Stands occur in shallow, mostly still water throughout much of the western United States and into northern Mexico, from sea level to upper montane altitudes. Stands occur on a variety of landforms, including lake margins, stream terraces, floodplains, gravel bars, and around springs or wet basins (cienegas).

Classification Comments: This alliance is primarily a freshwater alliance, although some stands may become brackish as ponds dry.

Internal Comments:

Other Comments:

Similar NVC Types:

- A4177 *Eleocharis macrostachya* Vernal Pool Alliance

Diagnostic Characteristics: Diagnostic of this herbaceous wetland alliance is the dominance or codominance of *Eleocharis palustris* and/or *Eleocharis macrostachya* and the presence of surface water for extended periods during the growing season.

VEGETATION

Physiognomy and Structure: This alliance is characterized by a rhizomatous perennial that dominates the graminoid stratum (up to 70% cover). The forb layer is sparse (0-20%) and contains both aquatic and terrestrial species.

Floristics: Associations within this alliance are dominated by *Eleocharis palustris* and/or *Eleocharis macrostachya*. Cover ranges from sparse to quite dense (10-80%). *Distichlis spicata* and *Muhlenbergia asperifolia* codominate the graminoid layer in cienegas (Arizona and New Mexico). Forb cover is composed of *Berula erecta* and *Nasturtium officinale* (= *Rorippa nasturtium-aquaticum*), especially in stands with deep water (Cross 1991). At higher montane elevations, other graminoids present include *Carex aquatilis*, *Carex buxbaumii*, *Carex utriculata*, *Deschampsia cespitosa*, and *Eleocharis rostellata*. Forb cover is typically low, but can be up to 25% in some stands. Common forb species include *Caltha leptosepala*, *Pedicularis groenlandica*, and *Rhodiola integrifolia* (Hansen et al. 1995, Kittel et al. 1999a). Crowe and Clausnitzer (1997) state that *Eleocharis palustris* is an aggressive species, typically excluding

other species from establishing. In Oregon stands, associated forbs include *Iris missouriensis*, *Mentha arvensis*, *Ranunculus cymbalaria*, and *Rumex crispus*.

In California, forb cover can be quite high, and a mixture of forbs will infrequently dominate the community. However, it is the cover of *Eleocharis*, which typically exceeds 50%, that distinguishes this community from others with high forb cover. Forbs present include *Berula erecta*, *Centaurea solstitialis*, *Euthamia occidentalis*, *Hydrocotyle umbellata*, *Melilotus indicus*, *Mentha arvensis*, *Mimulus guttatus*, *Perideridia parishii*, *Polygonum bistortoides*, *Pseudognaphalium canescens ssp. beneolens* (= *Gnaphalium canescens ssp. beneolens*), *Ranunculus californicus*, *Nasturtium officinale*, *Sonchus asper* (= *ssp. asper*), *Stachys pycnantha*, *Symphotrichum spathulatum* (= *Aster occidentalis*), *Trifolium wormskioldii*, and *Urtica dioica ssp. holosericea*. In vernal pools and other seasonally flooded wetlands, other forbs include *Eryngium castrense* and/or *Eryngium vaseyi*, *Juncus* sp., *Plagiobothrys stipitatus* var. *micranthus*, and *Psilocarphus brevissimus* var. *brevissimus*. Graminoids present include the characteristic *Eleocharis macrostachya*, with *Aira caryophyllea*, *Bromus arenarius*, *Bromus hordeaceus*, *Carex barbarae*, *Carex nebrascensis*, *Carex* spp., *Eleocharis acicularis*, *Eleocharis rostellata*, *Juncus bufonius*, *Juncus effusus* var. *pacificus*, *Juncus nevadensis*, *Lemna minor*, *Lolium perenne ssp. multiflorum* (= *Lolium multiflorum*), *Polypogon monspeliensis*, *Schoenoplectus americanus* (= *Scirpus americanus*), and *Vulpia myuros*.

ENVIRONMENT & DYNAMICS

Environmental Description: Elevation ranges from sea level in California to 3050 m in Colorado. Stands occur on a variety of landforms, including lake margins, stream terraces, floodplains, gravel bars, and wet basins (cienegas) or meadows. Stands occur on sites that are flat, 1% slope with all aspects (Crowe and Clausnitzer 1997). Most sites are permanently flooded or permanently saturated, but occasionally they can be seasonally saturated or seasonally flooded. Water is characteristically supplied from surface sheeting or subsurface flows originating upstream or upslope from the site. Soils vary from Histosols to Entisols. High-elevation stands consistently occur on organic (highly sapric) soils, or on a thick organic horizon that overlays fine to coarse alluvial material. Lower elevation stands occur on fresh alluvial deposits of fine-textured loamy sands, clays, and sandy clays (Kittel et al. 1999a). Soil reaction is often alkaline (Hansen et al. 1988). All sites are saturated throughout much of the growing season. Oregon stands are located on soils derived from volcanic (andesite, basalt) or sedimentary parent materials (Crowe and Clausnitzer 1997).

At higher elevation, *Carex aquatilis* or *Carex utriculata* meadows and *Salix wolfii* or *Salix planifolia* shrublands occur within the riparian mosaic. At lower elevation, *Schoenoplectus pungens* often occurs within the stream channel while wet meadow prairies of *Panicum virgatum* and *Sorghastrum nutans* occupy the immediate streambanks and low floodplains.

Dynamics: At lower elevation, *Eleocharis palustris* plant associations occur well within the active channel and are inundated annually. These early-seral communities colonize backwater eddies and shallow edges of slow-moving reaches of small and larger rivers. The stands are probably ephemeral, as the eddies and river edges are scoured out each year during high spring flows (Kittel et al. 1999a). These communities have also been described as early-seral stages by Padgett et al. (1989), who describe light-colored soils for the sites, indicating an early phase of soil development. Kovalchik (1987) reports that the lower elevation plant associations within this alliance frequently form seral communities in ponded sites between stream rehabilitation structures such as loose rock check dams. In the montane zone, associations within this alliance occur in ponded sites on faster moving streams. If siltation occurs, sites may become dominated by *Carex utriculata*. At higher elevations, the associations appear to be stable. Stands occur near seeps on soils with deep organic layers, often sapric, and are saturated throughout the growing season.

Crowe and Clausnitzer (1997) state that *Eleocharis palustris* is of little to no forage value to livestock and wild ungulates. On seasonally drier sites, ungulate trampling may cause this species to increase (Snyder 1992 as cited in Crowe and Clausnitzer 1997). However, this species does provide seed forage and cover to ducks and geese (Kovalchik 1987).

DISTRIBUTION

Geographic Range: This alliance is found in eastern Oregon and Washington, northeastern California, in the Sierra Nevada, Nevada, Idaho, Montana, Wyoming, Colorado, Utah, Arizona and New Mexico, and into northern Mexico.

Nations: MX, US

States/Provinces: AZ, CA, CO, ID, MT, MXSO, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- ? *Carex* spp. Series (Johnston 1987)
- ? *Eleocharis macrostachya* (Pale spike rush marshes) Alliance (Sawyer et al. 2009) [45.230.00]
- ? *Eleocharis macrostachya* Herbaceous Alliance (CNPS 2017) [45.230.00]

- ? Montane, Plains, and Great Basin Marshlands (Brown 1982a)

LOWER LEVEL UNITS

Associations:

- CEGLO02634 *Eleocharis palustris* - *Carex praegracilis* - *Berula erecta* Marsh
- CEGLO05662 *Carex atherodes* Interior West Wet Meadow

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel, D. Culver, and M.J. Russo

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Baker 1983c, Baker and Kennedy 1985, Brotherson 1987, Brotherson and Barnes 1984, Brown 1982a, Bunin 1985, CNPS 2017, Cronquist et al. 1977, Cross 1991, Crowe and Clausnitzer 1997, Durkin et al. 1995a, Ellis et al. 1979, Faber-Langendoen et al. 2017b, Flowers 1962, Hall and Hansen 1997, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Hendrickson and Minckley 1984, Johnston 1987, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999a, Kovalchik 1987, Kovalchik 1993, Manning and Padgett 1995, Muldavin et al. 2000a, Mutel 1973, Mutel and Marr 1973, Padgett et al. 1988b, Padgett et al. 1989, Ramaley 1919a, Ramaley 1942, Reid et al. 1994, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shupe et al. 1986, Stearns-Roger, Inc. 1978, Stewart 1940, Sturges 1968, Youngblood et al. 1985a

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G531. Arid West Interior Freshwater Marsh

A3892. *Equisetum fluviatile* - *Equisetum x ferrissii* Marsh Alliance

Type Concept Sentence: This alliance contains marshes dominated by emergent *Equisetum fluviatile*, *Equisetum laevigatum*, and/or *Equisetum x ferrissii* all of which can form monotypic stands. The water is shallow (<1 m) over mineral soils, usually sand/or silt, along wave-washed shores and stream channels of the western U.S. and Canada.

OVERVIEW

Scientific Name: *Equisetum fluviatile* - *Equisetum x ferrissii* Marsh Alliance

Common Name (Translated Scientific Name): Water Horsetail - Ferriss' Horsetail Marsh Alliance

Colloquial Name: Western Horsetail Marsh

Type Concept: This herbaceous alliance of shallow emergent marshes is dominated by *Equisetum fluviatile*, *Equisetum laevigatum*, and/or *Equisetum x ferrissii* as the most abundant species, which can form monotypic stands. In mixed stands, the graminoids *Agrostis gigantea*, *Alopecurus aequalis*, *Carex aquatilis*, *Carex rostrata*, *Carex utriculata*, *Eleocharis palustris* (= *Eleocharis smallii*), *Glyceria grandis*, *Juncus arcticus* ssp. *littoralis* (= *Juncus balticus*), *Muhlenbergia asperifolia*, *Scirpus* and/or *Schoenoplectus* spp., and the forbs *Bidens cernua*, *Epilobium leptophyllum*, *Galium trifidum*, *Mentha arvensis*, and *Scutellaria galericulata* may be present. Ponds are shallow (<1 m in depth), over mineral soils, usually sand or silt, located along wave-washed shores or lakes or stream channels, including the tidal reaches of the Columbia River. The water is nearly fresh with a very low salt content. In Montana, British Columbia and Alberta, stands occur in still water and on wet ground along the margins of ponds or protected bays in lakes and backwater areas of streams.

Classification Comments:

Internal Comments: MSR 1-17: AK removed. One of the associations in this alliance is probably very broad, and needs splitting.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Stands dominated by *Equisetum fluviatile*, *Equisetum laevigatum*, and/or *Equisetum x ferrissii*.

VEGETATION

Physiognomy and Structure: This alliance is characterized by a moderate to dense cover of emergent graminoids. The graminoids are rhizomatous perennials and the majority are less than 1 m in height. Few forb species are present.

Floristics: This herbaceous alliance contains stands dominated by *Equisetum fluviatile*, *Equisetum laevigatum*, and/or *Equisetum x ferrissii* as the most abundant species, which may form monotypic stands. In mixed stands, the graminoids *Agrostis gigantea*,

Alopecurus aequalis, *Carex aquatilis*, *Carex rostrata*, *Carex utriculata*, *Eleocharis palustris* (= *Eleocharis smallii*), *Glyceria grandis*, *Juncus balticus*, *Muhlenbergia asperifolia*, *Scirpus* and/or *Schoenoplectus* spp., and the forbs *Bidens cernua*, *Cirsium arvense*, *Epilobium leptophyllum*, *Galium trifidum*, *Mentha arvensis*, *Plantago lanceolata*, *Scutellaria galericulata*, and *Tragopogon dubius* may be present.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands are typically found in shallow (<1 m) water over mineral soils, usually sand or silt. Stands are often located along wave-washed shores and stream channels (Harris et al. 1996), along the tidal reaches of the Columbia River, in still water and wet ground along the margins of ponds or protected bays in lakes and backwater areas of streams (Hansen et al. 1995), or within narrow valley floors and low alluvial terraces of small perennial streams subject to periodic scouring from flooding. Elevations range from sea level to 1785 m (0-5855 feet), slopes generally do not exceed 8%, and aspect varies. Soils are alluvium derived from shales, sandstones or igneous rocks. The soil surface may be bare if flooding has occurred recently, or covered by a mat of older *Equisetum* stems. The water is nearly fresh with a very low salt content (Kunze 1994).

Dynamics: Clonal growth by means of rhizomes is a feature of the genus *Equisetum* and is very important to its ability to utilize groundwater and tolerate disturbance. A single rhizome system may cover hundreds of square feet (Hauke 1993). The rhizomes can penetrate to soil depths of 4 m in some circumstances (Page 1997). This deep rhizome growth gives the plants the ability to survive environmental disturbances such as plowing, burial, flooding, fire, and drought. *Equisetum* species have a remarkable ability to reproduce vegetatively. An extensive rhizome system allows *Equisetum* species to rapidly colonize disturbed areas (Hauke 1993). This ability gives *Equisetum* a distinct advantage over species requiring seed establishment or which have slow-growing rhizomes. The ability of *Equisetum* to survive and spread in areas of heavy sediment accumulation was dramatically demonstrated after the eruption of Mount St. Helens in 1980 when *Equisetum* formed almost monotypic stands in the newly deposited tephra (Rothwell 1996). The deep rhizome system of *Equisetum* also allows these plants to survive fire and rapidly recolonize burned-over sites (Sullivan 1993). It is probable that the vigorous and extensive rhizomatous habit of *Equisetum* has been very important to the long-term survival and spread of the genus (Hauke 1993). Fragmentation of rhizomes and stems allows *Equisetum* to disperse readily in suitable habitats where there is sufficient moisture. Even the aerial stem fragments can sprout and form new colonies (Wagner and Hammitt 1970). Hence, vegetative reproduction allows *Equisetum* clones to persist and spread even in the absence of sexual reproduction (Hauke 1993).

DISTRIBUTION

Geographic Range: This alliance occurs throughout the western U.S. and Canada.

Nations: CA, US

States/Provinces: AB, AZ, BC, ID, MT, OR, WA

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- ? Herbaceous and Sedge Wetlands (Chappell et al. 1997)
- >< Marsh: Spikerush - Water Horsetail: Mineral Substrate type (W6) (Harris et al. 1996)

LOWER LEVEL UNITS

Associations:

- CEGLO02746 *Equisetum fluviatile* Marsh
- CEGLO05394 *Equisetum x ferrissii* Marsh

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel, M. Damm, L. Allen, J. Coles, M. Reid

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Bursik and Moseley 1995, Chappell et al. 1997, Christy 1991, Faber-Langendoen et al. 1996, Faber-Langendoen et al. 2017b, Hansen et al. 1991, Hansen et al. 1995, Harris et al. 1996, Hauke 1993, Hitchcock et al. 1977a, Kovalchik 1993, Kunze 1994, MacKenzie and Moran 2004, Page 1977, Rothwell 1996, Sullivan 1993a, Wagner and Hammitt 1970, Willoughby et al. 2004

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G531. Arid West Interior Freshwater Marsh

A3894. *Paspalum distichum* Marsh Alliance

Type Concept Sentence: This alliance consists of dense, nearly monotypic stands dominated by *Paspalum distichum*. These stands are found on mud or sand flats, moist places, marshes and ditches of low valleys of Oregon, Washington, Nevada and California.

OVERVIEW

Scientific Name: *Paspalum distichum* Marsh Alliance

Common Name (Translated Scientific Name): Knotgrass Marsh Alliance

Colloquial Name: Knotgrass Marsh

Type Concept: This alliance consists of dense, nearly monotypic stands dominated by *Paspalum distichum*. Sites are on mud or sand flats, moist places, marshes and ditches that are flooded seasonally but dry out in summer while water tables are not far below the soil surface. Most occurrences are known from the Willamette Valley, the Columbia River floodplain and lowlands of California and Nevada.

Classification Comments:

Internal Comments: GK 4-14: Should this be in G525 Temperate Pacific Freshwater Wet Mudflat? It seems to occur in more than just mudflat situations. In addition, more information is needed on this alliance, especially about its diversity and where this association occurs.

Other Comments:**Similar NVC Types:**

Diagnostic Characteristics: Concentric rings of wet to drying vegetation around ponds and marshes dominated by *Paspalum distichum*.

VEGETATION

Physiognomy and Structure: Rhizomatous perennial graminoid growing in dense mats from 0.2 to 0.6 m (7-20 inches) tall.

Floristics: This alliance consists of dense, nearly monotypic stands dominated by *Paspalum distichum*.

ENVIRONMENT & DYNAMICS

Environmental Description: Sites are on mud or sand flats, moist places, marshes and ditches that are flooded seasonally but dry out in summer while water tables are not far below the soil surface.

Dynamics:**DISTRIBUTION**

Geographic Range: Most occurrences are known from the Willamette Valley of Oregon, the Columbia River floodplain of Washington, and lowlands of California and Nevada.

Nations: US

States/Provinces: CA, NV?, OR, WA

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY**LOWER LEVEL UNITS****Associations:**

- CEG003320 *Paspalum distichum* Marsh

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Faber-Langendoen et al. 2017b

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G531. Arid West Interior Freshwater Marsh

A3895. *Schoenoplectus americanus* - *Schoenoplectus acutus* - *Schoenoplectus californicus* Marsh Alliance

Type Concept Sentence: This alliance covers western freshwater marshes where the most abundant species are *Schoenoplectus acutus*, *Schoenoplectus americanus*, *Schoenoplectus californicus*, *Bolboschoenus fluviatilis*, *Bolboschoenus maritimus*, *Schoenoplectus pungens*, *Schoenoplectus tabernaemontani*, and/or *Scirpus microcarpus*. Stands are found throughout the central midwestern and western U.S. and Canada on sites flooded (on average 1 m deep) for most of the growing season.

OVERVIEW

Scientific Name: *Schoenoplectus americanus* - *Schoenoplectus acutus* - *Schoenoplectus californicus* Marsh Alliance

Common Name (Translated Scientific Name): Chairmaker's Bulrush - Hardstem Bulrush - California Bulrush Marsh Alliance

Colloquial Name: Western Emergent Bulrush Marsh

Type Concept: This alliance contains freshwater marshes dominated by one or two species of *Schoenoplectus*, *Scirpus*, and/or *Bolboschoenus*, such as *Schoenoplectus acutus* (= *Scirpus acutus*), *Schoenoplectus americanus*, *Bolboschoenus fluviatilis* (= *Scirpus fluviatilis*), *Bolboschoenus maritimus* (= *Scirpus maritimus*), *Schoenoplectus pungens* (= *Scirpus pungens*), *Schoenoplectus tabernaemontani* (= *Scirpus tabernaemontani*), and/or *Scirpus microcarpus*. *Phragmites australis* may be present. This alliance occurs throughout the central midwestern and western U.S. and Canada. Stands are flooded for most of the growing season up to 1.5 m deep and often drain completely in the winter, exposing bare ground.

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

- A3896 *Typha domingensis* - *Typha latifolia* - *Phragmites australis* ssp. *americanus* Western Marsh Alliance: can have stands codominated with *Schoenoplectus* or *Scirpus*, but the characteristic dominant is *Typha*.
- A3903 *Bolboschoenus maritimus* - *Schoenoplectus californicus* Salt Marsh Alliance: includes tidal coastal salt marshes of the western Pacific coast.

Diagnostic Characteristics: Stands of emergent vegetation in shallow water (<2 m) dominated by *Bolboschoenus*, *Scirpus* spp. and/or *Schoenoplectus* spp.

VEGETATION

Physiognomy and Structure: Vegetation is characterized by medium to tall perennial graminoids which typically range from 1 m to over 2 m.

Floristics: The vegetation is moderately dense to dense. Stands are typically dominated by one or two species of *Bolboschoenus*, *Schoenoplectus*, and/or *Scirpus*, and often have several other species of graminoids and forbs that are much shorter in stature. Abundant species include *Phragmites australis*, *Schoenoplectus acutus* (= *Scirpus acutus*), *Schoenoplectus americanus*, *Bolboschoenus fluviatilis* (= *Scirpus fluviatilis*), *Bolboschoenus maritimus* (= *Scirpus maritimus*), *Schoenoplectus pungens* (= *Scirpus pungens*), *Schoenoplectus tabernaemontani* (= *Scirpus tabernaemontani*), and/or *Scirpus microcarpus*. Lower stature (and generally less abundant) species may include *Chenopodium incanum*, *Distichlis spicata* (on drier margins), *Monolepis nuttalliana*, *Picradeniopsis oppositifolia*, *Ruppia maritima*, *Suaeda calceoliformis*, amongst many others. Species composition and abundance can vary from year to year depending mostly on water level fluctuations and degree of salinity (which is generally mild). Floating aquatic species may also be present, such as *Lemna* spp. and *Utricularia macrorhiza*.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands of this alliance are flooded for most or all of the growing season and can have water levels from completely drained (exposed soil) to approximately 1.5 m deep, but are usually is less than 1 m. Within a stand, water levels can vary by up to 1 m during the year. The water is fresh to mildly saline. Some species are quite tolerant of saline conditions, but generally the salinity is mild or if strong than only seasonally so. Soils are deep, poorly drained muck, peat, or mineral.

Dynamics:**DISTRIBUTION**

Geographic Range: This alliance occurs throughout the central midwestern and western U.S. and Canada.

Nations: CA, US

States/Provinces: AB, AZ, BC, CA, CO, ID, KS, MT, ND, NM, NV, OK, OR, SD, TX, UT, WA, WY

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007): 322Ab:CCC, 341Fc:CCC, 341Fd:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > *Schoenoplectus acutus* (Hardstem bulrush marsh) Alliance (Sawyer et al. 2009) [52.122.00]
- > *Schoenoplectus acutus* Alliance (Hardstem bulrush marsh) (Buck-Diaz et al. 2012)
- > *Schoenoplectus americanus* Alliance (American bulrush marsh) (Buck-Diaz et al. 2012)
- > *Schoenoplectus americanus* Herbaceous Alliance (Evens et al. 2014)
- >< *Schoenoplectus californicus* (California bulrush marsh) Alliance (Sawyer et al. 2009) [52.114.00]
- > *Schoenoplectus californicus* Alliance (California bulrush marsh) (Buck-Diaz et al. 2012)
- > *Scirpus acutus-Scirpus californicus* Herbaceous Alliance (Keeler-Wolf and Evens 2006)
- >< *Scirpus microcarpus* (Small-fruited bulrush marsh) Alliance (Sawyer et al. 2009) [52.113.00]

LOWER LEVEL UNITS**Associations:**

- C EGL001587 *Schoenoplectus pungens* Marsh
- C EGL001843 *Bolboschoenus maritimus* Marsh
- C EGL001840 *Schoenoplectus acutus* Marsh
- C EGL003469 *Schoenoplectus californicus* - *Typha latifolia* Salt Marsh
- C EGL005988 *Schoenoplectus pungens* - *Distichlis spicata* Marsh
- C EGL004592 *Schoenoplectus americanus* - *Flaveria chlorifolia* - (*Helianthus paradoxus*) Marsh
- C EGL002623 *Schoenoplectus tabernaemontani* Temperate Marsh
- C EGL005989 *Schoenoplectus pungens* - *Paspalum distichum* Marsh
- C EGL001841 *Schoenoplectus americanus* Western Marsh
- C EGL001585 *Schoenoplectus americanus* - *Eleocharis palustris* Marsh

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel and M.S. Reid

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Bradley 1970, Buck-Diaz et al. 2012, Evens et al. 2014, Faber-Langendoen et al. 2017b, Keeler-Wolf and Evens 2006, Keeler-Wolf and Vaghti 2000, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Sproul et al. 2011, VegCAMP and AIS 2013

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G531. Arid West Interior Freshwater Marsh

A3896. *Typha domingensis* - *Typha latifolia* - *Phragmites australis* ssp. *americanus* Western Marsh Alliance

Type Concept Sentence: This native alliance contains freshwater cattail marshes dominated by *Typha domingensis*, *Typha latifolia*, and/or *Phragmites australis* ssp. *americanus*, which can be monotypic stands or codominated by bulrush species such as *Schoenoplectus acutus*, *Schoenoplectus americanus*, or *Schoenoplectus pungens*. It is found most commonly along lake margins and in shallow basins, and occasionally in river backwaters in the semi-arid western U.S., including the semi-arid western Great Plains, and adjacent Canada, and possibly Mexico.

OVERVIEW

Scientific Name: *Typha domingensis* - *Typha latifolia* - *Phragmites australis* ssp. *americanus* Western Marsh Alliance

Common Name (Translated Scientific Name): Southern Cattail - Broadleaf Cattail - American Common Reed Western Marsh Alliance

Colloquial Name: Western Emergent Cattail - Common Reed Marsh

Type Concept: This alliance contains stands dominated by native species *Typha angustifolia*, *Typha domingensis*, and/or *Phragmites australis* ssp. *americanus* either alone as monotypic stands or in combination with other tall emergent freshwater marsh species. Associated species vary widely; they include many sedges such as *Carex aquatilis*, *Carex pellita* (= *Carex lanuginosa*), *Carex rostrata*, bulrushes such as *Schoenoplectus acutus* (= *Scirpus acutus*), *Schoenoplectus americanus* (= *Scirpus americanus*), and *Schoenoplectus heterochaetus* (= *Scirpus heterochaetus*), and broad-leaved herbs such as *Asclepias incarnata*, *Impatiens capensis*, *Sagittaria latifolia*, *Scutellaria lateriflora*, *Sparganium eurycarpum*, and *Verbena hastata*. It is found most commonly along lake margins and in shallow basins, and occasionally in river backwaters and other deep water habitats of the semi-arid western U.S., including the semi-arid western Great Plains, and adjacent Canada and possibly Mexico.

Classification Comments: This association is limited to the western U.S. and adjacent Mexico and Canada and is intended to cover the native stands of *Typha* and/or *Phragmites australis* ssp. *americanus*. Compare with similar monotypic stands in central Great Plains and eastern U.S. alliances. *Typha angustifolia* is considered to be non-native in the western U.S. and was removed as a nominal species from this alliance and placed into a ruderal marsh alliance. Disturbed stands may have *Typha angustifolia* present to codominant; monotypic stands of *Typha angustifolia* would indicate conversion to a ruderal vegetation type.

Internal Comments: KAS 8-17: The distributions and concepts of this alliance and its group G531 *Schoenoplectus* spp. - *Typha* spp. Interior Freshwater Marsh Group need to be better distinguished between A3487 *Typha angustifolia* - *Typha latifolia* - *Schoenoplectus* spp. Marsh Alliance and group G325 *Typha* spp. - *Schoenoplectus americanus* - *Scolochloa festucacea* Great Plains Freshwater Marsh Group. Cascading effect on associations also needs to be addressed. MX? added. mjr 1-17: CNPS recommends a rank of G5/S5.

Other Comments:

Similar NVC Types:

- A3895 *Schoenoplectus americanus* - *Schoenoplectus acutus* - *Schoenoplectus californicus* Marsh Alliance: can have bulrush - cattail marshes, but bulrushes are the dominant taxa.

Diagnostic Characteristics: Stands of emergent vegetation in shallow water (<2 m) dominated by native *Phragmites australis* ssp. *americanus* and/or native *Typha domingensis* or *Typha latifolia*.

VEGETATION

Physiognomy and Structure: Tall, emergent graminoid species, with cover usually dense, and averaging over 2 m, but <3 m in height. Shorter graminoids and forbs may be present, but typically are not abundant due to the dense cover of the taller species. When there is standing water during the growing season, floating and submerged aquatic species may be present.

Floristics: This alliance is characterized by the dominance of *Phragmites australis* ssp. *americanus*, *Typha domingensis*, and/or *Typha latifolia*, either alone or in combination with other tall emergent marsh species. Other graminoids commonly present can include *Carex aquatilis*, *Carex pellita* (= *Carex lanuginosa*), *Carex rostrata*, *Cyperus* spp., *Distichlis spicata*, *Eleocharis* spp., *Glyceria* spp., *Juncus* spp., *Schoenoplectus acutus* (= *Scirpus acutus*), *Schoenoplectus americanus* (= *Scirpus americanus*), *Schoenoplectus heterochaetus* (= *Scirpus heterochaetus*), *Schoenoplectus pungens* (= *Scirpus pungens*), *Schoenoplectus tabernaemontani* (= *Scirpus tabernaemontani*), and *Setaria magna*. Forbs may include *Ambrosia psilostachya*, *Anemopsis californica*, *Asclepias incarnata*, *Epilobium ciliatum*, *Glycyrrhiza lepidota*, *Hibiscus moscheutos*, *Impatiens capensis*, *Iva axillaris*, *Mentha arvensis*, *Polygonum amphibium*, *Sagittaria latifolia*, *Scutellaria lateriflora*, *Sparganium eurycarpum*, *Thelypteris palustris*, *Verbena hastata*, and many others. Aquatic species such as *Bacopa eisenii*, *Lemna minor*, *Potamogeton* spp., and *Sagittaria* spp. may be present and dominate the water surface (Anderson 1982, MNNHP 1993, Hansen et al. 1995).

Vegetative diversity and density are highly variable in response to water depth, water chemistry, and natural forces. Vegetation in this alliance may be natural or semi-natural and includes mixed stands of the nominal species, as well as essentially

monospecific stands. *Typha* often occurs in pure stands, and can colonize areas recently exposed by either natural or human causes. These monospecific stands occur especially in artificial wetlands, such as borrow pits or ponds.

ENVIRONMENT & DYNAMICS

Environmental Description: These are palustrine and lacustrine non-tidal cattail marshes. Elevations range from near sea level to around 2000 m. Many have a muck-bottom zone bordering the shoreline, where cattails are rooted in the bottom substrate, and a floating mat zone, where the roots grow suspended in a buoyant peaty mat. This alliance occurs on hydric soils in wetlands, ditches, ponds, lakes, and rivers, as well as on shorelines and streambanks. Inundation is commonly 3-6 dm (1-2 feet) in depth but can be as deep as 1.5 m for a significant part of the growing season. Occurrences may display areas of open water, but emergent vegetation dominates (80% cover). Seasonal flooding during winter and spring or flooding during heavy rains help maintain these marshes by causing water exchange which replenishes freshwater and circulates nutrients and organic debris. Soils which support this community can be mineral or organic but are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. Sites can be inter-dune ponds, mainland ponds, impoundments and tanks with brackish water from storm flooding, storm tides, or island overwash, adjacent to shallow lakes or ponds (Bundy et al. 1996), in areas of standing water or subirrigation along major stream bottoms (Baker 1982b), or in old oxbows (Haase 1972). Running water is uncommon, except during periods of extensive irrigation runoff or because of high precipitation. Usually if the water table is below the surface, capillary action will keep the soil saturated to the surface. In Nevada, soils were described by Bundy et al. (1996) to be very deep, somewhat poorly drained and composed of fine-grained alluvium. They may be slightly saline, but not strongly so. *Typha domingensis* is more tolerant of alkaline conditions than *Typha latifolia*. Soils are characterized by accumulations of organic matter over deposits of fine silt and clay (Hansen et al. 1995), or loams, sandy loams, or coarse sand (Jones and Walford 1995, Bundy et al. 1996). *Typha* often occurs in pure stands, and can colonize areas recently exposed by either natural or human causes.

Dynamics: *Typha* species are prolific seed producers, spreading rapidly to become the early colonizers of wet mineral soil and will persist under wet conditions (Hansen et al. 1995). Roots and lower stems are well-adapted to prolonged submergence, but periods of draw-down are required for seed germination to occur (Hansen et al. 1995). Haase (1972) reported that *Typha domingensis* communities have expanded their distribution in the lower Gila River basin, due to increased irrigation runoff. *Typha angustifolia* occupies inundated and disturbed ground and can tolerate deeper water and higher alkalinity levels than *Typha latifolia* (Great Plains Flora Association 1986). These are important wetland communities for many species of birds and waterfowl. Hansen et al. (1995) report that in Montana heavy livestock use may convert stands to *Carex nebrascensis*-dominated communities.

DISTRIBUTION

Geographic Range: This alliance occurs throughout interior non-tidal marshes of the western U.S., including the semi-arid western Great Plains, and adjacent Canada, and possibly Mexico.

Nations: CA, MX?, US

States/Provinces: AB, AZ, BC, CA, CO, ID, MT, NE, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]: 4:C, 5:C, 6:C, 11:C, 12:C, 13:C, 14:C, 15:C, 16:C, 17:C, 23:C

USFS Ecoregions (2007): 261A:CC, 261B:CC, 262A:CC, 263A:CC, 322Ab:CCC, 322Al:CCC, 322B:CC, 322C:CC, 341D:CC, 341Fc:CCC, 342B:CC, M261A:CC, M261B:CC, M261C:CC, M261D:CC, M261E:CC, M261F:CC, M261G:CC, M262A:CC, M262B:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Channel Islands, Death Valley, Mojave); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = *Typha (angustifolia, domingensis, latifolia)* (Cattail marshes) Alliance (Sawyer et al. 2009) [52.050.00]
- = *Typha (angustifolia, domingensis, latifolia)* Alliance (Cattail marshes) (Buck-Diaz et al. 2012)
- = *Typha (angustifolia, domingensis, latifolia)* Herbaceous Alliance (Evens et al. 2014)
- = *Typha (angustifolia, latifolia)* - (*Scirpus* spp.) Semipermanently Flooded Herbaceous Alliance [Provisional] (Keeler-Wolf et al. 2012)
- = *Typha domingensis* - *Typha latifolia* - *Typha angustifolia* Western Herbaceous Emergent Alliance (Rodriguez et al. 2017)
- ? *Typha latifolia* Habitat Type (Hansen et al. 1995)
- = *Typha (angustifolia, domingensis, latifolia)* Herbaceous Alliance (CNPS 2017) [52.050.00]
- >> Bulrush-Cattail Series (Sawyer and Keeler-Wolf 1995)
- >> Cattail Series (Sawyer and Keeler-Wolf 1995)
- >> Cismontane Alkali Marsh (#52310) (Holland 1986b)
- >> Coastal Brackish Marsh (#52200) (Holland 1986b)
- >> Coastal and Valley Freshwater Marsh (#52410) (Holland 1986b)
- >> Montane Freshwater Marsh (#52430) (Holland 1986b)

- >< Transmontane Alkali Marsh (#52320) (Holland 1986b)
- >< Transmontane Freshwater Marsh (#52420) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEGLO02010 *Typha (latifolia, angustifolia)* Western Marsh
- CEGLO06866 *Phragmites australis ssp. americanus* Native Western Marsh
- CEGLO01845 *Typha domingensis* Western Marsh

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel, M.S. Reid and K.A. Schulz

Acknowledgments:

Version Date: 2017/08/14

REFERENCES

References: Apfelbaum 1985, Baker 1982b, Baker and Kennedy 1985, Buck-Diaz et al. 2012, Bundy et al. 1996, Bunin 1985, CNPS 2017, Christy 1973, Cronquist et al. 1977, DiTomaso and Healy 2007, Dilts and Weisberg 2010, Evens and Kentner 2006, Evens and San 2006, Evens et al. 2014, Faber-Langendoen et al. 2017b, Ferren et al. 1996b, Grace and Wetzel 1981, Great Plains Flora Association 1986, Haase 1972, Hansen et al. 1991, Hansen et al. 1995, Hickson and Keeler-Wolf 2007, Holland 1986b, Jones and Walford 1995, Junak et al. 2007, Keeler-Wolf and Evens 2006, Keeler-Wolf and Vaghti 2000, Keeler-Wolf et al. 2012, Kittel et al. 1996, Kittel et al. 1999a, Klein et al. 2007, Komarkova 1976, Komarkova 1986, Kovalchik 1993, Lambert et al. 2016, Lambertini 2016, Lindauer 1978, Lindauer and Christy 1972, MacDonald 1988, Masek 1979, McEachern 1979, Mitsch and Gosselink 1993, Muldavin et al. 1993b, Muldavin et al. 2000a, Padgett et al. 1989, Pickart 2006, Rocchio pers. comm., Rodriguez et al. 2017, Sada and Cooper 2012, Saltonstall 2002, Saltonstall et al. 2004, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Simkins 1931, Smith and Allred 2016, Sproul et al. 2011, TNC 1995b, Thorne 1982, VegCAMP and AIS 2013, Youngblood et al. 1985a, Zedler 1982

M075. Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland

This macrogroup contains montane to subalpine and alpine wet meadows, marshes and wet shrublands throughout the Rocky Mountains of the U.S. and Canada, the Sierra Nevada, and Intermountain cordillera. Dominant species include graminoids such as *Calamagrostis canadensis*, *Carex scopulorum*, *Carex utriculata*, *Glyceria striata*, forbs such as *Caltha leptosepala*, *Dodecatheon jeffreyi*, *Sibbaldia procumbens*, and shrub species such as, but not limited to, *Alnus incana*, *Betula occidentalis*, *Betula glandulosa*, and many *Salix* species.

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

2.C.4.Nb.2.a. M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland

G526. Rocky Mountain-Great Basin Lowland-Foothill Riparian Shrubland

Type Concept Sentence: This group consists of riparian shrublands dominated by low to tall shrubs such as *Acer glabrum*, *Artemisia* spp., *Cornus sericea*, *Crataegus* spp., *Dasiphora fruticosa ssp. floribunda*, *Forestiera pubescens*, *Oplopanax horridus*, *Philadelphus lewisii*, *Prunus virginiana*, *Rhus trilobata*, *Rosa* spp., *Salix* spp., *Shepherdia argentea*, and *Symphoricarpos* spp. They do not occur up in the mountains, but rather in between mountain valleys and lowlands of the Interior West.

OVERVIEW

Scientific Name: *Salix exigua* - *Crataegus* spp. - *Forestiera pubescens* Rocky Mountain-Great Basin Riparian Shrubland Group

Common Name (Translated Scientific Name): Narrowleaf Willow - Hawthorn species - Stretchberry Rocky Mountain-Great Basin Riparian Shrubland Group

Colloquial Name: Silver Sagebrush Wet Shrubland

Type Concept: These short to tall shrublands (0.5-5 m in height) occur along streams at and below lower treeline, that is, not up in the mountains, but in between mountain valleys and lowlands of the Interior West. Dominant shrubs include *Acer glabrum*, *Artemisia cana*, *Artemisia cana ssp. bolanderi*, *Artemisia cana ssp. viscidula*, *Artemisia tridentata ssp. tridentata*, *Cornus sericea*, *Crataegus douglasii*, *Crataegus rivularis*, *Dasiphora fruticosa ssp. floribunda*, *Forestiera pubescens*, *Oplopanax horridus*, *Philadelphus lewisii*, *Prunus virginiana*, *Rhus trilobata*, *Rosa nutkana*, *Rosa woodsii*, *Salix exigua*, *Salix irrorata*, *Salix melanopsis*, *Shepherdia argentea*, and *Symphoricarpos* spp. Herbaceous layers are often dominated by *Athyrium filix-femina*, *Carex flava* (= *Carex nevadensis*), *Carex* spp., *Elymus trachycaulus*, *Equisetum arvense*, *Deschampsia cespitosa*, *Festuca idahoensis*, *Galium triflorum*, *Glyceria striata*, *Gymnocarpium dryopteris*, *Heracleum maximum*, *Iris missouriensis*, *Juncus arcticus ssp. littoralis* (= *Juncus balticus*),

Juncus spp., *Leymus cinereus*, *Maianthemum stellatum*, *Muhlenbergia filiformis*, *Muhlenbergia richardsonis*, *Pascopyrum smithii*, *Poa cusickii*, and *Poa secunda* (= *Poa nevadensis*). Introduced forage species such as *Agrostis stolonifera*, *Poa pratensis*, *Phleum pratense*, and the invasive annual *Bromus tectorum* are often present in disturbed stands. Streams are permanent, intermittent and ephemeral. Stands occur in steep-sided canyons or in broad flat valleys. They can be large, wide occurrences on mid-channel islands in larger rivers or narrow bands on small, rocky canyon tributaries and well-drained benches. They also are typically found in backwater channels and other perennially wet but less scoured sites, such as floodplain swales and irrigation ditches, and they can occur in depressional wetlands and non-alkaline playas. Stands may also occur on upper benches away from active channel movement. Willow-dominated shrublands require flooding and bare gravels for reestablishment. Stands are maintained by annual flooding and hydric soils throughout the growing season. Sites are subject to temporary flooding during spring runoff. The water table is often just below the ground surface. Occurrences are found within the flood zone of rivers, on islands, sand or cobble bars, and immediate streambanks and upper benches, and occasionally on hillslope springs. This group occurs throughout the Rocky Mountain and Colorado Plateau regions from approximately 780 to 1850 m (2560-6000 feet) in elevation, around the edges and between the mountain ranges of the Great Basin and along the lower eastern slope of the Sierra Nevada at about 1220 m (4000 feet) in elevation, at lowland and montane elevations in the Columbia Plateau, on the periphery of the mountains surrounding the Columbia River Basin, and along major tributaries and the main stem of the Columbia at relatively low elevations. It also occurs in the foothills of the northern Rocky Mountains and the east slopes of the Cascades in the lower montane and foothill zones. Climate is generally semi-arid.

Classification Comments: This group represents a range of short to tall shrubs (0.5-5 m in height). This group also represents lower elevation and foothill elevations shrublands. Higher elevation shrublands belong to Western Montane-Subalpine Riparian & Seep Shrubland Group (G527).

Similar NVC Types:

- G322 Vancouverian Wet Shrubland
- G527 Western Montane-Subalpine Riparian & Seep Shrubland: includes riparian shrublands that occur at high elevations and are dominated by more montane species, for example *Salix monticola*.
- G545 Colorado Plateau Hanging Garden Seep
- G568 Great Plains Riverscours Vegetation
- G337 Great Plains Riparian Wet Meadow & Shrubland

Diagnostic Characteristics: Short to tall (0.5-5 m) riparian and wetland shrublands at foothill and lower elevations of the temperate interior West.

VEGETATION

Physiognomy and Structure: Wetland and mesic shrublands dominated by short to tall shrubs (0.5-5 m).

Floristics: Dominant shrubs include *Acer glabrum*, *Amelanchier alnifolia*, *Artemisia cana* ssp. *bolanderi*, *Artemisia cana* ssp. *viscidula*, *Artemisia cana*, *Artemisia tridentata* ssp. *tridentata*, *Cornus sericea*, *Crataegus douglasii*, *Crataegus rivularis*, *Dasiphora fruticosa* ssp. *floribunda*, *Forestiera pubescens*, *Oplopanax horridus*, *Philadelphus lewisii*, *Prunus virginiana*, *Rhus trilobata*, *Rosa nutkana*, *Rosa woodsii*, *Salix exigua* (= ssp. *exigua*), *Salix irrorata*, *Salix melanopsis*, *Shepherdia argentea*, and *Symphoricarpos* spp. Herbaceous layers are often dominated by *Athyrium filix-femina*, *Carex flava* (= *Carex nevadensis*), *Carex* spp., *Elymus trachycaulus*, *Equisetum arvense*, *Deschampsia cespitosa*, *Festuca idahoensis*, *Galium triflorum*, *Glyceria striata*, *Gymnocarpium dryopteris*, *Heracleum maximum*, *Iris missouriensis*, *Juncus arcticus* ssp. *littoralis* (= *Juncus balticus*), *Juncus* spp., *Leymus cinereus*, *Maianthemum stellatum*, *Muhlenbergia filiformis*, *Muhlenbergia richardsonis*, *Pascopyrum smithii*, *Poa cusickii*, and *Poa secunda* (= *Poa nevadensis*). Introduced forage species such as *Agrostis stolonifera*, *Poa pratensis*, *Phleum pratense*, and the invasive annual *Bromus tectorum* are often present in disturbed stands. Floristic information was compiled from the following sources: Daubenmire (1952), Johnson and Simon (1985), Kovalchik (1987, 1992), Hansen et al. (1989), Manning and Padgett (1989, 1995), Padgett et al. (1989), Szaro (1989), MacKinnon et al. (1990), Banner et al. (1993), Delong et al. (1993), Sawyer and Keeler-Wolf (1995), Walford (1996), Crowe and Clausnitzer (1997), Steen and Coupe (1997), Walford et al. (1997, 2001), Kittel et al. (1999b), Muldavin et al. (2000a), Delong (2003), MacKenzie and Moran (2004), and Sawyer et al. (2009).

ENVIRONMENT & DYNAMICS

Environmental Description: *Climate:* Climate is generally semi-arid continental with typically cold winters and hot summers. *Soil/substrate/hydrology:* These shrublands occur along all streams at and below lower treeline, that is, not up in the mountains, but in the between- mountain valleys and lowlands of the interior west. Streams are permanent, intermittent and ephemeral. Stands occur in steep-sided canyons or in broad flat valleys. They can be large, wide occurrences on mid-channel islands in larger rivers or narrow bands on small, rocky canyon tributaries and well-drained benches. They also are typically found in backwater channels and other perennially wet but less scoured sites, such as floodplain swales and irrigation ditches, and they can occur in depressional

wetlands and non-alkaline playas, on hillside seeps and springs. These shrublands require flooding and bare gravels for reestablishment. Willow-dominated stands are maintained by annual flooding and hydric soils throughout the growing season. Sites are subject to temporary flooding during spring runoff. The water table is often just below the ground surface. Occurrences are found within the flood zone of rivers, on islands, sand or cobble bars, immediate streambanks and upper benches. Soils are typically alluvial deposits of sand, clays, silts and cobbles that are highly stratified with depth due to flood scour and deposition. Highly stratified profiles consist of alternating layers of clay loam and organic material with coarser sand or thin layers of sandy loam over very coarse alluvium. Soils are fine-textured with organic material over coarser alluvium. Some soils are more developed due to a slightly more stable environment and greater input of organic matter. Environmental information was compiled from the following sources: Daubenmire (1952), Johnson and Simon (1985), Kovalchik (1987, 1992), Hansen et al. (1989), Manning and Padgett (1989, 1995), Padgett et al. (1989), Szaro (1989), MacKinnon et al. (1990), Banner et al. (1993), DeLong et al. (1993), Sawyer and Keeler-Wolf (1995), Walford (1996), Crowe and Clausnitzer (1997), Steen and Coupe (1997), Walford et al. (1997, 2001), Kittel et al. (1999b), Muldavin et al. (2000a), DeLong (2003), MacKenzie and Moran (2004), and Sawyer et al. (2009).

Dynamics: Willow-dominated associations are disturbance-driven systems that require flooding, scour and deposition for germination and maintenance. Livestock grazing is a major influence in altering structure, composition, and function of the community (Baker 1988, 1989a, Padgett et al. 1989).

DISTRIBUTION

Geographic Range: This group is found throughout the Rocky Mountain and Colorado Plateau regions from approximately 900 to 1850 m (3000-6000 feet) in elevation, in the mountain ranges of the Great Basin and along the eastern slope of the Sierra Nevada from about 1220 m (4000 feet) in elevation, at lowland and montane elevations in the Columbia Plateau, on the periphery of the mountains surrounding the Columbia River Basin, and along major tributaries and the main stem of the Columbia at relatively low elevations. It also occurs in the northern Rocky Mountains and the east slopes of the Cascades in the lower montane and foothill zones.

Spatial Scale & Pattern [optional]: Linear, Small patch

Nations: CA, US

States/Provinces: AB, AZ, BC, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]: 6:C, 7:C, 8:C, 9:C, 11:C, 12:C, 18:C, 19:C, 20:C, 25:C, 26:C, 68:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313D:CC, 315A:CC, 315H:CC, 321A:CC, 322A:CC, 331A:CC, 331B:CC, 331D:CC, 331F:CC, 331G:CC, 331H:CC, 331I:CC, 331J:CC, 331K:C?, 331N:CP, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342A:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M242D:CP, M261D:CC, M261E:CC, M261G:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M341A:CC, M341B:CC, M341C:CC, M341D:CC

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- >< Other Sagebrush Types (408) (Shiflet 1994) [Artemisia cana ssp. viscidula shrublands are included.]
- < Riparian (422) (Shiflet 1994)

LOWER LEVEL UNITS

Alliances:

- A3800 *Salix exigua* - *Salix irrorata* Shrubland Alliance
- A2557 *Artemisia cana* Wet Shrubland Alliance
- A3799 *Rhus trilobata* - *Crataegus rivularis* - *Forestiera pubescens* Shrubland Alliance

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2011)

Author of Description: G. Kittel

Acknowledgments: J. Nachlinger, K. Schulz, J. Kagan, M.S. Reid

Version Date: 12/02/2015

Classif Resp Region: West

Internal Author: GK 12-10, 9-13, 12-15, 7-16

REFERENCES

References: Baker 1988, Baker 1989a, Baker 1989b, Baker 1990, Banner et al. 1993, Barbour and Billings 1988, Carsey et al. 2003a, Crowe and Clausnitzer 1997, Daubenmire 1952, DeLong 2003, DeLong et al. 1993, Eyre 1980, Faber-Langendoen et al. 2017a, Hansen et al. 1988b, Hansen et al. 1989, Johnson and Simon 1985, Kittel et al. 1999b, Kovalchik 1987, Kovalchik 1993, MacKenzie and Moran 2004, MacKinnon et al. 1990, Manning and Padgett 1989, Manning and Padgett 1995, Muldavin et al. 2000a, Padgett et al. 1989, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994, Steen and Coupé 1997, Szaro 1989, Walford 1996, Walford et al. 1997, Walford et al. 2001

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
G526. Rocky Mountain-Great Basin Lowland-Foothill Riparian Shrubland

A2557. Artemisia cana Wet Shrubland Alliance

Type Concept Sentence: This alliance consists of stands dominated by *Artemisia cana ssp. viscidula* or *Artemisia cana ssp. bolanderi*. It occurs in relatively moist environments, including riparian areas, alkaline or saline playa lakes, and is found throughout the northern half of the Intermountain West.

OVERVIEW

Scientific Name: *Artemisia cana* Wet Shrubland Alliance

Common Name (Translated Scientific Name): Silver Sagebrush Wet Shrubland Alliance

Colloquial Name: Silver Sagebrush Wet Shrubland

Type Concept: This is an alliance of shrublands dominated by *Artemisia cana ssp. viscidula* or *Artemisia cana ssp. bolanderi* where the shrub layer ranges from 0.5-1.5 m tall and the canopy cover ranges from 10-60%. In most stands, *Artemisia cana ssp. viscidula* or *Artemisia cana ssp. bolanderi* is the only dominant shrub, although other shrubs can be present. Herbaceous cover can be abundant to very sparse, but perennial graminoids generally total less than 20% cover. Species include *Danthonia intermedia*, *Deschampsia cespitosa*, *Eleocharis palustris*, *Elymus elymoides*, *Festuca idahoensis*, *Festuca ovina*, *Festuca thurberi*, *Leymus cinereus*, *Muhlenbergia richardsonis*, *Poa cusickii*, and *Poa secunda* (= *Poa nevadensis*). It occurs in relatively moist environments, including riparian areas, alkaline or saline playa lakes. This alliance occurs throughout the northern half of the Intermountain West.

Classification Comments: Sites are subirrigated and are not always considered wet or riparian, but they are more moist than other upland sage types.

There are taxonomic problems with the subspecies of *Artemisia cana*. For example, according to Kartesz (1999), the subspecies *bolanderi* is not reported to occur in Oregon, but is reported to occur by the Oregon Natural Heritage Program. Thus, the distribution of this alliance is subject to change as updated information becomes available.

The relationship of this alliance to others dominated by *Artemisia cana* is unclear. The hydrological divisions in the *Artemisia cana* group are poorly distinguished, particularly in the literature. In montane and subalpine meadows and along riparian stringers of western mountain ranges, *Artemisia cana* communities are often the driest of the recognizable riparian habitats. This transitional position and the broad floodplains where these shrublands typically occur blur wetland/upland distinctions. Most of these riparian stands have been placed in the temporarily flooded alliance. Although these sites generally have seasonally saturated soils and shallow water tables, the frequency of flooding is probably highly variable.

Internal Comments:

Other Comments:

Similar NVC Types:

- A3200 *Artemisia cana ssp. bolanderi* - *Artemisia cana ssp. viscidula* Steppe & Shrubland Alliance

Diagnostic Characteristics: Valley bottom stands dominated by *Artemisia cana ssp. viscidula* or *Artemisia cana ssp. bolanderi*.

VEGETATION

Physiognomy and Structure: These are microphyllous evergreen shrublands, often with a well-developed graminoid layer. Shrubs can be widely spaced or close together. When widely spaced, robust bunch or rhizomatous grasses can dominate the understory. The graminoids may exceed the shrubs in height and total cover in the open stands.

Floristics: In most stands, *Artemisia cana ssp. viscidula* or *Artemisia cana ssp. bolanderi* will be the only dominant shrub. *Artemisia tridentata* is the most consistent associate shrub species across the range of this alliance. Other shrubs may be common, including *Artemisia frigida*, *Ericameria nauseosa* (= *Chrysothamnus nauseosus*), *Gutierrezia sarothrae*, *Purshia tridentata*, *Rosa woodsii*, *Symphoricarpos occidentalis*, or *Symphoricarpos oreophilus*. At higher elevations *Artemisia tridentata ssp. vaseyana* occasionally occurs, and in alkaline areas *Atriplex canescens*, *Ericameria nauseosa* (= *Chrysothamnus nauseosus*), or *Sarcobatus vermiculatus* may

be present. The herbaceous layer is usually well-represented, but bare ground may be common in particularly arid or disturbed stands. Important understory associates include *Achnatherum occidentale*, *Carex praegracilis*, *Danthonia intermedia*, *Deschampsia cespitosa*, *Distichlis spicata*, *Eleocharis palustris*, *Elymus caninus*, *Elymus elymoides*, *Elymus elymoides*, *Elymus trachycaulus*, *Festuca idahoensis*, *Festuca ovina*, *Festuca thurberi*, *Hesperostipa comata* (= *Stipa comata*), *Koeleria macrantha* (= *Koeleria nitida*), *Leymus cinereus*, *Muhlenbergia richardsonis*, *Nassella viridula*, *Pascopyrum smithii*, *Poa cusickii*, *Poa fendleriana ssp. fendleriana*, and *Poa secunda* (= *Poa nevadensis*). Common exotic associates include *Poa pratensis*, *Taraxacum officinale*, and *Agrostis stolonifera*. Among the forbs that are typically found are *Achillea millefolium*, *Arnica* spp., *Artemisia ludoviciana*, *Astragalus lentiginosus*, *Astragalus* spp., *Camissonia tanacetifolia*, *Cirsium foliosum*, *Conyza canadensis*, *Epilobium brachycarpum*, *Fragaria virginiana*, *Gnaphalium palustre*, *Hymenoxys hoopesii* (= *Helenium hoopesii*), *Linum perenne*, *Lupinus argenteus*, *Madia gracilis*, *Navarretia intertexta*, *Orthocarpus* spp., *Perideridia gairdneri ssp. borealis* (= *Perideridia montana*), *Polyctenium fremontii*, *Potentilla gracilis*, *Rorippa* spp., *Symphotrichum campestre* var. *bloomeri* (= *Aster campestris* var. *bloomeri*), *Trifolium gymnocarpon*, and/or *Trifolium* spp.

ENVIRONMENT & DYNAMICS

Environmental Description: These shrublands are found between 1000 and 3300 m (3280-10,800 feet) in elevation. Stands occur on soils with a seasonally high table along low-gradient streams, in broad valleys, and in and around playas (internally drained basins with seasonal flooding). At its highest elevations, this alliance can be found in upland situations where more favorable soil conditions exist. Precipitation varies across the range, from less than 25 cm in semi-arid basins of southeastern Oregon, to over 90 cm in moist meadow habitats of the northern Rocky Mountains. The alliance occurs as an upper terrace community along mountain streams, where soils are saturated in spring and water tables remain within 0.5 m (2 feet) of the soil surface in May and June, dropping to 1.2-1.6 m (4-5.5 feet) below the soil surface in July through September. Other stands occur in valley bottoms without an active surface stream, but with subsurface irrigation. They can also occur in perennially moist, semi-alkaline playa lakebeds above 1065 m. Playas can be flooded for several months during the winter and early spring but rapidly dry up as the weather warms. Topography is usually mild, soils are fine to somewhat coarse alluvial soils, and some source of subsurface moisture is often present. Available water-holding capacity is moderately high. Some stands occur on well-drained, often sandy, glacial drift and sandy alluvium (Comer et al. 1999). Where herbaceous growth is vigorous and decomposition rates are low due to a high water table, soils may develop organic profiles.

Dynamics: This alliance is often grazed by domestic livestock and is strongly preferred during the growing season. Prolonged livestock use can decrease the abundance of native bunchgrasses and increase the cover of shrubs and non-native species, such as *Poa pratensis* and *Taraxacum officinale*. Unlike other *Artemisia* spp., *Artemisia cana* resprouts vigorously following spring fire, and prescribed burning may increase shrub cover. Conversely, fire in the fall may decrease shrub abundance. Comparisons of grazed and protected (ungrazed) floodplain sites showed a tendency for *Artemisia cana* to occur more commonly in grazed than ungrazed sites with similar groundwater hydrology.

DISTRIBUTION

Geographic Range: This alliance is found west of the Continental Divide from the Rocky Mountains across the Great Basin to the Sierra Nevada and Cascade Range.

Nations: US

States/Provinces: CA, CO, ID, MT, NV, OR, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Artemisia cana* (Silver sagebrush scrub) Alliance (Sawyer et al. 2009) [35.150.00]
- = *Artemisia cana* Shrubland Alliance (CNPS 2017) [35.150.00]
- < SRM Cover Type #408 - Other Sagebrush Types (Shiflet 1994)

LOWER LEVEL UNITS

Associations:

- CEGLO01552 *Artemisia cana ssp. viscidula* / *Festuca idahoensis* Shrub Wet Meadow
- CEGLO01074 *Artemisia cana ssp. viscidula* / *Deschampsia cespitosa* Wet Shrubland
- CEGLO01076 *Artemisia cana ssp. viscidula* / *Festuca ovina* Wet Shrubland
- CEGLO01075 *Artemisia cana ssp. viscidula* - (*Salix* spp.) / *Festuca idahoensis* Wet Shrubland
- CEGLO05998 *Artemisia cana* / *Juncus arcticus ssp. littoralis* Wet Shrubland
- CEGLO01460 *Artemisia cana (ssp. bolanderi, ssp. viscidula)* / *Leymus cinereus* Wet Shrubland

- C EGL002987 *Artemisia cana* ssp. *bolanderi* / *Eleocharis palustris* Wet Shrubland
- C EGL001743 *Artemisia cana* ssp. *bolanderi* / *Muhlenbergia richardsonis* Wet Shrub Meadow
- C EGL003475 *Artemisia cana* ssp. *bolanderi* / *Iris missouriensis* - *Juncus arcticus* ssp. *littoralis* Wet Shrubland
- C EGL001548 *Artemisia cana* (ssp. *bolanderi*, ssp. *viscidula*) / *Poa secunda* Wet Shrubland

AUTHORSHIP

Primary Concept Source: S. Rust, D. Tart, D. Sarr, J. Tuhy, M.S. Reid, R.J. Rondeau, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Bramble-Brodahl 1978, CNPS 2017, Chappell et al. 1997, Comer et al. 1999, Cunningham 1971, Daubenmire 1970, Dealy 1971, Faber-Langendoen et al. 1996, Faber-Langendoen et al. 2017b, Francis 1983, Franklin and Dyrness 1973, Hansen et al. 1984, Hansen et al. 1991, Hansen et al. 1995, Hanson and Whitman 1938, Hess 1981, Hironaka et al. 1983, Jankovsky-Jones et al. 2001, Johnston 1987, Kartesz 1999, Kovalchik 1987, Manning and Padgett 1991, Manning and Padgett 1995, Mueggler and Stewart 1980, Mutz and Graham 1982, Mutz and Queiroz 1983, ORNHP unpubl. data, Padgett 1982, Padgett et al. 1988b, Padgett et al. 1989, Reid et al. 1994, Sarr 1995, Sawyer et al. 2009, Schlatterer 1972, Shiflet 1994, Soil Conservation Service 1978, Tiedemann et al. 1987, Tuhy 1981, Tuhy and Jensen 1982, Turner 1969, USFS 1992, Winward 1980b, Youngblood et al. 1985a

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G526. Rocky Mountain-Great Basin Lowland-Foothill Riparian Shrubland

A3799. *Rhus trilobata* - *Crataegus rivularis* - *Forestiera pubescens* Shrubland Alliance

Type Concept Sentence: This shrubland alliance is dominated by *Corylus cornuta*, *Crataegus rivularis*, *Elaeagnus commutata*, *Forestiera pubescens*, *Rhamnus alnifolia*, *Shepherdia argentea*, and/or *Rhus trilobata*. Usually these are single-species shrublands, but all occupy similar environments. It is an eclectic mix of mesic shrubs that form small, narrow stands at the base of steep hills and cliffs and along washes and upper benches and terraces of riparian areas in the Rocky Mountains and throughout the cool interior western U.S. These are "fringe" riparian shrublands that occur on upper benches and terraces, dry washes and areas near but not necessarily in the wettest part of riparian areas, but receive more moisture than surrounding upland slopes.

OVERVIEW

Scientific Name: *Rhus trilobata* - *Crataegus rivularis* - *Forestiera pubescens* Shrubland Alliance

Common Name (Translated Scientific Name): Skunkbush Sumac - River Hawthorn - Stretchberry Shrubland Alliance

Colloquial Name: Skunkbush Sumac - River Hawthorn - Stretchberry Shrubland

Type Concept: This semi-riparian shrubland alliance is dominated by *Corylus cornuta*, *Crataegus rivularis*, *Elaeagnus commutata*, *Forestiera pubescens*, *Rhamnus alnifolia*, *Shepherdia argentea*, and/or *Rhus trilobata*, generally in monotypic stands, but they can be mixed as well. Other shrub associates may include *Prunus virginiana*. It is an eclectic mix of mesic shrubs that form small, narrow stands at the base of steep hills and cliffs and along washes and upper benches and terraces of riparian areas. These are "fringe" riparian shrublands that occur on upper benches and terraces, dry washes and areas near but not necessarily in the wettest part of riparian areas, but which receive more moisture than surrounding upland slopes. Often these are single-species shrublands, but all occupy similar environments. The alliance has a broad north to south range in the Rocky Mountains and throughout the cool interior western U.S.

Classification Comments: Includes shrub species that generally do not form large stands in upland environments.

Internal Comments: mjr 12-14: CA added for MOJN.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Greater than 30% relative cover of *Corylus cornuta*, *Crataegus rivularis*, *Elaeagnus commutata*, *Forestiera pubescens*, *Rhamnus alnifolia*, and/or *Rhus trilobata*.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a typically dense, cold-deciduous shrub layer (approximately 70% cover). The herbaceous layer is also dense and is dominated by perennial graminoids (80%). Forbs have relatively sparse cover (<20%), but have high diversity. Moss has high cover in some stands (70%).

Floristics: Stands have a dense layer of cold-deciduous shrubs (<2 m) that are dominated by *Amelanchier alnifolia*, *Elaeagnus commutata*, *Lonicera involucrata*, *Prunus virginiana*, *Rhamnus alnifolia*, *Ribes lacustre*, *Rosa woodsii*, and/or *Symphoricarpos albus*. A few other shrubs species, such as *Salix bebbiana* or *Salix exigua*, may be co-associates, but these are not abundant and do not characterize the stand. The herbaceous layer is typically dense with graminoids such as *Calamagrostis canadensis*, *Elymus glaucus*, *Elymus lanceolatus*, *Hesperostipa comata* (= *Stipa comata*), and *Koeleria macrantha*. Dominant forbs include *Dryas drummondii*, *Galium triflorum*, *Geum macrophyllum*, *Heracleum maximum* (= *Heracleum lanatum*), and *Maianthemum stellatum*. The spikemoss *Selaginella densa* can be abundant in some stands. Introduced grasses such as *Bromus inermis*, *Poa pratensis*, and *Phleum pratense* can also be abundant.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands are generally found on elevated benches along streams, on floodplains, adjacent to seeps and can form narrow stringers on stream terraces. Elevations range from approximately 700 to 2400 m. Sites are gently sloping and are temporarily flooded during spring runoff and high-intensity rainstorms. Soils are alluvial or may be well-developed Mollisols.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is found throughout the Rocky Mountains and other areas of the cool interior western U.S. and is documented from eastern Oregon and Washington, Idaho, Alberta, Montana, Wyoming, Colorado, New Mexico, Utah and the highlands of northern Arizona.

Nations: CA, US

States/Provinces: AB, AZ, CA, CO, ID, MT, NM, OR, UT, WA, WY

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Mojave); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > *Forestiera pubescens* (Desert olive patches) Alliance (Sawyer et al. 2009) [61.580.00]
- > *Forestiera pubescens* Alliance (Desert olive patches) (Buck-Diaz et al. 2012)
- > *Forestiera pubescens* Shrubland Alliance (Evens et al. 2014)
- ? *Rhus trilobata* (Basket bush thickets) Provisional Alliance (Sawyer et al. 2009) [37.802.00]

LOWER LEVEL UNITS

Associations:

- CEG001098 *Elaeagnus commutata* Wet Shrubland
- CEG001132 *Rhamnus alnifolia* Riparian Wet Shrubland
- CEG001168 *Forestiera pubescens* Wet Shrubland
- CEG002889 *Crataegus rivularis* Wet Shrubland
- CEG002903 *Corylus cornuta* Wet Shrubland
- CEG001121 *Rhus trilobata* Moist Wet Shrubland
- CEG001108 *Prunus virginiana* - (*Prunus americana*) Wet Shrubland

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2016/10/17

REFERENCES

References: Buck-Diaz et al. 2012, Bursik and Moseley 1995, DeVelice et al. 1995, Evens et al. 2014, Faber-Langendoen et al. 2017b, Hansen and Hoffman 1988, Hansen et al. 1995, Harvey 1980, Jones 1992b, Sawyer et al. 2009, Thompson and Hansen 2002, VegCAMP and AIS 2013, Welsh et al. 1987, Youngblood et al. 1985a

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G526. Rocky Mountain-Great Basin Lowland-Foothill Riparian Shrubland

A3800. *Salix exigua* - *Salix irrorata* Shrubland Alliance

Type Concept Sentence: This riparian shrubland alliance is dominated by *Salix exigua*, *Salix irrorata*, and/or *Salix melanopsis*. The canopy is tall (2-5 m), and typically many-branched with continuous cover of 60-100%. Communities occur along streams throughout the western U.S. They are found in streambanks, marshes and wet ditches.

OVERVIEW

Scientific Name: *Salix exigua* - *Salix irrorata* Shrubland Alliance

Common Name (Translated Scientific Name): Narrowleaf Willow - Dewystem Willow Shrubland Alliance

Colloquial Name: Narrowleaf Willow - Dewystem Willow Shrubland

Type Concept: Dominant species are *Salix exigua*, *Salix interior*, *Salix irrorata*, and/or *Salix melanopsis*. It is typically a monotypic stand with some herbaceous understory; however, other shrubs and trees can be present. The herbaceous stratum can have sparse to moderate cover, including a variety of pioneer species. Other codominants may include *Populus fremontii*, *Populus deltoides*, *Populus angustifolia*, and *Acer negundo*. Other shrubs within this alliance consist of *Alnus incana*, *Cornus sericea*, *Rosa* spp., *Rubus idaeus* ssp. *strigosus* (= *Rubus strigosus*), *Ribes aureum*, *Ribes inerme*, and other *Salix* species. Common herbaceous species include *Artemisia ludoviciana*, *Epilobium* spp., *Equisetum* spp., *Fragaria virginiana* ssp. *glauca* (= *Fragaria ovalis*), *Geranium* spp., *Hackelia* spp., *Maianthemum stellatum*, *Mertensia ciliata*, *Osmorhiza occidentalis*, *Thalictrum fendleri*, and *Urtica dioica*. Non-native species can be abundant, such as *Poa pratensis*, *Bromus inermis*, *Taraxacum officinale*, and *Cirsium arvense*. Elevation ranges from 0 to 2950 m (0-9680 feet). These shrublands are found on open sand and gravel bars without tree canopy shading, on a wide variety of streams and rivers and even ditches. *Salix exigua* is one of the most common willows found throughout the western U.S. *Salix irrorata* has similar habitat, but a much more limited range of distribution. Stands are associated with annual flooding and inundation and will grow well into the active stream channel, where it is flooded, even in drier years. Even though flooding is frequent, surface water may not be present for much of the growing season, and the water table is well below the surface, especially in the warmer and hotter parts of the western U.S. Some stands form large, wide stands on mid-channel islands on larger rivers, or narrow stringer bands on small, rocky tributaries. Streams range widely from moderately sinuous and moderate-gradient reaches to broad, meandering rivers with wide floodplains or broad, braided channels. Many stands also occur within highly entrenched or eroding gullies.

Classification Comments: *Salix interior* Rowlee has been recently raised to species level and was formerly *Salix exigua* Nutt. subsp. *interior* (Rowlee) Cronquist. Stands west of the 100th meridian are included in the concept of this alliance, including those stands in eastern Wyoming, Montana, Colorado and New Mexico.

Internal Comments:

Other Comments:

Similar NVC Types:

- A3646 *Salix interior* Riverscour Shrubland Alliance: occurs in the Great Plains, midwestern and eastern U.S.

Diagnostic Characteristics: Greater than 5% relative cover of *Salix exigua*, *Salix interior*, *Salix irrorata*, and/or *Salix melanopsis*.

VEGETATION

Physiognomy and Structure: The canopy is dominated by a tall (2-5 m), broad-leaved deciduous shrub that is typically many-branched with continuous cover of 60-100%. The herbaceous stratum is sparse to moderate cover, including a variety of pioneer species.

Floristics: Plant associations within this alliance are characterized as temporarily flooded cold-deciduous shrublands dominated by *Salix exigua*, *Salix irrorata*, *Salix melanopsis*, and/or *Salix interior*. The tall-shrub layer has 15-90% cover, ranging in height between 2-5 m. Other shrubs can occur in the canopy, including *Salix eriocephala*, *Salix lasiolepis*, *Salix ligulifolia*, *Salix lutea*, and/or *Salix monticola*. Occasionally, taller *Acer negundo*, *Alnus rhombifolia*, *Juglans hindsii*, *Populus angustifolia*, *Populus deltoides*, *Populus balsamifera*, *Populus fremontii*, *Salix gooddingii*, *Salix laevigata*, *Salix lucida*, *Salix amygdaloides*, or *Tamarix* spp. occur within the tree subcanopy. The herbaceous layer varies greatly over the broad range of the alliance. It may have as much as 20-35% cover of various graminoid species, including *Carex nebrascensis*, *Carex pellita* (= *Carex lanuginosa*), *Equisetum arvense*, *Muhlenbergia rigens*, *Panicum bulbosum*, *Phalaris arundinacea*, and *Spartina pectinata*. Other common herbaceous species include *Artemisia ludoviciana*, *Epilobium* spp., *Equisetum* spp., *Fragaria virginiana* ssp. *glauca* (= *Fragaria ovalis*), *Geranium* spp., *Hackelia* spp., *Maianthemum stellatum*, *Mertensia ciliata*, *Osmorhiza occidentalis*, *Glycyrrhiza lepidota*, *Thalictrum fendleri*, and *Urtica dioica*. Non-native species can be abundant, such as *Medicago sativa*, *Agrostis gigantea*, *Agrostis stolonifera*, *Poa pratensis*, *Bromus inermis*, *Melilotus officinalis*, *Taraxacum officinale*, *Cirsium arvense*, and/or *Trifolium repens*. The understory can also have no herbaceous growth at all and be completely barren ground, gravels or other alluvium.

ENVIRONMENT & DYNAMICS

Environmental Description: Plant associations within this alliance are located on floodplains and gravel bars at an elevational range between 0 and 2950 m (0-9680 feet) in the western U.S. These shrublands are found on open sandbars without canopy shading on large or small streams and rivers with sandy or cobble substrates. They are associated with annual flooding and inundation and will grow well into the active river channel, where it is flooded even in drier years. Even though flooding is frequent, surface water is not present for much of the growing season, and the water table is well below the surface, especially in warmer and drier parts of the western U.S. Some stands form large, wide stands on mid-channel islands on larger rivers, or narrow stringer bands on small, rocky tributaries. Stream reaches range widely from moderately sinuous and moderate-gradient reaches to broad, meandering rivers with wide floodplains or broad, braided channels. Many stands also occur within highly entrenched or eroding gullies. It can be found along wet ditches as well.

Soils of this alliance are typically coarse alluvial deposits of sand, silt and cobbles that are highly stratified with depth from flooding scour and deposition. The stratified profiles consist of alternating layers of clay loam and organic material with coarser sand or thin layers of sandy loam over very coarse alluvium. Occasionally, stands may occur on deep pockets of sand. The pH of the substrate ranges from 6.0-6.8 (Johnston 1987).

Dynamics: This alliance represents an early-seral primary successional stage on newly deposited sediments that may persist under a regime of repeated fluvial disturbance. *Salix exigua*, *Salix interior*, and *Salix irrorata* are highly adapted to most forms of disturbance, are prolific sprouters, and will re-establish themselves on sites dominated by other disturbance-associated species, e.g., *Glycyrrhiza lepidota* and *Pascopyrum smithii*.

DISTRIBUTION

Geographic Range: This alliance is found throughout the lower elevations of the Interior West from Arizona to Alberta west to California and Washington.

Nations: CA, US

States/Provinces: AB, AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- ? *Salix* spp. Series (Johnston 1987)
- ? Plains and Great Basin Riparian Wetlands (Brown 1982a)

LOWER LEVEL UNITS

Associations:

- CEGLO01198 *Salix exigua* / *Elymus x pseudorepens* Wet Shrubland
- CEGLO01214 *Salix irrorata* Wet Shrubland
- CEGLO01197 *Salix exigua* Riparian Wet Shrubland
- CEGLO02655 *Salix exigua* - *Salix ligulifolia* Wet Shrubland
- CEGLO01202 *Salix exigua* / Mesic Forbs Wet Shrubland
- CEGLO01204 *Salix exigua* - *Salix lucida* ssp. *caudata* Wet Shrubland
- CEGLO05656 *Salix exigua* / Gravel Bar Wet Shrubland
- CEGLO01201 *Salix exigua* / *Equisetum arvense* Wet Shrubland
- CEGLO05986 *Salix irrorata* / *Carex rostrata* Wet Shrubland
- CEGLO05987 *Salix irrorata* / *Eleocharis palustris* Wet Shrubland
- CEGLO05984 *Salix irrorata* - *Salix exigua* Wet Shrubland
- CEGLO05983 *Salix irrorata* - *Cornus sericea* ssp. *sericea* Wet Shrubland
- CEGLO05985 *Salix irrorata* - *Salix lucida* ssp. *lasiandra* Wet Shrubland
- CEGLO01203 *Salix exigua* / Mesic Graminoids Western Wet Shrubland

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2016/10/17

REFERENCES

References: Borchert et al. 2004, Brown 1982a, Brown et al. 1979, Christy 1973, Cooper and Cottrell 1990, Dale and Kuroda 1979, Dick-Peddie 1993, Dick-Peddie et al. 1984, Dorn 1997, Evenden 1990, Faber-Langendoen et al. 1996, Faber-Langendoen et al. 2017b, Hansen et al. 1989, Hansen et al. 1991, Hansen et al. 1995, Johnston 1987, Jones and Walford 1995, Kagan 1997, Kearney et al. 1969, Kittel 1994, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996, Kittel et al. 1999a, Kovalchik 1987, Martin and Hutchins 1980, Muldavin et al. 1993a, Muldavin et al. 1994a, Muldavin et al. 2000a, Myhre and Clements 1972, Padgett et al. 1988b, Padgett et al. 1989, Phillips 1977, Sawyer and Keeler-Wolf 1995, Shelford 1954, Szaro 1989, Thompson and Hansen 2002, Tuhy and Jensen 1982, Vaghti 2003, Weber 1990, Youngblood et al. 1985a

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

2.C.4.Nb.2.b. M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland

G521. Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh

Type Concept Sentence: This group consists of wet meadows dominated by graminoids such as *Calamagrostis canadensis*, *Carex aquatilis*, *Carex utriculata*, and *Eleocharis palustris* or forbs such as *Camassia quamash*, *Cardamine cordifolia*, *Dodecatheon jeffreyi*, *Phippisia algida*, *Rorippa alpina*, *Senecio triangularis*, and *Veratrum californicum* found throughout low and high montane altitudes of the western U.S. and Canada.

OVERVIEW

Scientific Name: *Carex* spp. - *Calamagrostis* spp. Montane Wet Meadow & Marsh Group

Common Name (Translated Scientific Name): Sedge species - Reedgrass species Montane Wet Meadow & Marsh Group

Colloquial Name: Western Glaucous Bluegrass Wet Meadow

Type Concept: This group contains the wet meadows found in low and high montane and subalpine elevations, occasionally reaching into the lower edges of the alpine elevations (about 1000-3600 m), from California's Transverse and Peninsular ranges north to British Columbia's Coastal Mountains and from throughout the Rocky Mountains of Canada and the U.S. (including the Black Hills of South Dakota) and mountain ranges of the intermountain Interior West. Varying dominant herbaceous species include graminoids *Calamagrostis canadensis*, *Calamagrostis stricta*, *Carex bolanderi*, *Carex exsiccata*, *Carex illota*, *Carex microptera*, *Carex scopulorum*, *Carex utriculata*, *Carex vernacula*, *Deschampsia cespitosa*, *Eleocharis quinqueflora*, *Glyceria striata* (= *Glyceria elata*), *Juncus drummondii*, *Juncus nevadensis*, and *Scirpus* and/or *Schoenoplectus* spp. Forb species include *Camassia quamash*, *Cardamine cordifolia*, *Dodecatheon jeffreyi*, *Phippisia algida*, *Rorippa alpina*, *Senecio triangularis*, *Trifolium parryi*, and *Veratrum californicum*. Common but sparse shrubs may include *Betula glandulosa*, *Salix* spp., *Vaccinium macrocarpon*, and *Vaccinium uliginosum*. Wet meadows occur in open wet depressions, basins and flats with low-velocity surface and subsurface flows. They can be large meadows in montane or subalpine valleys, or occur as narrow strips bordering ponds, lakes and streams, and along toeslope seeps. They are typically found on flat areas or gentle slopes, but may also occur on subirrigated sites with slopes up to 10%. In alpine regions, sites typically are small depressions located below late-melting snow patches. Sites are usually seasonally wet, often drying by late summer, and many occur in a tension zone between perennial wetlands and uplands, where water tables fluctuate in response to long-term climatic cycles. They may have surface water for part of the year, but depths rarely exceed a few centimeters. Wet meadows can be tightly associated with snowmelt and typically are not subjected to high velocity disturbance, but can be flooded by slow-moving waters. Soils are mostly mineral and show typical hydric soil characteristics such as low chroma and redoximorphic features; some areas may have high organic content as inclusions or pockets. Vegetation of this group can manifest as a mosaic of several plant associations, or be a monotypic stand of a single association which is dominated by graminoids or forbs.

Classification Comments:**Similar NVC Types:**

- G520 Vancouverian-Rocky Mountain Subalpine-Alpine Snowbed, Wet Meadow & Dwarf-shrubland: is more or less a strictly alpine group that occurs at higher elevations with different dominant species, and is restricted to alpine or upper subalpine environments; however, it may be adjacent to or even overlap with G521 in some areas.
- G517 Vancouverian Freshwater Wet Meadow & Marsh: occurs at lower elevations within 2 miles of coast.
- G524 Western North American Ruderal Marsh, Wet Meadow & Shrubland
- G531 Arid West Interior Freshwater Marsh
- G545 Colorado Plateau Hanging Garden Seep

Diagnostic Characteristics: Perennial herbaceous wet meadows found in the montane, subalpine and lower alpine elevations (about 1000-3600 m) of western mountain ranges. Sites are usually seasonally wet, often drying by late summer, and many occur in a tension zone between perennial wetlands and uplands, where water tables fluctuate in response to long-term climatic cycles.

VEGETATION

Physiognomy and Structure: Open wet meadows dominated by perennial cold-dormant graminoids or forbs, usually less than 1 m in height, often a pocket surrounded by forests. Wet meadows may be large and carpet an entire valley floor, or they can be very small patches or narrow linear strips. They can also occur in complex mosaics of meadows intermixed with patches of dwarf- or tall shrublands.

Floristics: Vegetation of this group can manifest as a mosaic of several plant associations, or be a monotypic stand of a single association which is dominated by graminoids or forbs. Varying dominant herbaceous species include graminoids *Calamagrostis canadensis*, *Calamagrostis stricta*, *Carex bolanderi*, *Carex utriculata*, *Carex illota*, *Carex exsiccata*, *Carex nigricans*, *Carex microptera*, *Carex scopulorum*, *Carex vernacula*, *Deschampsia cespitosa*, *Eleocharis quinqueflora*, *Glyceria striata* (= *Glyceria elata*), *Juncus drummondii*, *Juncus nevadensis*, and *Scirpus* and/or *Schoenoplectus* spp. Forb species may include *Camassia quamash*, *Cardamine cordifolia*, *Caltha leptosepala*, *Dodecatheon jeffreyi*, *Phippsia algida*, *Rorippa alpina*, *Senecio triangularis*, *Trifolium parryi*, *Trollius laxus*, and *Veratrum californicum*. Common but sparse shrubs may include *Salix* spp., *Vaccinium uliginosum*, *Betula glandulosa*, and *Vaccinium macrocarpon*. Floristic information compiled from Komarkova (1976, 1986), Nachlinger (1985), Kovalchik (1987, 1993), Barbour and Major (1988), Meidinger et al. (1988), Padgett et al. (1988a), Lloyd et al. (1990), Banner et al. (1993), DeLong et al. (1993), Manning and Padgett (1995), Sawyer and Keeler-Wolf (1995), Sanderson and Kettler (1996), Crowe and Clausnitzer (1997), Steen and Coupe (1997), Kittel et al. (1999b), and MacKenzie and Moran (2004).

ENVIRONMENT & DYNAMICS

Environmental Description: *Soil/substrate/hydrology:* Wet meadows are typically found on flat areas or gentle slopes, but may also occur on subirrigated sites with slopes up to 10%. In alpine regions, sites typically are small depressions located below late-melting snow patches. Sites are usually seasonally wet, often drying by late summer, and many occur in a tension zone between perennial wetlands and uplands, where water tables fluctuate in response to long-term climatic cycles. They may have surface water for part of the year, but depths rarely exceed a few centimeters. Wet meadows can be tightly associated with snowmelt and typically are not subjected to high velocity disturbance, but can be flooded by slow-moving waters. Moisture for these wet meadow community types is acquired from groundwater, stream discharge, overland flow, overbank flow, and on-site precipitation. Salinity and alkalinity are generally low due to the frequent flushing of moisture through the meadow. Depending on the slope, topography, hydrology, soils and substrate, intermittent, ephemeral, or permanent pools may be present.

These areas may support species more representative of purely aquatic environments. Standing water may be present during some or all of the growing season, with water tables typically remaining at or near the soil surface. Fluctuations of the water table throughout the growing season are not uncommon, however. On drier sites supporting the less mesic types, the late-season water table may be 1 m or more below the surface.

Soils are mostly mineral and show typical hydric soil characteristics such as low chroma and redoximorphic features; some areas may have high organic content as inclusions or pockets. Soils may have organic soils inclusions. The presence and amount of organic matter may vary considerably depending on the frequency and magnitude of alluvial deposition (Kittel et al. 1999b). Organic composition of the soil may include a thin layer near the soil surface or accumulations of highly sapric material of up to 120 cm thick. Soils may exhibit gleying and/or mottling throughout the profile. Wet meadows provide important water filtration, flow attenuation, and wildlife habitat functions. Environmental information compiled from Komarkova (1976, 1986), Nachlinger (1985), Kovalchik (1987, 1993), Barbour and Major (1988), Meidinger et al. (1988), Padgett et al. (1988a), Lloyd et al. (1990), Banner et al. (1993), DeLong et al. (1993), Manning and Padgett (1995), Sawyer and Keeler-Wolf (1995), Sanderson and Kettler (1996), Crowe and Clausnitzer (1997), Steen and Coupe (1997), Kittel et al. (1999b), and MacKenzie and Moran (2004).

Dynamics: This group has soils that may be flooded or saturated throughout the growing season. It may also occur on areas with soils that are only saturated early in the growing season, or intermittently. Typically these associations are tolerant of moderate-intensity surface fires and late-season livestock grazing (Kovalchik 1987). Most appear to be relatively stable types, although in some areas these may be impacted by intensive livestock grazing.

DISTRIBUTION

Geographic Range: This group occurs in the mountains in California's Transverse and Peninsular ranges north to British Columbia's coastal ranges and is found throughout the Rocky Mountains (including the Black Hills of South Dakota) of the U.S. and Canada as well as the intermountain ranges of the interior west, ranging in elevation from montane to alpine (1000-3600 m).

Spatial Scale & Pattern [optional]: Small patch

Nations: CA, MX?, US

States/Provinces: AB, AK?, AZ, BC, CA, CO, ID, MT, NM, NV, OR, SD, UT, WA, WY

TNC Ecoregions [optional]: 3:C, 4:C, 5:C, 7:C, 8:C, 9:C, 11:C, 12:C, 16:C, 18:C, 19:C, 20:C, 21:C, 22:P, 25:C, 68:C, 69:C, 81:C

USFS Ecoregions (2007): 262A:PP, 263A:PP, 313A:CP, 313B:CC, 313D:C?, 315A:C?, 315B:C?, 315H:CC, 321A:??, 322A:CC, 331A:CP, 331H:CP, 331I:CP, 331J:CC, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341F:CP, 341G:CP, 342B:CC, 342C:CC, 342D:C?, 342E:CC, 342F:CP,

CBR alliances

342G:CC, 342H:CC, 342I:CP, 342J:CP, M242A:CC, M242B:CC, M242C:CC, M242D:CP, M261A:CC, M261B:CC, M261D:CC, M261E:CC, M261F:CC, M261G:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M334A:PP, M341A:CP, M341B:CC, M341C:CC, M341D:CC

Omerik Ecoregions:

Federal Lands [optional]: NPS (Great Basin); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: High.

SYNONYMY

- < Alpine Grassland (213) (Shiflet 1994) [SRM type 213 includes all alpine communities in Sierra, Klamath and California Cascades, both herbaceous and shrub-dominated, and wet meadows.]
- >> Alpine Rangeland (410) (Shiflet 1994) [Alpine wet meadows are included in this SRM type.]
- < Montane Meadows (216) (Shiflet 1994)
- >> Tall Forb (409) (Shiflet 1994) [Forb-dominated wet meadows are included in this group.]
- >> Tufted Hairgrass - Sedge (313) (Shiflet 1994) [Wetter portions of this SRM type overlap with this group.]

LOWER LEVEL UNITS

Alliances:

- A2584 *Carex amplifolia* - *Carex interior* - *Carex sheldonii* Wet Meadow Alliance
- A2564 *Elymus glaucus* - *Carex pellita* - *Carex feta* Wet Meadow Alliance
- A3815 *Calamagrostis canadensis* - *Calamagrostis stricta* - *Poa palustris* Wet Meadow Alliance
- A3810 *Saxifraga odontoloma* - *Senecio triangularis* - *Mertensia ciliata* Wet Meadow Alliance
- A3806 *Carex praegracilis* - *Carex scopulorum* - *Eleocharis quinqueflora* Wet Meadow Alliance
- A3807 *Eleocharis palustris* - *Eleocharis acicularis* Marsh Alliance
- A3809 *Heracleum maximum* - *Veratrum californicum* - *Rorippa* spp. Wet Meadow Alliance
- A3812 *Mimulus* spp. - *Primula parryi* - *Dodecatheon redolens* Wet Meadow Alliance
- A3814 *Danthonia* spp. - *Camassia* spp. Wet Meadow Alliance
- A3813 *Carex densa* Wet Meadow Alliance
- A2642 *Argentina anserina* Wet Meadow Alliance
- A3539 *Equisetum arvense* - *Equisetum hyemale* - *Equisetum variegatum* Wet Meadow Alliance
- A3804 *Carex aquatilis* - *Carex utriculata* - *Deschampsia cespitosa* Wet Meadow Alliance
- A1374 *Juncus arcticus* ssp. *littoralis* - *Juncus mexicanus* Wet Meadow Alliance
- A1361 *Poa glauca* Wet Meadow Alliance
- A3805 *Carex nebrascensis* - *Carex vesicaria* - *Carex pellita* Wet Meadow Alliance
- A3808 *Glyceria grandis* - *Glyceria striata* - *Glyceria borealis* Wet Meadow Alliance

AUTHORSHIP

Primary Concept Source: P. Comer and G. Kittel, in Faber-Langendoen et al. (2011)

Author of Description: P. Comer, G. Kittel and C. Chappell

Acknowledgments:

Version Date: 12/02/2015

Classif Resp Region: West

Internal Author: GK 12-10, 12-15, 10-16

REFERENCES

References: Banner et al. 1993, Barbour and Major 1988, Cooper 1986b, Crowe and Clausnitzer 1997, DeLong 2003, DeLong et al. 1990, DeLong et al. 1993, Faber-Langendoen et al. 2017a, Holland and Keil 1995, Kittel et al. 1999b, Komarkova 1976, Komarkova 1986, Kovalchik 1987, Kovalchik 1993, Lloyd et al. 1990, MacKenzie and Moran 2004, MacKinnon et al. 1990, Manning and Padgett 1995, Meidinger and Pojar 1991, Meidinger et al. 1988, Nachlinger 1985, Padgett et al. 1988a, Reed 1988, Rodriguez et al. 2017, Sanderson and Kettler 1996, Sawyer and Keeler-Wolf 1995, Shiflet 1994, Steen and Coupé 1997, Stout et al. 2013

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G521. Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh

G520. Vancouverian-Rocky Mountain Subalpine-Alpine Snowbed, Wet Meadow & Dwarf-shrubland

Type Concept Sentence: These alpine herbaceous and dwarf-shrub communities are found on wet sites throughout the western U.S. and Canada in high mountainous regions. They are dominated by graminoids such as *Carex illota*, *Carex lachenalii*, *Carex nigricans*, *Carex vernacula*, *Deschampsia cespitosa*, *Juncus drummondii*, or forbs *Caltha leptosepala*, *Trollius laxus*, *Phippsia algida*, *Rorippa alpina*, *Sibbaldia procumbens*, and *Trifolium parryi*, as well as dwarf-shrubs that may also be scattered to moderately dense, including *Dasiphora*, *Kalmia*, *Salix* or *Vaccinium* species.

OVERVIEW

Scientific Name: *Caltha leptosepala* - *Carex nigricans* - *Kalmia microphylla* Subalpine-Alpine Snowbed, Wet Meadow & Dwarf-shrubland Group

Common Name (Translated Scientific Name): White Marsh-marigold - Black Alpine Sedge - Alpine Laurel Subalpine-Alpine Snowbed, Wet Meadow & Dwarf-shrubland Group

Colloquial Name: Rocky Mountain Shrubby-cinquefoil Wet Shrubland

Type Concept: These are high-elevation communities found throughout the Rocky Mountains, Pacific Northwest and Intermountain West regions, dominated by herbaceous species found on wetter sites with very low-velocity surface and subsurface flows. They range in elevation from upper subalpine to alpine (1500-3600 m) depending on latitude. These types occur as large meadows in subalpine valleys, as narrow strips bordering ponds, lakes and streams, and along toeslope seeps. They are typically found on flat areas or gentle slopes, but may also occur on subirrigated sites with slopes up to 10%. In alpine regions, sites typically are small depressions located below late-melting snow patches or on snowbeds. Soils of this group are mineral or with a thin (<40 cm) organic layer over mineral layers (aka not peatland). Soils show hydric soil characteristics, including high organic content and/or low chroma and redoximorphic features. This group often occurs as a mosaic of several plant associations, often dominated by graminoids such as *Carex illota*, *Carex lachenalii*, *Carex nigricans*, *Carex vernacula*, *Deschampsia cespitosa*, *Juncus drummondii*, and forbs *Caltha leptosepala*, *Trollius laxus*, *Phippsia algida*, *Rorippa alpina*, *Sibbaldia procumbens*, and *Trifolium parryi*. Often scattered to moderately dense dwarf-shrubs are present, especially *Dasiphora*, *Kalmia*, *Salix* or *Vaccinium*, which when present form alpine dwarf-shrublands. Wet meadows are tightly associated with snowmelt and typically not subjected to high disturbance events such as flooding.

Classification Comments: This group includes sparsely vegetated alpine areas that nonetheless have lush wet meadows and dwarf-shrublands are included together in one group because the alpine mesic floristic composition is more diagnostic than vegetation structure. This might be confusing with Rocky Mountain-Sierran Alpine Dwarf-shrubland & Krummholz Group (G316) because it includes mesic dwarf-shrublands; however, this group includes the true wetland associations.

Similar NVC Types:

- G271 Rocky Mountain-North Pacific Subalpine-Montane Mesic Grassland & Meadow
- G521 Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh: is lower in elevation (montane to subalpine) and may overlap slightly but has a different suite of dominant species than G520.
- G320 North Pacific Alpine-Subalpine Tundra: is similar in structure but does not contain wetland associations.
- G316 Rocky Mountain-Sierran Alpine Dwarf-shrubland & Krummholz: is similar in structure but does not contain wetland associations.
- G317 North Pacific Alpine-Subalpine Dwarf-shrubland & Heath: is similar in structure but does not contain wetland associations.

Diagnostic Characteristics: This group includes open to closed-canopy herbaceous stands dominated by Rocky Mountain alpine wetland species as well as open to closed dwarf-shrublands. Wetland graminoids may include *Carex illota*, *Carex lachenalii*, *Carex nigricans*, *Carex vernacula*, *Deschampsia cespitosa*, *Juncus drummondii*, and *Juncus mertensianus*; forbs include *Caltha leptosepala*, *Trollius laxus*, *Parnassia fimbriata*, *Phippsia algida*, *Polygonum bistortoides*, *Rorippa alpina*, *Sibbaldia procumbens*, and *Trifolium parryi*. Scattered to moderately dense dwarf-shrubs may also be present, especially *Dasiphora fruticosa* ssp. *floribunda* and *Kalmia microphylla*, which form alpine dwarf-shrublands.

VEGETATION

Physiognomy and Structure: This group is variable structurally and includes open to closed-canopy, graminoid- and forb-dominated herbaceous stands as well as stands dominated by dwarf-shrublands. Sometimes rings of different plant communities form around a late-melting snowbed because of different soil moisture requirements (drier turf species on outside edges, wetland species near the middle and sometimes a sparsely vegetated center because of the extremely short growing season).

Floristics: This group often occurs as a mosaic of several plant associations, often dominated by graminoids, including *Carex illota*, *Carex lachenalii*, *Carex nigricans*, *Carex vernacula*, *Deschampsia cespitosa*, *Juncus drummondii*, *Juncus mertensianus*, and forbs *Caltha leptosepala*, *Trollius laxus*, *Parnassia fimbriata*, *Phippsia algida*, *Polygonum bistortoides*, *Rorippa alpina*, *Sibbaldia*

procumbens, and *Trifolium parryi*. Often scattered to moderately dense dwarf-shrubs are present, especially *Dasiphora fruticosa* ssp. *floribunda*, *Kalmia microphylla*, or *Vaccinium uliginosum*, which form alpine dwarf-shrublands. Wet meadows are tightly associated with snowmelt and typically not subjected to high disturbance events such as flooding. Floristic information was compiled from Willard (1963), Komarkova (1976, 1986), Nachlinger (1985), Cooper (1986b), Kovalchik (1987, 1993), Padgett et al. (1988a), Reed (1988), Meidinger and Pojar (1991), Shiflet (1994), Manning and Padgett (1995), Sanderson and Kettler (1996), Zwinger and Willard (1996), Cooper et al. (1997), Crowe and Clausnitzer (1997), and Kittel et al. (1999b).

ENVIRONMENT & DYNAMICS

Environmental Description: These are high-elevation communities found throughout the Rocky Mountains, Pacific Northwest and Intermountain West regions, dominated by herbaceous species found on wetter sites with very low-velocity surface and subsurface flows. They range in elevation from upper subalpine to alpine (1500-3600 m) depending on latitude. These types occur as large meadows in subalpine valleys, as narrow strips bordering ponds, lakes and streams, and along toeslope seeps. They are typically found on flat areas or gentle slopes, but may also occur on subirrigated sites with slopes up to 10%. In alpine regions, sites typically are small depressions located below late-melting snow patches or on snowbeds. Soils of this group are mineral or with a thin (<40 cm) organic layer over mineral layers (aka not peatland).

Moisture for these wet meadow community types is acquired from groundwater, stream discharge, overland flow, overbank flow, and on-site precipitation. Salinity and alkalinity are generally low due to the frequent flushing of moisture through the meadow. Depending on the slope, topography, hydrology, soils and substrate, intermittent, ephemeral or permanent pools may be present. These areas may support species more representative of purely aquatic environments. Standing water may be present during some or all of the growing season, with water tables typically remaining at or near the soil surface. Fluctuations of the water table throughout the growing season are not uncommon, however. On drier sites supporting the less mesic types, the late-season water table may be 1 m or more below the surface.

Soil/substrate/hydrology: Soils typically possess a high proportion of organic matter, but this may vary considerably depending on the frequency and magnitude of alluvial deposition (Kittel et al. 1999b). Organic composition of the soil may include a thin layer near the soil surface or accumulations of highly sapric material up to 30 cm thick (aka not peatland). Soils may exhibit gleying and/or mottling throughout the profile. Wet meadow ecological systems provide important water filtration, flow attenuation, and wildlife habitat functions. Environmental information was compiled from Willard (1963), Komarkova (1976, 1986), Nachlinger (1985), Cooper (1986b), Kovalchik (1987, 1993), Padgett et al. (1988a), Reed (1988), Meidinger and Pojar (1991), Shiflet (1994), Manning and Padgett (1995), Sanderson and Kettler (1996), Zwinger and Willard (1996), Cooper et al. (1997), Crowe and Clausnitzer (1997), and Kittel et al. (1999b).

Dynamics: Associations in this group are adapted to soils that may be flooded or saturated throughout the growing season. They may also occur on areas with soils that are only saturated early in the growing season or intermittently. Typically these associations are tolerant of moderate-intensity surface fires and late-season livestock grazing (Kovalchik 1987). Most appear to be relatively stable types, although in some areas these may be impacted by intensive livestock grazing.

DISTRIBUTION

Geographic Range: This group is found throughout the Rocky Mountains, Pacific Northwest and Intermountain West regions, ranging in elevation from upper subalpine to alpine (1500-3600 m) depending on latitude.

Spatial Scale & Pattern [optional]: Small patch

Nations: CA, US

States/Provinces: AB, AZ, BC, CA, CO, ID, MT, NM, NV, OR, SD, UT, WA, WY

TNC Ecoregions [optional]: 7:C, 8:C, 9:C, 11:C, 18:C, 19:C, 20:C, 21:C, 22:P, 25:C, 68:C

USFS Ecoregions (2007): 313A:CP, 313B:CC, 313D:C?, 315A:C?, 315B:C?, 315H:CC, 321A:??, 322A:CC, 331H:CP, 331I:CP, 331J:CC, 341A:CC, 341B:CC, 341C:CC, 341F:CP, 341G:CP, 342B:CC, 342C:CC, 342D:C?, 342E:CC, 342F:CP, 342G:CC, 342H:CC, 342J:CP, M242D:PP, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M334A:PP, M341A:CP, M341B:CC, M341C:CC, M341D:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: High.

SYNONYMY

- >< Alpine Rangeland (410) (Shiflet 1994) [Alpine wet meadows are included in this SRM type.]
- >< Tall Forb (409) (Shiflet 1994) [Forb-dominated wet meadows are included in this group.]
- >< Tufted Hairgrass - Sedge (313) (Shiflet 1994) [Wetter portions of this SRM type overlap with this group.]

LOWER LEVEL UNITS

Alliances:

- A3831 *Kalmia microphylla* - *Cassiope mertensiana* - *Dryas drummondii* Wet Dwarf-shrubland Alliance
- A3832 *Carex nigricans* - *Sibbaldia procumbens* - *Trollius laxus* Wet Meadow Alliance
- A1309 *Carex vernacula* - *Phippsia algida* - *Ptilagrostis kingii* Wet Meadow Alliance
- A0958 *Dasiphora fruticosa* ssp. *floribunda* Wet Shrubland Alliance
- A1424 *Carex lachenalii* - *Carex capillaris* - *Carex illota* Wet Meadow Alliance
- A1698 *Caltha leptosepala* - *Rhodiola rhodantha* Wet Meadow Alliance

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2011)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 12/02/2015

Classif Resp Region: West

Internal Author: KAS 12-10, 3-11, mod. GK 9-13, 12-15

REFERENCES

References: Cooper 1986b, Cooper et al. 1997, Crowe and Clausnitzer 1997, Faber-Langendoen et al. 2017a, Kittel et al. 1999b, Komarkova 1976, Komarkova 1986, Kovalchik 1987, Kovalchik 1993, Manning and Padgett 1995, Meidinger and Pojar 1991, Nachlinger 1985, Padgett et al. 1988a, Reed 1988, Sanderson and Kettler 1996, Shiflet 1994, Willard 1963, Zwinger and Willard 1996

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G520. Vancouverian-Rocky Mountain Subalpine-Alpine Snowbed, Wet Meadow & Dwarf-shrubland

G527. Western Montane-Subalpine Riparian & Seep Shrubland

Type Concept Sentence: These are montane to subalpine riparian shrublands ranging from short to tall (0.5-15 m) that occur in steep and narrow to wide, low-gradient valley bottoms and floodplains as well as steep moist avalanche chutes. They are generally dominated by any or a mix of the following: *Alnus incana*, *Alnus oblongifolia*, *Alnus viridis*, *Betula occidentalis*, *Betula glandulosa*, *Betula occidentalis*, *Cornus sericea*, *Salix bebbiana*, *Salix boothii*, *Salix brachycarpa*, *Salix drummondiana*, *Salix eriocephala*, *Salix geyeriana*, *Salix monticola*, *Salix planifolia*, and/or *Salix wolfii*.

OVERVIEW

Scientific Name: *Salix* spp. - *Alnus* spp. - *Betula occidentalis* Riparian & Seep Shrubland Group

Common Name (Translated Scientific Name): Willow species - Alder species - Water Birch Riparian & Seep Shrubland Group

Colloquial Name: Western Alder Wet Shrubland

Type Concept: These are montane to subalpine riparian shrublands occurring as narrow bands or broad shrublands and are found throughout the Rocky Mountain cordillera from New Mexico north into Montana and northwestern Alberta. They also occur in mountainous areas of the interior Intermountain West and on the Colorado Plateau. This group often occurs as part of a mosaic of multiple communities that are shrub- and herb-dominated and includes above-treeline, willow-dominated, snowmelt-fed basins that feed into streams. Shrubs range from short to tall (0.5-15 m). The shrub species that can be dominant reflect the large elevational gradient of this group and include *Alnus incana*, *Alnus oblongifolia*, *Alnus viridis*, *Betula occidentalis*, *Betula glandulosa*, *Betula occidentalis*, *Cornus sericea*, *Salix bebbiana*, *Salix boothii*, *Salix brachycarpa*, *Salix drummondiana*, *Salix eriocephala*, *Salix geyeriana*, *Salix monticola*, *Salix planifolia*, and *Salix wolfii*. Generally the upland vegetation surrounding these wet shrublands is either conifer or aspen forest. Stands occur on streambanks, stream benches and alluvial terraces in steep narrow to wide, low-gradient valley bottoms and floodplains with sinuous stream channels, as well as steep moist avalanche chutes. This group is generally found at higher elevations, but can be found anywhere from 1500-3475 m, and may occur at even lower elevations in the Canadian Rockies. Occurrences can also be found around seeps, fens, and isolated springs on hillslopes away from valley bottoms. Many of the plant associations found within this group are associated with beaver activity.

Classification Comments:

Similar NVC Types:

- G507 North Pacific Montane Riparian Woodland
- G322 Vancouverian Wet Shrubland: occurs at lower elevations along the Pacific Northwest coast.
- G526 Rocky Mountain-Great Basin Lowland-Foothill Riparian Shrubland: occurs at lower elevations and may overlap with G527.

Diagnostic Characteristics: Montane wet shrublands of the Rocky Mountains of Canada and the U.S., and mountain ranges in the Intermountain West. These shrublands line streams and valley bottoms and are often associated with beaver activity.

VEGETATION

Physiognomy and Structure: Montane wetlands dominated by short to tall (0.5-15 m) cold-deciduous shrubs with multiple stems, occurring as narrow bands of shrubs lining streambanks and alluvial terraces in narrow to wide, low-gradient valley bottoms and floodplains with sinuous stream channels.

Floristics: The dominant shrubs reflect the large elevational gradient and include *Alnus incana*, *Betula glandulosa*, *Betula occidentalis*, *Cornus sericea*, *Salix bebbiana*, *Salix boothii*, *Salix brachycarpa*, *Salix drummondiana*, *Salix eriocephala*, *Salix geyeriana*, *Salix monticola*, *Salix planifolia*, and *Salix wolfii*. Generally the upland vegetation surrounding these riparian systems is either conifer or aspen forest. Floristic information was compiled from Padgett (1982), Kovalchik (1987, 1993, 2001), Baker (1988, 1989a, 1989b, 1990), Padgett et al. (1988a, 1988b), Kittel (1993, 1994), Manning and Padgett (1995), Kittel et al. (1996, 1999a, 1999b), Walford (1996), Crowe and Clausnitzer (1997), Steen and Coupe (1997), and Muldavin et al. (2000a).

ENVIRONMENT & DYNAMICS

Environmental Description: *Soil/substrate/hydrology:* These are montane to subalpine riparian shrublands occurring as narrow bands lining streambanks and alluvial terraces in narrow to wide, low-gradient valley bottoms and floodplains with sinuous stream channels. Generally, the group is found at higher elevations, but can be found anywhere from 1500-3475 m, and may occur at even lower elevations in the Canadian Rockies. Occurrences can also be found around seeps, fens, and isolated springs on hillslopes away from valley bottoms. They occur on mineral soils or, if on organic soil, these are not deep (not >30-40 cm). Environmental information was compiled from Padgett (1982), Kovalchik (1987, 1993, 2001), Baker (1988, 1989a, 1989b, 1990), Padgett et al. (1988a, 1988b), Kittel (1993, 1994), Manning and Padgett (1995), Kittel et al. (1996, 1999a, 1999b), Walford (1996), Crowe and Clausnitzer (1997), Steen and Coupe (1997), and Muldavin et al. (2000a).

Dynamics: These shrublands are very tolerant of soil saturation, flooding and flooding disturbance. They require moist to saturated soils throughout the growing season, and regrow quickly after damage to tissue from flood and debris flows or avalanches.

DISTRIBUTION

Geographic Range: This group is found throughout the Rocky Mountain cordillera from New Mexico north into Montana and the Canadian Rockies of Alberta and British Columbia (including the isolated "island" mountain ranges of central and eastern Montana), and in mountainous areas of the Intermountain West and on the Colorado Plateau.

Spatial Scale & Pattern [optional]: Linear, Small patch

Nations: CA, US

States/Provinces: AB, AZ, BC, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]: 6:P, 7:C, 8:C, 9:C, 11:C, 18:C, 19:C, 20:C, 21:C, 25:C, 26:C, 68:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313D:CC, 315A:P?, 315H:PP, 321A:PP, 331A:C?, 331B:C?, 331J:CC, 341A:CP, 341B:CP, 341C:CP, 341D:CP, 341F:CC, 342A:CC, 342B:CP, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342J:CC, M242C:CP, M242D:CC, M261E:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M341B:CC, M341C:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Great Basin)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: High.

SYNONYMY

- < Riparian (422) (Shiflet 1994)

LOWER LEVEL UNITS

Alliances:

- A0977 *Salix lasiolepis* Wet Shrubland Alliance
- A1003 *Salix commutata* Wet Shrubland Alliance
- A3774 *Salix eastwoodiae* - *Salix lemmonii* Wet Shrubland Alliance
- A0981 *Salix monticola* Wet Shrubland Alliance
- A3770 *Salix wolfii* - *Salix brachycarpa* - *Betula glandulosa* Wet Shrubland Alliance
- A2563 *Salix orestera* Wet Shrubland Alliance
- A3974 *Crataegus douglasii* / *Symphoricarpos albus* Wet Shrubland Alliance

- A3973 *Celtis laevigata* var. *reticulata* / *Philadelphus lewisii* Wet Scrub Alliance
- A3771 *Alnus incana* - *Alnus viridis* Wet Shrubland Alliance
- A3769 *Salix boothii* - *Salix geyeriana* - *Salix lutea* Montane Wet Shrubland Alliance
- A3773 *Cornus sericea* - *Dasiphora fruticosa* ssp. *floribunda* - *Ribes* spp. Wet Shrubland Alliance
- A3772 *Betula occidentalis* Wet Shrubland Alliance

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2011)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 12/02/2015

Classif Resp Region: West

Internal Author: GK 12-10, 9-13, 12-15

REFERENCES

References: Baker 1988, Baker 1989a, Baker 1989b, Baker 1990, Crowe and Clausnitzer 1997, Faber-Langendoen et al. 2017a, Kittel 1993, Kittel 1994, Kittel et al. 1996, Kittel et al. 1999a, Kittel et al. 1999b, Kovalchik 1987, Kovalchik 1993, Kovalchik 2001, Manning and Padgett 1995, Muldavin et al. 2000a, Padgett 1982, Padgett et al. 1988a, Padgett et al. 1988b, Shiflet 1994, Steen and Coupé 1997, Szaro 1989, Walford 1996, Willoughby 2007

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G527. Western Montane-Subalpine Riparian & Seep Shrubland

A3771. *Alnus incana* - *Alnus viridis* Wet Shrubland Alliance

Type Concept Sentence: Vegetation types within this riparian tall (>1.5 m) shrubland alliance typically occur adjacent to streams and in mountain meadows at moderate to high-elevation (1200-3000 m) riparian habitats of the northern Rocky Mountains and Cascade Range where deep snow accumulations are common. Landforms associated with this alliance are streambanks, alluvial bars, and floodplains. *Alnus incana* or *Alnus viridis* ssp. *sinuata* forms a dense canopy with at least 90% cover. *Acer circinatum* may be codominant in the tall-shrub layer in some stands.

OVERVIEW

Scientific Name: *Alnus incana* - *Alnus viridis* Wet Shrubland Alliance

Common Name (Translated Scientific Name): Gray Alder - Green Alder Wet Shrubland Alliance

Colloquial Name: Western Alder Wet Shrubland

Type Concept: *Alnus incana* or *Alnus viridis* ssp. *sinuata* forms a dense canopy with at least 90% cover. *Acer circinatum* may be codominant in the tall-shrub layer in some stands. The diverse understory shrub layer may include *Acer glabrum*, *Ribes lacustre*, and *Sorbus scopulina*. In the northern Rocky Mountains, *Abies lasiocarpa* colonizes these communities, and scattered seedlings or saplings may be present. Low cold-deciduous or ericaceous shrubs may be abundant, including *Betula occidentalis*, *Cornus sericea*, *Oplopanax horridus*, *Paxistima myrsinites*, *Ribes hudsonianum*, *Rubus parviflorus*, *Rubus spectabilis*, *Salix drummondiana*, *Sambucus racemosa*, *Symphoricarpos albus*, and *Vaccinium* spp. The forb layer is sparse and may include *Achillea millefolium*, *Aconitum columbianum*, *Canadanthus modestus* (= *Aster modestus*), *Galium triflorum*, *Heracleum maximum* (= *Heracleum lanatum*), *Osmorhiza berteroi* (= *Osmorhiza chilensis*), *Polystichum munitum*, *Senecio triangularis*, *Symphyotrichum spathulatum* (= *Aster occidentalis*), *Thalictrum occidentale*, *Urtica dioica*, and *Veratrum viride*. The graminoid layer is usually dominated by 1 or 2 species that include *Agrostis stolonifera* and *Calamagrostis canadensis*. The fern and fern allies layer is generally dense with at least 40% cover. The dominant species typically are *Gymnocarpium dryopteris* and *Athyrium filix-femina*. This alliance is found in the Rocky Mountains, the highlands of Arizona, intermountain ranges of Nevada, and montane areas of California. Stands occur adjacent to streams and in mountain meadows at moderate to high-elevation (1200-3000 m) riparian habitats. Landforms associated with this alliance are streambanks, alluvial bars, and floodplains. Soils are shallow, skeletal alluvium over water-worked cobbles and gravels.

Classification Comments: Alder- and maple-dominated riparian and wetland shrublands.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Tall (>1.5 m) shrublands dominated by *Alnus incana*, *Alnus viridis* ssp. *sinuata*, *Alnus oblongifolia*, and/or *Acer glabrum*.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance is dominated by a relatively dense tall-shrub layer that is 2-15 m tall, that may or may not have a short-shrub layer that is <2 m tall. The herbaceous layer is dominated by perennial forbs with some perennial graminoids.

Floristics: *Alnus incana*, *Alnus viridis ssp. sinuata*, *Alnus oblongifolia*, and/or *Acer glabrum* form a dense canopy layer. *Acer circinatum* may be codominant in the tall-shrub layer in some stands. The diverse understory shrub layer may include *Ribes lacustre*, and *Sorbus scopulina*. In the northern Rocky Mountains, *Abies lasiocarpa* may colonize these communities, and scattered seedlings or saplings may be present. Low cold-deciduous or ericaceous shrubs may be abundant, including *Cornus sericea*, *Betula occidentalis*, *Oplopanax horridus*, *Paxistima myrsinites*, *Ribes hudsonianum*, *Rubus parviflorus*, *Rubus spectabilis*, *Sambucus racemosa*, *Salix drummondiana*, *Symphoricarpos albus*, and *Vaccinium* spp. The forb layer is sparse and may include *Achillea millefolium*, *Aconitum columbianum*, *Canadanthus modestus* (= *Aster modestus*), *Galium triflorum*, *Heracleum maximum* (= *Heracleum lanatum*), *Osmorhiza berteroi* (= *Osmorhiza chilensis*), *Polystichum munitum*, *Senecio triangularis*, *Symphyotrichum spathulatum* (= *Aster occidentalis*), *Thalictrum occidentale*, *Urtica dioica*, and *Veratrum viride*. The graminoid layer is usually dominated by 1 or 2 species that include *Agrostis stolonifera* and *Calamagrostis canadensis*. The fern and fern allies layer is generally dense with at least 40% cover. The dominant species typically are *Gymnocarpium dryopteris* and *Athyrium filix-femina*.

ENVIRONMENT & DYNAMICS

Environmental Description: Vegetation types within this riparian tall (>1.5 m) shrubland alliance typically occur adjacent to streams and in mountain meadows at moderate to high-elevation (1200-3000 m) riparian habitats of the northern Rocky Mountains and Cascade Range where deep snow accumulations are common. Landforms associated with this alliance are streambanks, alluvial bars, and floodplains. Sites are young, active channel shelves that lie between active and flood-stage streambanks along second-order and larger streams in moderately graded (3-5%) valleys. Soils are shallow, skeletal alluvium over water-worked cobbles and gravels. Active channel shelves have surface soil textures that are loamy sands, while older sites are silts and loam. Available water-holding capacity is low; surface water is present briefly during the growing season. The water table usually lies well below the ground surface.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is found in the Rocky Mountains of eastern Oregon, Washington, Idaho, Montana, British Columbia, Alberta, Wyoming, Colorado, Utah, and New Mexico, the highlands of Arizona, intermountain ranges of Nevada, and montane areas of California.

Nations: CA, US

States/Provinces: AB, AZ, BC, CA, CO, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Alnus incana* (Mountain alder thicket) Alliance (Sawyer et al. 2009) [63.210.00]
- ? *Alnus viridis* (Sitka alder thickets) Provisional Alliance (Sawyer et al. 2009) [63.220.00]

LOWER LEVEL UNITS

Associations:

- CEGLO01158 *Alnus* spp. Avalanche Chute Wet Shrubland
- CEGLO02633 *Alnus viridis ssp. sinuata* / Mesic Forbs Wet Shrubland
- CEGLO01146 *Alnus incana* / *Equisetum arvense* Wet Shrubland
- CEGLO01156 *Alnus viridis ssp. sinuata* / *Athyrium filix-femina* - *Cinna latifolia* Wet Shrubland
- CEGLO01153 *Alnus incana* / *Symphoricarpos albus* Wet Shrubland
- CEGLO01144 *Alnus incana* / *Carex (aquatilis, lenticularis, luzulina, pellita)* Wet Shrubland
- CEGLO02602 *Alnus viridis ssp. sinuata* / *Rubus (lasiococcus, parviflorus)* Wet Shrubland
- CEGLO02628 *Alnus incana* / *Athyrium filix-femina* Wet Shrubland
- CEGLO01141 *Alnus incana* Wet Shrubland
- CEGLO00481 *Alnus incana* / *Scirpus microcarpus* Wet Shrubland
- CEGLO01145 *Alnus incana* / *Cornus sericea* Wet Shrubland

- CEGLO02652 *Alnus incana* - *Salix drummondiana* Wet Shrubland
- CEGLO01142 *Alnus incana* - *Betula occidentalis* Wet Shrubland
- CEGLO01148 *Alnus incana* / Mesic Graminoids Wet Shrubland
- CEGLO00122 *Alnus incana* / *Carex scopulorum* var. *prionophylla* Wet Shrubland
- CEGLO01152 *Alnus incana* / *Spiraea douglasii* Wet Shrubland
- CEGLO01143 *Alnus incana* / *Calamagrostis canadensis* Wet Shrubland
- CEGLO02629 *Alnus incana* / *Lysichiton americanus* Wet Shrubland
- CEGLO02651 *Alnus incana* - *Salix* (*monticola*, *lucida*, *ligulifolia*) Wet Shrubland
- CEGLO01151 *Alnus incana* / *Ribes* (*inerme*, *hudsonianum*, *lacustre*) Wet Shrubland
- CEGLO01147 *Alnus incana* / Mesic Forbs Wet Shrubland
- CEGLO00228 *Alnus incana* / *Glyceria striata* Wet Shrubland
- CEGLO02687 *Alnus incana* ssp. *tenuifolia* - *Salix irrorata* Wet Shrubland

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Faber-Langendoen et al. 2017b, Sawyer et al. 2009

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G527. Western Montane-Subalpine Riparian & Seep Shrubland

A3772. *Betula occidentalis* Wet Shrubland Alliance

Type Concept Sentence: This riparian shrubland alliance occurs on moderately wide stream benches and floodplains. It may also occur on hillside seeps in the mountains and foothills. Sites are relatively flat (1-5% slope) stream benches and often extend away from the channel edge. The substrate is usually exposed, but surface water can be present for variable periods without detectable seasonal periodicity. *Betula occidentalis* forms a dense, closed canopy with cover up to 95%. It occurs in the Rocky Mountains, intermountain ranges of Nevada and Sierra Nevada of California.

OVERVIEW

Scientific Name: *Betula occidentalis* Wet Shrubland Alliance

Common Name (Translated Scientific Name): Water Birch Wet Shrubland Alliance

Colloquial Name: Western Water Birch Wet Shrubland

Type Concept: In this alliance, *Betula occidentalis* forms a dense, closed canopy with cover up to 95%. The shrub layer may also include *Alnus incana*, *Artemisia tridentata* ssp. *vaseyana*, *Cornus sericea*, *Crataegus douglasii*, *Dasiphora fruticosa* ssp. *floribunda* (= *Pentaphylloides floribunda*), *Juniperus horizontalis*, *Purshia tridentata*, *Purshia tridentata*, *Rosa woodsii*, and *Salix* spp. Due to the dense shrub canopy, herbaceous undergrowth is usually limited. Forb species include *Aquilegia formosa*, *Maianthemum stellatum* (= *Smilacina stellata*), and *Urtica dioica*. Graminoid cover is usually low and is typically composed of introduced hay grasses. This riparian shrubland alliance occurs in the Rocky Mountains, intermountain ranges of Nevada and Sierra Nevada of California on moderately wide stream benches and floodplains. It may also occur on hillside seeps in the mountains and foothills. Sites are relatively flat (1-5% slope) stream benches and often extend away from the channel edge. The substrate is usually exposed, but surface water can be present for variable periods without detectable seasonal periodicity. Inundation is not predictable to a given season and is dependent upon highly localized rainstorms (e.g., summer thunderstorms in eastern Oregon and Idaho). Soils are derived from alluvium and are fairly shallow, ranging from 30 cm to greater than 60 cm. Substrates are typically alluvial and range from fairly shallow, finer-textured soils to gravel and boulders. Soils usually have signs of saturation (mottles).

Classification Comments: Tall riparian shrublands may be mixed with other tall riparian shrubland alliances such as *Alnus*- and *Salix*-dominated communities.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Tall (>1.5 m) shrubland dominated by *Betula occidentalis*.

VEGETATION

Physiognomy and Structure: The tall-shrub layer is dominated by broad-leaved deciduous shrubs or small trees reaching heights of up to 8-9 m. The tree canopy is dominated by conifers of variable density. The tall-shrub stratum is dense with up to 98% cover. The short-shrub layer (1-2 m tall) is sparse to dense with 25-60% cover. The graminoid layer consists of mainly introduced hay grasses and constitutes up to 35% cover. The forb layer has 0-40% cover depending on the overstory canopy cover.

Floristics: Plant associations within this alliance are classified as intermittently flooded, cold-deciduous shrublands. *Betula occidentalis* forms a dense, closed canopy with cover up to 95%. The shrub layer may also include *Alnus incana*, *Artemisia tridentata* ssp. *vaseyana*, *Cornus sericea*, *Crataegus douglasii*, *Dasiphora fruticosa* ssp. *floribunda* (= *Pentaphylloides floribunda*), *Juniperus horizontalis*, *Purshia tridentata*, *Rosa woodsii*, and *Salix* spp. The tree canopy has a moderate cover and includes any of the following species: *Abies lasiocarpa*, *Acer negundo*, *Alnus rhombifolia*, *Picea pungens*, *Populus angustifolia*, *Populus tremuloides*, *Pseudotsuga menziesii*, and *Thuja occidentalis*. Due to the dense shrub canopy, herbaceous undergrowth is usually limited. Forb species include *Aquilegia formosa*, *Maianthemum stellatum* (= *Smilacina stellata*), and *Urtica dioica*. Graminoid cover is usually low and includes *Carex utriculata*, *Carex pellita* (= *Carex lanuginosa*), *Carex microptera*, *Carex nebrascensis*, *Glyceria* spp., *Juncus balticus*, and introduced hay grasses.

ENVIRONMENT & DYNAMICS

Environmental Description: Plant associations within this alliance occupy moderately wide stream benches and floodplains in moderately wide valleys and on hillside seeps in the mountains and foothills. Sites are relatively flat (1-5% slope) stream benches and often extend away from the channel edge. Elevation ranges up to 2700 m in Idaho. The substrate is usually exposed, but surface water can be present for variable periods without detectable seasonal periodicity. Inundation is not predictable to a given season and is dependent upon highly localized rainstorms e.g., summer thunderstorms in eastern Oregon and Idaho. Soils derived from alluvium are fairly shallow, ranging from 30 to greater than 60 cm.

Dynamics: *Betula occidentalis* is highly adapted to most forms of disturbance. However, heavy grazing may eliminate the more palatable native graminoids, thereby replacing them with introduced species or nonpalatable native species in the understory (Hansen et al. 1995).

DISTRIBUTION

Geographic Range: This alliance is found in the Rocky Mountains of eastern Oregon and Washington, Idaho, British Columbia, Alberta, Montana, Wyoming, Colorado, New Mexico, and Utah, as well as intermountain ranges of Nevada and Sierra Nevada of California.

Nations: CA, US

States/Provinces: AB, BC, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- ? *Betula occidentalis* (Water birch thicket) Alliance (Sawyer et al. 2009) [63.610.00]

LOWER LEVEL UNITS

Associations:

- CEG003450 *Betula occidentalis* - *Celtis laevigata* var. *reticulata* Wet Shrubland
- CEG000489 *Betula occidentalis* / *Philadelphus lewisii* - *Symphoricarpos albus* Wet Shrubland
- CEG001083 *Betula occidentalis* - *Dasiphora fruticosa* ssp. *floribunda* Wet Shrubland
- CEG001080 *Betula occidentalis* Wet Shrubland
- CEG002668 *Betula occidentalis* / *Philadelphus lewisii* Wet Shrubland
- CEG001084 *Betula occidentalis* / *Purshia tridentata* / *Hesperostipa comata* Wet Shrubland
- CEG001162 *Betula occidentalis* / *Maianthemum stellatum* Wet Shrubland
- CEG001081 *Betula occidentalis* / *Crataegus douglasii* Wet Shrubland
- CEG001161 *Betula occidentalis* / *Cornus sericea* Wet Shrubland
- CEPP009680 *Betula occidentalis* Desert Spring Shrubland
- CEG002654 *Betula occidentalis* / Mesic Graminoids Wet Shrubland

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Faber-Langendoen et al. 2017b, Hansen et al. 1995, Sawyer et al. 2009

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G527. Western Montane-Subalpine Riparian & Seep Shrubland

A3973. *Celtis laevigata* var. *reticulata* / *Philadelphus lewisii* Wet Scrub Alliance

Type Concept Sentence: This *Celtis laevigata* var. *reticulata*- and/or *Philadelphus lewisii*-dominated scrub woodland and shrubland alliance is found in the lower montane and foothill regions around the Columbia Basin, and north and east into the Central Rockies in Idaho and northwestern Wyoming where it occurs as numerous relatively small stands, dispersed and clustered in valley bottoms along riparian margins, on lower slopes of river terraces near seepage lines, and on scree slopes.

OVERVIEW

Scientific Name: *Celtis laevigata* var. *reticulata* / *Philadelphus lewisii* Wet Scrub Alliance

Common Name (Translated Scientific Name): Netleaf Hackberry / Lewis' Mock Orange Wet Scrub Alliance

Colloquial Name: Valley Bottom Netleaf Hackberry / Lewis' Mock Orange Wet Scrub

Type Concept: The upper canopy of this scrub woodland and shrubland alliance is dominated by *Celtis laevigata* var. *reticulata* and/or *Philadelphus lewisii*, often forming dense thickets. *Celtis laevigata* var. *reticulata* occurs either as a short tree or tall shrub between 3-6 m in height. *Philadelphus lewisii* occurs as a tall shrub between 2-5 m in height. The short-shrub layer often contains *Rosa woodsii*, *Rosa nutkana*, or *Sambucus nigra* ssp. *cerulea* with other riparian shrubs such as *Holodiscus discolor* or occasionally *Symphoricarpos albus* and *Toxicodendron rydbergii* on moist sites. If present, the herbaceous layer may be dominated by the perennial bunchgrass *Pseudoroegneria spicata*. *Poa secunda* and *Aristida purpurea* var. *longiseta* are often present also. This alliance is found in the lower montane and foothill regions around the Columbia Basin, and north and east into the Central Rockies in Idaho and northwestern Wyoming, and south into canyons in the Colorado Plateau and in riparian areas in the southeastern Colorado plains. Stands occur as numerous relatively small stands, dispersed and clustered in valley bottoms along riparian margins, on lower slopes of river terraces near seepage lines, and on scree slopes. It can also occur in the active floodplain of intermittent streams and deep canyon bottoms of the Snake and Salmon rivers. Elevations range from 250-550 m in the Columbia Basin and 1400-1700 m in Colorado. Although sites are predominately on hot, dry southeastern to southwestern aspects, these trees access additional soil moisture that accumulates at the base of the colluvial slopes, or are riparian. Soils are poorly developed, well-drained alluvial or colluvial sands that often have a high percentage of rock fragments.

Classification Comments: Stands included in this alliance from riparian areas in the southeastern Colorado plains and canyons in the Colorado Plateau (Carsey et al. 2003a) need further review as they may be more appropriately placed in a plains riparian alliance or Colorado Plateau seep alliance.

Internal Comments: KAS 2-14: This is a messy alliance with some associations occurring as both upland seep associations and riparian stands in the PNW. More review is need to clarify if this is the appropriate group for some of this associations or if they need to be split into riparian and upland types. In addition, stands of *Celtis laevigata* var. *reticulata* / *Pseudoroegneria spicata* Woodland (CEGL001085) attributed to Colorado is a long way from the Columbia Basin. Carsey et al. (2003a) describe two occurrences in Colorado. The Colorado Plateau stands are likely *Celtis laevigata* var. *reticulata* Slickrock Canyon Woodland (CEGL002359) and possibly the one in a riparian area in the southeastern Colorado plains.

Other Comments:

Similar NVC Types: Western Interior Riparian Forest & Woodland Group (G797) is a western group that also has stands dominated by *Celtis laevigata* var. *reticulata* included in it and may be more appropriate for stands of this alliance described in Colorado.

Diagnostic Characteristics: This scrub woodland and shrubland alliance is dominated by diagnostic species *Celtis laevigata* var. *reticulata* and/or *Philadelphus lewisii*, often forming dense thickets. *Celtis laevigata* var. *reticulata* occurs either as a short tree or tall shrub between 3-6 m in height. *Philadelphus lewisii* occurs as a tall shrub between 2-5 m in height.

VEGETATION

Physiognomy and Structure: Vegetation in this alliance has an open to moderately dense layer of broad-leaved deciduous small trees or shrubs forming a scrub woodland or tall shrubland less than 6 m tall.

Floristics: This scrub woodland and shrubland alliance has an upper canopy dominated by *Celtis laevigata* var. *reticulata* and/or *Philadelphus lewisii*, often forming dense thickets. *Celtis laevigata* var. *reticulata* occurs either as a short tree or tall shrub between 3-6 m in height. *Philadelphus lewisii* occurs as a tall shrub between 2-5 m in height. The short-shrub layer often contains *Rosa woodsii*, *Rosa nutkana*, or *Sambucus nigra* ssp. *cerulea* with other riparian shrubs such as *Holodiscus discolor* or occasionally *Amelanchier alnifolia*, *Crataegus douglasii*, *Cornus sericea*, *Frangula purshiana* (= *Rhamnus purshiana*), *Prunus virginiana*, and *Symphoricarpos albus*. *Toxicodendron rydbergii* is more abundant on moist sites. If present, the herbaceous layer has sparse to moderate cover. It is dominated by the perennial bunchgrass *Pseudoroegneria spicata* with smaller amounts of *Aristida purpurea* var. *longisetata* and *Poa secunda*. Other species include forbs such as *Achillea millefolium*, *Erigeron pumilus*, *Galium aparine*, *Heterotheca villosa*, *Lotus unifoliolatus* (= *Lotus purshianus*), *Scutellaria angustifolia*, *Stellaria nitens*, and the cactus *Opuntia polyacantha*. Mosses and lichens are usually present and average about 20% cover. Litter cover is relatively high. Exotic species may dominate these often disturbed stands, particularly the annual grass *Bromus tectorum*, but also *Bromus arvensis* (= *Bromus japonicus*), *Hypericum perforatum*, *Melilotus officinalis*, *Verbascum* spp., and others.

ENVIRONMENT & DYNAMICS

Environmental Description: This scrub woodland and shrubland alliance is found in the lower montane and foothill regions around the Columbia Basin, and north and east into the Central Rockies in Idaho and northwestern Wyoming and south into canyons in the Colorado Plateau and in riparian areas in the southeastern Colorado plains. It can occur in the active floodplain of intermittent streams and deep canyon bottoms of the Snake and Salmon rivers. Elevations range from 250-550 m in the Columbia Basin (Tisdale 1986) and 1400-1700 m in Colorado (Carsey et al. 2003a). The climate is temperate, continental with a mean annual precipitation of approximately 25-30 cm. Precipitation primarily occurs in the winter as snow or rain. This moisture is stored in the soil and utilized during the typically dry summers. Stands are typically found on moderately steep footslopes and toeslopes in canyons where gravel and boulder-sized colluvium accumulate; near the seepage lines on river terraces; on riparian margins and river bars; and forest openings in the mountains. Although sites are predominately on hot, dry southeastern to southwestern aspects, these trees access additional soil moisture that accumulates at the base of the colluvial slopes, or are riparian. Soils are poorly developed, well-drained alluvial or colluvial sands that often have a high percentage of rock fragments. There are reports of this alliance occurring on colluvial talus cones (Daubenmire 1970), but generally sites are more stable than adjacent *Rhus glabra* stands. On lowland sites surface water can be present for variable periods without detectable seasonal periodicity. Inundation is not predictable to a given season and is dependent upon highly localized rainstorms. Other adjacent stands may include other riparian vegetation and xeric grasslands dominated by *Pseudoroegneria spicata* or *Poa secunda* on the upper slopes.

Dynamics: *Celtis laevigata* var. *reticulata* tolerates fires. It is rarely killed when burned and sprouts vigorously from underground rhizomes following a fire (FEIS 1998). However, the sprouts and seedlings may not compete well with grassland vegetation, and frequent fire is thought to exclude *Celtis laevigata* var. *reticulata* from grasslands (Johnson and Simon 1987). These stands occur on rocky slopes that are likely to have few fires (Johnson and Simon 1987). The biggest threat is exotic plants that have invaded many stands. Common exotics include annual grasses such as *Bromus tectorum*, *Bromus arvensis*, and *Bromus briziformis*, and the perennial forbs *Hypericum perforatum* and *Conyza canadensis*.

DISTRIBUTION

Geographic Range: This scrub woodland and shrubland alliance is found in the lower montane and foothill regions around the Columbia Basin, and north and east into the Central Rockies in Idaho and northwestern Wyoming and south into canyons in the Colorado Plateau and in riparian areas in the southeastern Colorado plains.

Nations: US

States/Provinces: CA?, CO, ID, OR, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- >< *Celtis reticulata* Series (Tisdale 1986)

LOWER LEVEL UNITS

Associations:

- CEGLO01085 *Celtis laevigata* var. *reticulata* / *Pseudoroegneria spicata* Wet Scrub
- CEGLO00792 *Celtis laevigata* var. *reticulata* / *Philadelphus lewisii* Wet Scrub
- CEGLO00875 *Philadelphus lewisii* / *Symphoricarpos albus* Wet Shrubland
- CEGLO03451 *Celtis laevigata* var. *reticulata* / *Toxicodendron rydbergii* Wet Scrub
- CEGLO01170 *Philadelphus lewisii* Wet Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by D. Culver.

Version Date: 2014/03/14

REFERENCES

References: Carsey et al. 2003a, Daubenmire 1970, Evans 1989a, FEIS 1998, Faber-Langendoen et al. 2017b, Johnson and Simon 1987, Moseley 1987a, Tisdale 1986

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G527. Western Montane-Subalpine Riparian & Seep Shrubland

A3773. *Cornus sericea* - *Dasiphora fruticosa* ssp. *floribunda* - *Ribes* spp. Wet Shrubland Alliance

Type Concept Sentence: This western alliance comprises short-statured to medium-tall (usually <1.5 m, but can be up to 3 m) shrublands dominated by *Cornus sericea*, *Dasiphora fruticosa* ssp. *floribunda*, *Rosa woodsii*, *Ribes lacustre*, and/or *Ribes hudsonianum*. Understories are graminoid- or forb-dominated. Environments are riparian areas, wet valley bottoms and lower slopes that have seasonal subirrigation.

OVERVIEW

Scientific Name: *Cornus sericea* - *Dasiphora fruticosa* ssp. *floribunda* - *Ribes* spp. Wet Shrubland Alliance

Common Name (Translated Scientific Name): Red-osier Dogwood - Shrubby-cinquefoil - Currant species Wet Shrubland Alliance

Colloquial Name: Western Non-willow Wet Shrubland

Type Concept: This western alliance comprises short-statured to medium-tall (usually <1.5 m, but can be up to 3 m) shrublands dominated by *Cornus sericea*, *Dasiphora fruticosa* ssp. *floribunda*, *Rosa woodsii*, *Ribes lacustre*, and/or *Ribes hudsonianum*. Understories are graminoid- or forb-dominated. Environments are riparian areas, wet valley bottoms and lower slopes that have seasonal subirrigation.

Classification Comments: These are riparian shrublands that are not wet enough to support *Salix* or *Alnus* species.

Internal Comments: mjr 8-15: CA? added based on member distribution. mjr 2-15: NV added for MOJN.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Riparian shrublands dominated by *Cornus sericea*, *Dasiphora fruticosa* ssp. *floribunda*, *Rosa woodsii*, *Ribes lacustre*, and/or *Ribes hudsonianum*.

VEGETATION

Physiognomy and Structure: The short-shrub stratum is dominated by broad-leaved deciduous shrubs that typically are 1 m tall or less. The open canopy cover ranges from 10-90%. The herbaceous layer can be sparse with heavy overstory or dense graminoid cover formed by rhizomatous sedges and bunch grasses. The forb layer is usually dominated by perennial forbs and can be sparse to nonexistent in some stands.

Floristics: Plant associations within this alliance are classified as temporarily flooded, cold-deciduous shrublands. *Cornus sericea*, *Dasiphora fruticosa* ssp. *floribunda* (= *Pentaphylloides floribunda*), or *Ribes lacustre* dominates the overstory. Other shrub species may include *Acer glabrum*, *Alnus incana*, *Artemisia cana*, *Artemisia tridentata* ssp. *vaseyana*, *Betula occidentalis*, *Cornus sericea* (= *Cornus stolonifera*), *Juniperus communis*, *Lonicera involucrata*, *Ribes inerme*, *Rosa woodsii*, *Rubus idaeus*, *Salix bebbiana*, and other *Salix* species. The herbaceous understory is sparse to moderate cover that may include graminoids *Andropogon gerardii*, *Bromus ciliatus*, *Carex aquatilis*, *Carex buxbaumii*, *Carex microptera*, *Carex pachystachya*, *Festuca campestris*, *Festuca idahoensis*, *Festuca rubra*, *Juncus arcticus* ssp. *littoralis* (= *Juncus balticus*), *Muhlenbergia filiformis*, *Phalaris arundinacea*, *Poa palustris*, *Poa secunda*, and/or *Schizachyrium scoparium*, and/or forbs such as *Galium triflorum*, *Heracleum maximum* (= *Heracleum lanatum*),

Maianthemum stellatum, *Mertensia ciliata*, *Saxifraga odontoloma*, and/or *Trifolium longipes*. Exotic forage species such as *Phleum pratense*, *Poa pratensis*, and the annual forb *Taraxacum officinale* may be present in disturbed stands.

ENVIRONMENT & DYNAMICS

Environmental Description: Plant associations within this alliance occur adjacent to glacial depressions, terraces along meandering streams, slopes near springs and seeps, steep scree slopes, or broad mountain meadows. They may occur in foothill canyons, on intermittent streams with beds of limestone cobbles and boulders, or near springs at the base of limestone talus or limestone bedrock. They typically occur on alluvial terraces adjacent to stream channels and near seeps on moist toeslopes (slope 0-10%) of canyon walls. They also occur on narrow stream benches in ravines and on narrow terraces of wider valleys. They range in elevation from 860 to 3000 m. Surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface. Parent materials for sites supporting stands of this alliance are either alluvial-glacial or organic. The soils are typically sandy loams over sand and gravel layers.

Dynamics: Heavily grazed sites may support *Dasiphora*-dominated communities (Komarkova 1986, Padgett et al. 1989). With continuous heavy grazing, *Dasiphora fruticosa* ssp. *floribunda* will increase in abundance because it is unpalatable to livestock. Other species that increase with grazing are *Poa pratensis*, *Juncus arcticus* ssp. *littoralis* and *Taraxacum officinale* (Padgett et al. 1989). Stands dominated by *Cornus sericea* forms a relatively stable community because of its strong rhizomes and stolons (Hansen et al. 1988b).

DISTRIBUTION

Geographic Range: This western alliance is found in eastern Oregon and Washington, Idaho, Montana, Wyoming, Colorado, Nevada and Utah.

Nations: CA?, US

States/Provinces: CO, ID, MT, NV, OR, UT, WA, WY

TNC Ecoregions [optional]: 11:C

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > *Rosa woodsii* (Interior rose thickets) Provisional Alliance (Sawyer et al. 2009) [63.320.00]
- > *Rosa woodsii* Shrubland Alliance (Evens et al. 2014)

LOWER LEVEL UNITS

Associations:

- C EGL001107 *Dasiphora fruticosa* ssp. *floribunda* / *Deschampsia cespitosa* Wet Shrubland
- C EGL001167 *Cornus sericea* / *Heracleum maximum* Wet Shrubland
- C EGL001165 *Cornus sericea* Rocky Mountain Wet Shrubland
- C EGL001172 *Ribes lacustre* / *Mertensia ciliata* Wet Shrubland
- C EGL003445 *Ribes lacustre* - *Ribes hudsonianum* / *Cinna latifolia* Wet Shrubland
- C EGL001126 *Rosa woodsii* Wet Shrubland
- C EGL003446 *Ribes lacustre* - *Ribes hudsonianum* / *Glyceria striata* Wet Shrubland
- C EGL001166 *Cornus sericea* / *Galium triflorum* Wet Shrubland

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Evens et al. 2014, Faber-Langendoen et al. 2017b, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Komarkova 1986, Padgett et al. 1988b, Padgett et al. 1989, Sanderson and March 1996, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Tuhý and Jensen 1982, Welsh et al. 1987, Youngblood et al. 1985a, Youngblood et al. 1985b

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G527. Western Montane-Subalpine Riparian & Seep Shrubland

A3974. *Crataegus douglasii* / *Symphoricarpos albus* Wet Shrubland Alliance

Type Concept Sentence: This deciduous broad-leaved shrubland alliance is dominated by *Crataegus douglasii*, often forming dense thickets, and is found in the lower montane and foothill regions around the Columbia Basin, and north and east into the Central Rockies in Idaho and northwestern Wyoming.

OVERVIEW

Scientific Name: *Crataegus douglasii* / *Symphoricarpos albus* Wet Shrubland Alliance

Common Name (Translated Scientific Name): Black Hawthorn / Common Snowberry Wet Shrubland Alliance

Colloquial Name: Valley Bottom Black Hawthorn / Common Snowberry Wet Shrubland

Type Concept: The shrub canopy of this deciduous broad-leaved shrubland alliance is dominated by *Crataegus douglasii*, often forming dense thickets. Occasional the broad-leaved deciduous trees *Populus tremuloides* or *Populus balsamifera ssp. trichocarpa* may codominate the tree layer for a period of years before dying back from heart rot. Other trees are occasionally present with low cover. The understory is dominated by short shrubs or herbaceous species. Common shrubs include *Rosa nutkana*, *Rosa woodsii*, *Spiraea betulifolia*, and *Symphoricarpos albus*. The sparse to moderately dense herbaceous layer is composed of perennial graminoids, such as *Deschampsia cespitosa*, *Elymus glaucus*, and *Leymus cinereus* (= *Elymus cinereus*), and diverse forbs. The herbaceous layer is relatively depauperate if *Heracleum maximum* is abundant due to the extreme shading. Many weedy introduced grasses are common, such as the perennial forage species *Bromus inermis*, *Phleum pratense*, *Poa pratensis*, and invasive annual grass *Bromus tectorum*. This alliance is found in the lower montane and foothill regions around the Columbia Basin, and north and east into the Central Rockies in Idaho and northwestern Wyoming. Stands occur on relatively moist sites on deep soils within flat valleys on low-gradient streams with broad floodplains that flood seasonally. Elevations range between 400 and 850 m. Stands often extend up adjacent north-facing toeslopes where seepage provides constant moisture. Soils are typically deep and fine-textured.

Classification Comments: Associations within this alliance are often degraded and poorly described. Characteristics which differentiate this alliance from the moister *Crataegus douglasii* alliances are not clearly quantified.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: The alliance is characterized by dominance of diagnostic species *Crataegus douglasii*, often forming dense thickets 3-8 m tall. Broad-leaved deciduous trees *Populus tremuloides* and *Populus balsamifera ssp. trichocarpa* may codominate the tree layer for a period of years before dying back and *Crataegus douglasii* becoming dominant again. Occasional individuals of *Alnus incana*, *Betula occidentalis*, or *Celtis laevigata var. reticulata* may be present with low cover. The understory is dominated by short shrubs or herbaceous species. If present the shrub layer is composed of associated species *Amelanchier alnifolia*, *Cornus sericea*, *Rosa nutkana*, *Rosa woodsii*, *Salix exigua*, *Spiraea betulifolia*, or *Symphoricarpos albus*. A sparse to moderately dense herbaceous layer may be present, typically composed of mesic perennial graminoids and forbs. Associated species include grasses *Deschampsia cespitosa*, *Elymus glaucus*, *Leymus cinereus*, and many forbs such as *Geum macrophyllum*, *Heracleum maximum*, *Hydrophyllum fendleri*, *Iris missouriensis*, *Lithophragma parviflorum*, *Pteridium aquilinum*, and *Urtica dioica*.

VEGETATION

Physiognomy and Structure: Associations in this alliance generally support a dense thicket of tall (2-8 m) cold-deciduous woody shrubs with a secondary canopy of low shrubs. The herbaceous layer is usually well-developed and diverse, ranging from low-statured graminoids to coarse forbs approaching 2 m in height. A phase described by Daubenmire (1970) has an emergent open tree canopy of cold-deciduous trees, but this does not occur in all stands.

Floristics: The shrub canopy of this deciduous broad-leaved shrubland alliance is dominated by *Crataegus douglasii*, often forming dense thickets 3-7 m tall. Occasionally the broad-leaved deciduous trees *Populus tremuloides* or *Populus balsamifera ssp. trichocarpa* may codominate the tree layer for a period of years before dying back from heart rot (Daubenmire 1970). These *Populus*-codominated phases may repeat periodically when *Populus* stems sprout from roots. The process is described by Daubenmire (1970). Other trees occasionally present with low cover are *Alnus incana*, *Betula occidentalis*, or *Celtis laevigata var. reticulata*, but they never dominate the stand. The understory is dominated by short shrubs or herbaceous species. Shrubs may include *Amelanchier alnifolia*, *Cornus sericea*, *Rosa nutkana*, *Rosa woodsii*, *Salix exigua*, *Spiraea betulifolia*, and *Symphoricarpos albus*. The sparse to moderately dense herbaceous layer is composed of perennial graminoids, such as *Carex* spp., *Deschampsia cespitosa*, *Elymus glaucus*, and *Leymus cinereus* (= *Elymus cinereus*), and forbs such as *Achillea millefolium*, *Besseyia rubra*, *Galium boreale*, *Geranium viscosissimum*, *Geum macrophyllum*, *Heracleum maximum*, *Hydrophyllum fendleri*, *Iris missouriensis*, *Lithophragma parviflorum*, *Osmorhiza berteroi*, *Potentilla arguta*, *Potentilla gracilis*, *Pteridium aquilinum*, and *Urtica dioica*. The herbaceous layer is relatively depauperate if *Heracleum maximum* is abundant due to extreme shading. Many weedy introduced

grasses are common in the understories of most *Crataegus* stands. These can include perennial forage species *Bromus inermis*, *Phleum pratense*, *Poa pratensis*, invasive annual grass *Bromus tectorum*, and many others.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance is found in the lower montane and foothill regions around the Columbia Basin, and north and east into the Central Rockies in Idaho and northwestern Wyoming. Elevations range between 400 and 850 m. The climate of the region is characterized by a mix of continental and maritime influences. It is in the rainshadow of the Cascades, with annual precipitation between 23 and 51 cm (9-20 inches). Between 55 and 75% of the precipitation falls as snow during October through March, and summers are typically dry. Summer temperatures can be hot, and winters are typically cold. Stands occur on relatively moist sites on deep soils within flat valleys on low-gradient streams with broad floodplains that flood seasonally. This alliance is typically found on aggraded valley floors which border intermittent or permanent streams and have dependable soil moisture through the growing season (Daubenmire 1970). These sites may be flooded seasonally, but due to the low gradients are rarely scoured. Soils are generally accumulated glacial outwash composed of fine silts and clays of moderate to deep depths. Stands of this alliance often extend up adjacent north-facing toeslopes where seepage provides constant moisture. Adjacent vegetation is usually *Artemisia* steppe or *Pseudoroegneria - Festuca* grassland.

Dynamics: Historically, fire appears to have been important in maintaining the open nature of *Crataegus* shrublands (Daubenmire 1970). Fire may also have been somewhat influential in maintaining the much branched morphology of the dominant shrubs. Most stands have been severely degraded by livestock grazing. Livestock browse all accessible parts of *Crataegus douglasii*, and can eliminate entire stands (Daubenmire 1970).A

DISTRIBUTION

Geographic Range: This deciduous broadleaf shrubland alliance is found in the lower montane and foothill regions around the Columbia Basin, and north and east into the Central Rockies in Idaho and northwestern Wyoming.

Nations: US

States/Provinces: CA?, ID, OR, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > *Crataegus douglasii* / *Heracleum lanatum* Association Habitat types (Daubenmire 1970)
- > *Crataegus douglasii* / *Symphoricarpos albus* Association Habitat types (Daubenmire 1970)
- > *Crataegus douglasii* Shrubland Alliance (Bourgeron and Engelking 1994)

LOWER LEVEL UNITS

Associations:

- CEG001095 *Crataegus douglasii* / *Rosa woodsii* Wet Shrubland
- CEG001096 (*Populus tremuloides*) / *Crataegus douglasii* / *Symphoricarpos albus* Wet Shrubland
- CEG001094 (*Populus tremuloides*) / *Crataegus douglasii* / *Heracleum maximum* Wet Shrubland

AUTHORSHIP

Primary Concept Source: R.F. Daubenmire (1970)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by D. Sarr.

Version Date: 2014/03/14

REFERENCES

References: Bourgeron and Engelking 1994, Crowe and Clausnitzer 1997, Daubenmire 1970, Evans 1989a, Faber-Langendoen et al. 2017b, Kovalchik 1987, ORNHP unpubl. data, Reid et al. 1994

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G527. Western Montane-Subalpine Riparian & Seep Shrubland

A3769. Salix boothii - Salix geyeriana - Salix lutea Montane Wet Shrubland Alliance

Type Concept Sentence: This alliance contains tall (>1.5 m) *Salix*-dominated shrublands in riparian and wetland settings. It is dominated by single or multiple *Salix* species, including *Salix bebbiana*, *Salix boothii*, *Salix drummondiana*, *Salix eriocephala*, *Salix geyeriana*, *Salix ligulifolia*, *Salix lucida ssp. caudata*, *Salix lucida ssp. lasiandra*, *Salix lutea*, *Salix planifolia*, and *Salix prolixa*. These shrub species occur in the same broad geographic region, spreading from eastern Oregon and Washington, Idaho, Montana, Wyoming, Colorado, Utah, Nevada, New Mexico, and Arizona.

OVERVIEW

Scientific Name: *Salix boothii* - *Salix geyeriana* - *Salix lutea* Montane Wet Shrubland Alliance

Common Name (Translated Scientific Name): Booth's Willow - Geyer's Willow - Yellow Willow Montane Wet Shrubland Alliance

Colloquial Name: Western Montane Tall Willow Wet Shrubland

Type Concept: This alliance contains tall (>1.5 m) *Salix*-dominated shrublands in riparian and wetland settings. It is dominated by single or multiple *Salix* species including *Salix bebbiana*, *Salix boothii*, *Salix drummondiana*, *Salix eriocephala*, *Salix geyeriana*, *Salix ligulifolia*, *Salix lucida ssp. caudata*, *Salix lucida ssp. lasiandra*, *Salix lutea*, *Salix planifolia*, and *Salix prolixa*. *Salix monticola* may also be present but is not a dominant species. These shrub species occur in the same broad geographic region, spreading from eastern Oregon and Washington, Idaho, Montana, Wyoming, Colorado, Utah, Nevada, New Mexico, and Arizona. Understories range from thick graminoids or forbs to very sparse cover depending on the degree of overstory shading. Common dominant graminoid species include *Calamagrostis canadensis*, *Carex aquatilis*, *Carex utriculata*, *Carex nebrascensis*, and *Deschampsia cespitosa*. Forb species are often mixed. These are generally subirrigated soils that are mineral with some degree of organic layers, but not deep peat soils.

Classification Comments: This covers the tall willow shrublands in the heart of the Intermountain West and Rocky Mountains within the U.S. Some of the associations include stands on mineral soils and stands on peat soils, and these will need to be separated into organic and non-organic soil counterparts. Many of these species are codominant in varying combinations, making single-*Salix* species alliances problematic. Stands with codominance of *Salix monticola* belong to *Salix monticola* Wet Shrubland Alliance (A0981).

Internal Comments:

Other Comments:

Similar NVC Types:

- A0981 *Salix monticola* Wet Shrubland Alliance: may have some of the same codominant *Salix* species.

Diagnostic Characteristics: Dominance or codominance (>5% relative cover) of one or more of the following tall *Salix* species: *Salix bebbiana*, *Salix boothii*, *Salix drummondiana*, *Salix eriocephala*, *Salix geyeriana*, *Salix ligulifolia*, *Salix lucida ssp. caudata*, *Salix lucida ssp. lasiandra*, *Salix lutea*, *Salix planifolia*, and *Salix prolixa*.

VEGETATION

Physiognomy and Structure: This alliance is dominated by tall (1-4 m) broad-leaved deciduous shrublands. It is characterized by a dense to open canopy. The herbaceous layer can be dominated by graminoids or forbs and is often a mix.

Floristics: The tall-shrub layer is dominated by large stands of one or several willow species, including *Salix bebbiana*, *Salix boothii*, *Salix drummondiana*, *Salix eriocephala*, *Salix geyeriana*, *Salix ligulifolia*, *Salix lucida ssp. caudata*, *Salix lucida ssp. lasiandra*, *Salix lutea*, *Salix planifolia*, and *Salix prolixa*. *Salix monticola* may also be present but not dominant. Other shorter shrub species include *Dasiphora fruticosa ssp. floribunda* (= *Pentaphylloides fruticosa*), *Lonicera utahensis*, and *Ribes* spp. The herbaceous layer is characterized by a moderate forb layer or dense graminoids. When forbs dominate the herbaceous layer, rarely is one forb species dominant, but rather several species form a combined cover. Forb species include *Achillea millefolium*, *Epilobium ciliatum*, *Galium trifidum*, *Geum macrophyllum*, *Heracleum maximum* (= *Heracleum lanatum*), *Pedicularis groenlandica*, *Polygonum bistortoides*, *Pyrola asarifolia*, and *Swertia perennis*. Graminoids, when dominant, can be only one or two species and include *Carex aquatilis*, *Carex utriculata*, *Carex microptera*, *Calamagrostis canadensis*, *Calamagrostis stricta*, and *Poa palustris*.

ENVIRONMENT & DYNAMICS

Environmental Description: Vegetation types in this alliance occur in valley bottoms on swales, banks, and occasionally terraces of stream channels, areas which may have surface water in wet years. The ground surface is often uneven and hummocky. Soils are typically highly stratified with alternating layers of sandy loam and clay loam and are mottled within the top 10 cm. Other soils are finely textured, dark-colored, highly organic soils with silty clay loam. Lower profiles typically contain a gravel or cobble layer which may indicate that the soil section is a silted-in beaver pond (Kittel et al. 1999b).

Dynamics: Stands within this alliance are generally highly productive. Understory production varies, depending on the density of overstory shrubs. Characteristics of the herbaceous layer and soils suggest that many of the vegetation types within this alliance are stable (Youngblood et al. 1985b). However, livestock or wildlife grazing pressure will cause a decrease in the native graminoids (Hansen et al. 1995), and an opening of the overstory canopy, especially if browsing pressure is heavy. Beavers can increase the amount of surface water and decrease willow density.

DISTRIBUTION

Geographic Range: Montane elevations in eastern Oregon and Washington, Idaho, Montana, Wyoming, Colorado, Utah, Nevada, New Mexico, and Arizona.

Nations: CA, US

States/Provinces: AZ, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Salix* spp. Series (Johnston 1987)

LOWER LEVEL UNITS

Associations:

- CEG001173 *Salix bebbiana* Wet Shrubland
- CEG001190 *Salix drummondiana* Wet Shrubland [Placeholder]
- CEG001181 *Salix boothii* / Mesic Graminoids Wet Shrubland
- CEG001233 *Salix eriocephala* / *Ribes aureum* - *Rosa woodsii* Wet Shrubland
- CEG001180 *Salix boothii* / Mesic Forbs Wet Shrubland
- CEG002621 *Salix lucida* ssp. *caudata* / *Rosa woodsii* Wet Shrubland
- CEG001205 *Salix geyeriana* / *Calamagrostis canadensis* Wet Shrubland
- CEG001208 *Salix geyeriana* / *Deschampsia cespitosa* Wet Shrubland
- CEG002975 *Salix ligulifolia* / *Carex utriculata* Wet Shrubland
- CEG002671 *Salix boothii* / *Equisetum arvense* Wet Shrubland
- CEG001218 *Salix ligulifolia* Wet Shrubland
- CEG002904 *Salix boothii* / *Deschampsia cespitosa* - *Geum rossii* Wet Shrubland
- CEG001187 *Salix boothii* / *Maianthemum stellatum* Wet Shrubland
- CEG001211 *Salix geyeriana* / *Poa palustris* Wet Shrubland
- CEG001186 *Salix boothii* - *Salix lemmonii* Wet Shrubland
- CEG002607 *Salix boothii* - *Salix eastwoodiae* / *Carex nigricans* Wet Shrubland
- CEG001219 *Salix lutea* / *Calamagrostis canadensis* Wet Shrubland
- CEG001220 *Salix lutea* / *Carex utriculata* Wet Shrubland
- CEG001174 *Salix bebbiana* / Mesic Graminoids Wet Shrubland
- CEG001184 *Salix boothii* - *Salix geyeriana* Wet Shrubland
- CEG003452 *Salix prolixa* / *Rosa woodsii* Wet Shrubland
- CEG001176 *Salix (boothii, geyeriana)* / *Carex aquatilis* Wet Shrubland
- CEG001212 *Salix geyeriana* - *Salix lemmonii* / *Carex aquatilis* var. *dives* Wet Shrubland
- CEG001584 *Salix drummondiana* / *Carex scopulorum* var. *prionophylla* Wet Shrubland
- CEG002631 *Salix drummondiana* / *Carex utriculata* Wet Shrubland
- CEG002667 *Salix drummondiana* / *Calamagrostis canadensis* Wet Shrubland
- CEG001185 *Salix boothii* - *Salix geyeriana* / *Carex angustata* Wet Shrubland
- CEG001192 *Salix drummondiana* / Mesic Forbs Wet Shrubland
- CEG005937 *Salix planifolia* / *Carex utriculata* Wet Shrubland
- CEG001247 *Salix geyeriana* - *Salix monticola* / *Calamagrostis canadensis* Wet Shrubland
- CEG002624 *Salix lutea* / *Rosa woodsii* Wet Shrubland
- CEG001177 *Salix boothii* / *Carex nebrascensis* Wet Shrubland
- CEG001213 *Salix geyeriana* - *Salix eriocephala* Wet Shrubland
- CEG002666 *Salix geyeriana* / Mesic Forbs Wet Shrubland
- CEG001210 *Salix geyeriana* / Mesic Graminoids Wet Shrubland

- CEGLO01183 *Salix boothii* / *Poa palustris* Wet Shrubland
- CEGLO01178 *Salix boothii* / *Carex utriculata* Wet Shrubland
- CEGLO01137 *Salix glauca* / *Deschampsia cespitosa* Wet Shrubland
- CEGLO02774 *Salix lutea* / Mesic Forbs Wet Shrubland
- CEGLO01175 *Salix boothii* / *Calamagrostis canadensis* Wet Shrubland
- CEGLO01224 *Salix planifolia* Wet Shrubland
- CEGLO02893 *Salix planifolia* / Mesic Forbs Wet Shrubland
- CEGLO01206 *Salix geyeriana* / *Carex aquatilis* Wet Shrubland
- CEGLO02073 *Salix lutea* / Mesic Graminoids Wet Shrubland
- CEGLO01207 *Salix geyeriana* / *Carex utriculata* Wet Shrubland
- CEGLO03780 *Salix lutea* Wet Shrubland
- CEGLO05322 *Salix lutea* / *Leymus cinereus* Wet Shrubland
- CEGLO05363 *Salix eriocephala* / Mesic Graminoids Wet Shrubland
- CEGLO01215 *Salix lucida* ssp. *caudata* Wet Shrubland
- CEGLO01223 *Salix geyeriana* - *Salix monticola* / Mesic Forbs Wet Shrubland

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Carsey et al. 2003a, Carsey et al. 2003b, Cooper and Cottrell 1990, Dorn 1997, Evenden 1990, Faber-Langendoen et al. 2017b, Girard et al. 1997, Hallock et al. 1986, Hansen et al. 1991, Hansen et al. 1995, Hess 1981, Jensen and Tuhy 1981, Johnston 1987, Jones 1992b, Kagan 1997, Kearney et al. 1969, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1999a, Kittel et al. 1999b, Kovalchik 1987, MTNHP unpubl. data, Manning and Padgett 1991, Manning and Padgett 1992, Manning and Padgett 1995, Mutz and Graham 1982, Mutz and Queiroz 1983, Norton et al. 1981, ORNHP unpubl. data, Padgett 1982, Padgett and Manning 1988, Padgett et al. 1988b, Padgett et al. 1989, Phillips 1977, Reid 1990, Sawyer and Keeler-Wolf 1995, Tuhy and Jensen 1982, Weixelman et al. 1996, Youngblood et al. 1985a, Youngblood et al. 1985b

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G527. Western Montane-Subalpine Riparian & Seep Shrubland

A1003. *Salix commutata* Wet Shrubland Alliance

Type Concept Sentence: These are short-statured (<1.5 m) willow-dominated communities found at subalpine elevations. *Salix commutata* dominates the shrub canopy with cover of >25%. Stands are confined to narrow riparian zones along upper reaches of streams and to elongated openings in higher elevation forests. Stands are typically found at moderate to high elevations between 2065 and 2220 m in British Columbia, Oregon, Washington, Idaho, western Montana and just into northern California and possibly as far east as Wyoming.

OVERVIEW

Scientific Name: *Salix commutata* Wet Shrubland Alliance

Common Name (Translated Scientific Name): Undergreen Willow Wet Shrubland Alliance

Colloquial Name: Cascadian Undergreen Willow Wet Shrubland

Type Concept: These are short-statured (<1.5 m) willow-dominated communities found at subalpine elevations. Stands within this alliance are classified as seasonally flooded, cold-deciduous shrublands. *Salix commutata* dominates the shrub canopy with cover of >25%. *Salix planifolia* and *Lonicera caerulea* may also be present. *Carex scopulorum* dominates the herbaceous layer with *Calamagrostis canadensis*. *Galium trifidum* has high constancy, and some stands contain a complement of wet-site forbs such as *Aconitum columbianum* and *Caltha leptosepala* ssp. *howellii* (= *Caltha biflora*). Adjacent communities may be herbaceous bogs dominated by *Eleocharis quinqueflora* (= *Eleocharis pauciflora*). In some stands, a fringe of *Vaccinium uliginosum* (= *Vaccinium occidentale*) separates the bog from the willow stands. Stands are confined to narrow riparian zones along upper reaches of streams and to elongated openings in higher elevation forests. Stands are typically found at moderate to high elevations between 2065 and 2220 m in British Columbia, Oregon, Washington, Idaho, western Montana and just into northern California and possibly as far east as Wyoming. Microtopography is usually hummocky to undulating. Slopes range from 2-4%. Soils in Idaho stands are wet to saturated at the surface by flowing groundwater for most or all of the growing season. Soils are poorly to very poorly drained due to accumulation of organic material.

Classification Comments: This is the short shrub of higher elevations in the Cascades and Rocky Mountains that does not tend to overlap with other short-statured willows.

Internal Comments:

Other Comments:

Similar NVC Types:

- A3770 *Salix wolfii* - *Salix brachycarpa* - *Betula glandulosa* Wet Shrubland Alliance: occupies similar environments and has similar stature, with some shared species, but tends to be further west and north.

Diagnostic Characteristics: Greater than 5% relative cover of *Salix commutata*.

VEGETATION

Physiognomy and Structure: This alliance is dominated by short, 1- to 2-m tall, broad-leaved deciduous shrublands. Canopy cover is continuous with 60-100% cover. The herbaceous layer is dominated by graminoids (60-100% cover) and a sparse forb layer.

Floristics: Stands within this alliance are classified as seasonally flooded, cold-deciduous shrublands. *Salix commutata* dominates the shrub canopy with cover of >25%. *Salix planifolia* and *Lonicera caerulea* may also be present. *Carex scopulorum* dominates the herbaceous layer with *Calamagrostis canadensis*. *Galium trifidum* has high constancy, and some stands contain a complement of wet-site forbs such as *Aconitum columbianum* and *Caltha leptosepala* ssp. *howellii* (= *Caltha biflora*).

ENVIRONMENT & DYNAMICS

Environmental Description: Communities found within this alliance are found in the subalpine zone. Stands are confined to narrow riparian zones along upper reaches of streams and to elongated openings in higher elevation forests. Stands are typically found at moderate to high elevations between 2065 and 2220 m. Microtopography is usually hummocky to undulating. Slopes range from 2-4%. Soils in Idaho stands are wet to saturated to the surface by flowing groundwater for most or all of the growing season. Soils are poorly to very poorly drained due to accumulation of organic material.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is found in British Columbia, Oregon, Washington, Idaho, western Montana and just into northern California and possibly as far east as Wyoming.

Nations: CA, US

States/Provinces: BC, CA, ID, MT, OR, WA, WY?

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEG003497 *Salix commutata* / Mesic Graminoid Wet Shrubland
- CEG001189 *Salix commutata* / *Carex scopulorum* Wet Shrubland

AUTHORSHIP

Primary Concept Source: D. Culver, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Dorn 1984, Faber-Langendoen et al. 2017b, Hickman 1993, Hitchcock et al. 1964, Tuhy and Jensen 1982

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

A3774. *Salix eastwoodiae* - *Salix lemmonii* Wet Shrubland Alliance

Type Concept Sentence: These riparian shrublands, found scattered throughout high-elevation, late-snowmelt areas of the western U.S., are dominated by *Salix eastwoodiae* and/or *Salix lemmonii*. Other species such as *Salix planifolia*, *Salix boothii*, and *Betula glandulosa* may also occur in the shrub layer. They are found within glacial valley bottoms (e.g., seeps, toeslopes, benches, and stream benches), wet mountain meadows, and streambanks with gentle slopes (3%). Elevations range from 2300-3200 m. Sites that support these communities contain surface waters that collect in rivulets or are fed by seeps with water flowing at or near the surface.

OVERVIEW

Scientific Name: *Salix eastwoodiae* - *Salix lemmonii* Wet Shrubland Alliance

Common Name (Translated Scientific Name): Mountain Willow - Lemmon's Willow Wet Shrubland Alliance

Colloquial Name: Mountain Willow - Lemmon's Willow Wet Shrubland

Type Concept: These riparian shrublands, found scattered throughout high-elevation, late-snowmelt areas, are dominated by *Salix eastwoodiae* and/or *Salix lemmonii*. Other species such as *Salix planifolia*, *Salix boothii*, and *Betula glandulosa* may also occur in the shrub layer. Total shrub cover varies from 30 to over 75%. *Carex scopulorum*, *Carex aquatilis*, and *Carex utriculata* are usually dominant in the understory with at least 40% cover. *Carex cusickii* (= *Carex obovoidea*) and *Carex luzulina* are frequent and abundant. *Calamagrostis canadensis* is a dominant graminoid in Idaho stands. Forb cover is low with *Mertensia ciliata*, *Saxifraga odontoloma*, and *Thalictrum occidentale*. Adjacent upland communities are dominated by *Pinus monticola*, *Pinus contorta*, and *Abies concolor*. This alliance is found in the Rocky Mountains of western Wyoming and eastern Idaho, and the Sierra Nevada of western Nevada and California. These shrublands are found within glacial valley bottoms (e.g., seeps, toeslopes, benches, and stream benches), wet mountain meadows, and streambanks with gentle slopes (3%). Elevations range from 2300-3200 m. Sites that support these communities contain surface waters that collect in rivulets or are fed by seeps with water flowing at or near the surface. Soils are characterized by organic surface horizons. Textures of the underlying mineral horizons range from silty clay loam to loam sand.

Classification Comments: These *Salix* species do overlap somewhat with other Rocky Mountain tall willows, but are centered in their distribution further west and extend into California.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Riparian shrublands dominated by *Salix eastwoodiae* and/or *Salix lemmonii*.

VEGETATION

Physiognomy and Structure: This alliance is composed of tall (2-5 m), broad-leaved deciduous shrublands. They are characterized by intermittent shrub cover (30-75%). The herbaceous layer is dominated by 10-20% cover of graminoids. Forb cover is low to none.

Floristics: Vegetation types within this alliance are characterized as cold-deciduous, seasonally flooded shrublands. They are dominated by *Salix eastwoodiae* and/or *Salix lemmonii*. *Salix planifolia*, *Salix boothii*, and *Betula glandulosa* also occur in the shrub layer. Total shrub cover varies from 30 to over 75%. *Carex scopulorum*, *Carex aquatilis*, and *Carex utriculata* are usually dominant in the understory with at least 40% cover. *Carex cusickii* (= *Carex obovoidea*) and *Carex luzulina* are frequent and abundant (Mutz and Queiroz 1983). Tuhy and Jensen (1982) report *Calamagrostis canadensis* as a dominant graminoid in their Idaho stands. Forb cover is low with *Mertensia ciliata*, *Saxifraga odontoloma*, and *Thalictrum occidentale*.

ENVIRONMENT & DYNAMICS

Environmental Description: Communities within this shrubland alliance are scattered throughout the high-elevation, late-snowmelt areas. They are found within glacial valley bottoms (e.g., seeps, toeslopes, benches, and stream benches), wet mountain meadows, and streambanks with gentle slopes (3%). Elevations range from 2300-3200 m (Dorn 1997). Sites that support these communities contain surface waters that collect in rivulets or are fed by seeps with water flowing at or near the surface (Mutz and Queiroz 1983). Soils are characterized by organic surface horizons. Textures of the underlying mineral horizons range from silty clay loam to loam sand.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is found in the Rocky Mountains of western Wyoming and eastern Idaho, and the Sierra Nevada of western Nevada and California.

Nations: US

States/Provinces: CA, ID, NV, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > *Salix eastwoodiae* (Sierran willow thickets) Alliance (Sawyer et al. 2009) [61.112.00]
- > *Salix lemmonii* (Lemmon's willow thickets) Alliance (Sawyer et al. 2009) [61.113.00]

LOWER LEVEL UNITS

Associations:

- CEGLO02772 *Salix lemmonii* / *Rosa woodsii* Wet Shrubland
- CEGLO03128 *Salix eastwoodiae* / *Deschampsia cespitosa* Wet Shrubland
- CEGLO08698 *Salix lemmonii* Sierran Wet Shrubland
- CEGLO02069 *Salix lemmonii* / Mesic Graminoids Wet Shrubland
- CEGLO02771 *Salix lemmonii* / Mesic-Tall Forbs Wet Shrubland
- CEGLO01194 *Salix eastwoodiae* Wet Shrubland
- CEGLO01196 *Salix eastwoodiae* / *Carex utriculata* Wet Shrubland
- CEGLO01195 *Salix eastwoodiae* / *Carex aquatilis* Wet Shrubland

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Dorn 1997, Faber-Langendoen et al. 2017b, Mutz and Queiroz 1983, Padgett and Manning 1988, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Tuhy and Jensen 1982, Walford et al. 1997, Youngblood et al. 1985a

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G527. Western Montane-Subalpine Riparian & Seep Shrubland

A0977. *Salix lasiolepis* Wet Shrubland Alliance

Type Concept Sentence: Communities within this cold-deciduous, temporarily (or seasonally) flooded shrubland alliance occupy stream benches and occasionally seeps. They can form stringer communities along drainages with slopes ranging between 1-15%. Elevations range between 259 and 2490 m. Soils are xeric and developed on alluvium. The tall-shrub layer is dominated by *Salix lasiolepis* which forms a dense overstory ranging from 60-100% cover.

OVERVIEW

Scientific Name: *Salix lasiolepis* Wet Shrubland Alliance

Common Name (Translated Scientific Name): Arroyo Willow Wet Shrubland Alliance

Colloquial Name: Arroyo Willow Wet Shrubland

Type Concept: The tall-shrub layer of this alliance is dominated by *Salix lasiolepis* which forms a dense overstory ranging from 60-100% cover. Other shrubs that may be equally important include *Baccharis pilularis*, *Baccharis salicifolia*, *Cephalanthus occidentalis*, *Cornus sericea*, *Morella californica*, and *Toxicodendron diversilobum*. Emergent trees may include *Acer macrophyllum*, *Platanus racemosa*, *Populus balsamifera*, *Populus fremontii*, *Salix* spp., and *Sambucus nigra* ssp. *canadensis*. *Ribes aureum*, *Rosa californica*, or *Rosa woodsii* typically form a low-shrub layer near the base of the willows. The undergrowth is typically depauperate, with *Clematis ligusticifolia* and *Maianthemum stellatum* (= *Smilacina stellata*) present in minor amounts. Bare ground and/or leaf litter from the willow overstory are characteristic. This alliance occurs in California, Nevada, southwestern Utah, Oregon, and Idaho. Communities within this cold-deciduous, temporarily (or seasonally) flooded shrubland alliance occupy stream benches and occasionally seeps. They can form stringer communities along drainages with slopes ranging from 1-15%. Elevations range between 259 and 2490 m. Soils are xeric and developed on alluvium. Water tables were rarely reached by researchers within the depth of soil pits, and mottles were not evident because of the coarse soil texture.

Classification Comments: *Salix lasiolepis* mixes with other tall willows in the northern and eastern portions of its range in Oregon, Idaho, Nevada and Utah, but the only associations described to date are single willow-dominated types.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Riparian stands dominated by *Salix lasiolepis*.

VEGETATION

Physiognomy and Structure: The tall-shrub layer is dominated by broad-leaved, deciduous shrubs that can reach heights of 5 m. The canopy is dense with cover of over 90%. The understory forms a moderately dense, low-shrub stratum with a sparse graminoid/forb layer.

Floristics: Communities within this alliance are defined as cold-deciduous, temporarily (or seasonally) flooded shrublands. The tall-shrub layer is dominated by *Salix lasiolepis* which forms a dense overstory ranging from 60-100% cover. Other woody species in the shrub or emergent tree layer include *Acer macrophyllum*, *Baccharis pilularis*, *Baccharis salicifolia*, *Cephalanthus occidentalis*, *Cornus sericea*, *Morella californica*, *Platanus racemosa*, *Populus balsamifera*, *Populus fremontii*, *Salix* spp., and *Sambucus nigra* ssp. *canadensis*. *Ribes aureum*, *Rosa californica*, or *Rosa woodsii* typically form a low-shrub layer near the base of the willows. The undergrowth is typically depauperate, with *Artemisia douglasiana*, *Clematis ligusticifolia* or other *Clematis* sp., *Juncus* spp., and *Maianthemum stellatum* (= *Smilacina stellata*) present in minor amounts. Bare ground and/or leaf litter from the willow overstory are characteristic of stands within this alliance.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands occupy stream benches and occasionally seeps. They can form stringer communities along drainages with slopes ranging from 1-15% cover. Elevations range between 259 and 2490 m. Soils are xeric and developed on alluvium. Water tables were rarely reached within the depth of soil pits, and mottles were not evident because of the coarse soil texture (Padgett et al. 1989, Manning and Padgett 1995). Adjacent uplands can be dominated by *Pinus edulis*, *Juniperus osteosperma*, *Quercus gambelii*, or *Artemisia tridentata* ssp. *vaseyana*.

Dynamics: These plant associations are disturbance-dependent with seasonal flooding and appear to be stable and long-lived in Nevada (Manning and Padgett 1995). The depauperate undergrowth is likely indicative of the xeric surface soil conditions or grazing pressures (Padgett et al. 1989). There were several weedy species within the understory, including *Bromus tectorum*, *Melilotus indicus*, *Poa pratensis*, *Rumex crispus*, and *Taraxacum officinale*.

DISTRIBUTION

Geographic Range: This alliance occurs in California, Nevada, southwestern Utah, Oregon, and Idaho.

Nations: US

States/Provinces: CA, ID, NV, OR, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- < *Salix lasiolepis* (Arroyo willow thickets) Alliance (Sawyer et al. 2009) [61.201.00]
- = *Salix lasiolepis* Alliance (Arroyo willow thickets) (Buck-Diaz et al. 2012)
- = *Salix lasiolepis* Temporarily Flooded Shrubland Alliance (Keeler-Wolf et al. 2012)
- = *Salix lasiolepis* Woodland/Forest Alliance (Keeler-Wolf and Evens 2006)

LOWER LEVEL UNITS

Associations:

- CEG001216 *Salix lasiolepis* / Barren Ground Wet Shrubland
- CEG003453 *Salix lasiolepis* - *Cornus sericea* / *Rosa woodsii* Wet Shrubland
- CEG001217 *Salix lasiolepis* / *Rosa woodsii* / Mixed Herbs Wet Shrubland

AUTHORSHIP

Primary Concept Source: D. Culver, J. Evens and A. Klein, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Blackburn et al. 1968a, Buck-Diaz et al. 2012, Faber-Langendoen et al. 2017b, Hitchcock et al. 1964, Kearney et al. 1969, Keeler-Wolf and Evens 2006, Keeler-Wolf et al. 2012, Manning and Padgett 1992, Manning and Padgett 1995, Martin and Hutchins 1980, Moseley 1998, Moseley et al. 1998, Padgett et al. 1989, Sawyer et al. 2009, Sproul et al. 2011

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G527. Western Montane-Subalpine Riparian & Seep Shrubland

A0981. *Salix monticola* Wet Shrubland Alliance

Type Concept Sentence: This is a montane riparian shrubland alliance that is characterized by a tall, nearly closed canopy of *Salix monticola* often with one or more other willow species such as *Salix geyeriana*, *Salix drummondiana*, *Salix lucida ssp. lasiandra*, *Salix planifolia*, and *Salix wolfii*. It occurs in the Rocky Mountains along stream reaches in wide to narrow valleys (20-500 m) with broad, swift-moving streams and active, flat (3-8%) floodplains. Elevations range between 2310 and 3350 m.

OVERVIEW

Scientific Name: *Salix monticola* Wet Shrubland Alliance

Common Name (Translated Scientific Name): Park Willow Wet Shrubland Alliance

Colloquial Name: Park Willow Wet Shrubland

Type Concept: This is a montane riparian shrubland alliance that is characterized by a tall, nearly closed canopy of *Salix monticola* often with one or more other willow species such as *Salix geyeriana*, *Salix drummondiana*, *Salix lucida ssp. lasiandra* (= *Salix lasiandra*), *Salix planifolia* and *Salix wolfii*. Other shrubs may be present as well, such as *Cornus sericea*, *Betula glandulosa*, and *Lonicera involucrata*. The forb layer is dense (up to 50%) and consists of *Angelica ampla*, *Galium boreale*, *Geum macrophyllum*, *Senecio bigelovii*, *Solidago canadensis*, and others. Graminoids can also be very abundant with species such as *Calamagrostis canadensis*, *Carex utriculata*, and *Carex aquatilis*. This alliance occurs in the Rocky Mountains along stream reaches in wide to narrow valleys (20-500 m) with broad, swift-moving streams and active, flat (3-8%) floodplains. Elevations range between 2310 and 3350 m. Large stands occur between meanders and at the edges of beaver ponds. The ground surface is usually undulating, from past flooding or beaver activity. These shrublands occur right at stream's edge, and up to 15 m from the channel, usually >0.5 m above the channel elevation. Soils are predominantly heavy silty clays with occasional to abundant mottling evident. Some stands occur on coarse, well-drained alluvium.

Classification Comments: This tall willow species does not range as widely as others in the Rocky Mountains, so it seems prudent to keep it as its own alliance. It could be included with *Salix boothii* - *Salix geyeriana* - *Salix lutea* Montane Wet Shrubland Alliance (A3769), as many of the willow species included there can co-occur with *Salix monticola*.

Internal Comments:

Other Comments:

Similar NVC Types:

- A3769 *Salix boothii* - *Salix geyeriana* - *Salix lutea* Montane Wet Shrubland Alliance

Diagnostic Characteristics: Riparian shrublands dominated by *Salix monticola*.

VEGETATION

Physiognomy and Structure: This alliance is dominated by a tall (2-5 m) broad-leaved deciduous shrub. It forms a thick, closed canopy (30-75%) with a short-shrub layer (25-35% cover). The graminoid and forb layer varies widely among associations, but percent cover averages 30%.

Floristics: Plant associations within this alliance are intermittent in the montane areas of the Rocky Mountains. They are temporarily flooded, cold-deciduous shrublands dominated by *Salix monticola*. The tall-shrub layer is characterized by a tall, nearly closed canopy of *Salix monticola* (8-70%), typically with *Salix geyeriana* (40-50%) or *Salix drummondiana* (10%). Other shrubs present include *Betula glandulosa*, *Salix lucida ssp. lasiandra* (= *Salix lasiandra*), *Salix planifolia*, and *Salix wolfii*. The short-shrub layer is dominated by *Cornus sericea* and *Lonicera involucrata*. The forb layer is dense (up to 50%) and consists of *Angelica ampla*, *Galium*

boreale, *Geum macrophyllum*, *Senecio bigelovii*, *Solidago canadensis*, and others. *Calamagrostis canadensis* comprises a dense graminoid layer of 40-50% cover. *Carex utriculata* and *Carex aquatilis* also contribute to the graminoid understory in several associations.

ENVIRONMENT & DYNAMICS

Environmental Description: Plant associations occur in the mountains along stream reaches in moderately wide to narrow valleys (20-120 m) with broad, swift-moving streams and active, flat (3-8%) floodplains. Elevations range between 2310 and 3350 m. Large stands occur between meanders and at the edges of beaver ponds. The ground surface is usually undulating, from past flooding or beaver activity. Associations occur right at stream's edge, and up to 15 m from the channel, usually >0.5 m above the channel elevation. Adjacent riparian vegetation can include deciduous shrublands and woodlands with mesic meadows. Adjacent upslope vegetation is typically coniferous forests dominated by *Pinus contorta*, *Picea* spp., and *Populus tremuloides*. Soils are predominantly heavy silty clays with occasional to abundant mottling evident. Some stands occur on coarse, well-drained alluvium.

Dynamics: Several associations within this alliance are influenced by beaver activity. *Carex utriculata* usually forms monotypic stands at the edge of ponds, where a persistent high water table limits the occurrence of other species. *Carex* stands are slowly invaded by *Salix* spp. as the ground becomes less saturated (Hansen et al. 1988b). Presence of dying conifer trees may indicate an increase in the water table due to decreased transpiration rates, allowing for expansion of *Calamagrostis canadensis* and conversion from a conifer / *Calamagrostis canadensis* plant association to a *Salix monticola* / *Calamagrostis canadensis* association (Padgett et al. 1989).

DISTRIBUTION

Geographic Range: This alliance is intermittent in the montane areas of the Rocky Mountains of Wyoming, Colorado and New Mexico.

Nations: US

States/Provinces: CO, NM, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- C EGL001139 *Salix monticola* Thicket Wet Shrubland
- C EGL001222 *Salix monticola* / *Calamagrostis canadensis* Wet Shrubland
- C EGL002656 *Salix monticola* / *Carex aquatilis* Wet Shrubland
- C EGL001221 *Salix monticola* / *Angelica ampla* Wet Shrubland
- C EGL002657 *Salix monticola* / *Carex utriculata* Wet Shrubland
- C EGL002659 *Salix monticola* / Mesic Graminoids Wet Shrubland
- C EGL002658 *Salix monticola* / Mesic Forbs Wet Shrubland

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Andrews 1983, Baker 1989b, Carsey et al. 2003a, Carsey et al. 2003b, Cooper and Cottrell 1990, Faber-Langendoen et al. 2017b, Hansen et al. 1988b, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996, Kittel et al. 1997a, Kittel et al. 1999a, Kittel et al. 1999b, Padgett et al. 1989, Richard et al. 1996, Sanderson and Kettler 1996

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G527. Western Montane-Subalpine Riparian & Seep Shrubland

A2563. Salix orestera Wet Shrubland Alliance

Type Concept Sentence: This vegetation forms a dense shrub canopy between 0.5 and 2 m in height, dominated by the tall willow *Salix orestera*. It grows on low-gradient basin floors, streamsides, and wet meadows around 3050-3200 m (10,000-10,500 feet) elevation in the Sierra Nevada of California and in Oregon and Nevada. Soils are silt or clay loams derived from metamorphic parent materials.

OVERVIEW

Scientific Name: *Salix orestera* Wet Shrubland Alliance

Common Name (Translated Scientific Name): Sierra Willow Wet Shrubland Alliance

Colloquial Name: Sierra Willow Wet Shrubland

Type Concept: This vegetation forms a dense shrub canopy between 0.5 and 2 m in height, dominated by the tall willow *Salix orestera*. Other shrub species that may be present to codominant include *Ribes montigenum*, *Vaccinium cespitosum*, and *Phyllodoce breweri*. The herbaceous understory tends to be light cover dominated by graminoids such as *Calamagrostis breweri*, *Carex exserta*, *Carex fissuricola*, *Carex spectabilis*, *Juncus parryi*, *Luzula subcongesta*, *Phleum alpinum*, *Poa secunda*, *Poa stebbinsii*, and *Ptilagrostis kingii*. Forbs present may include *Achillea millefolium*, *Allium validum*, *Antennaria media*, *Antennaria rosea*, *Arnica mollis*, *Castilleja lemmonii*, *Chamerion angustifolium* (= *Epilobium angustifolium*), *Cirsium* sp., *Lupinus lepidus*, *Mimulus primuloides*, *Montia chamissoi*, *Muhlenbergia filiformis*, *Oreostemma alpigenum* var. *alpigenum*, *Pedicularis attollens*, *Penstemon rydbergii*, *Potentilla drummondii*, *Potentilla gracilis*, *Senecio scorzonella*, *Senecio triangularis*, and/or *Symphotrichum spathulatum* var. *spathulatum* (= *Aster occidentalis* var. *occidentalis*). This vegetation grows on low-gradient basin floors, streamsides, and wet meadows around 3050-3200 m (10,000-10,500 feet) elevation in the Sierra Nevada of California and in Oregon and Nevada. Soils are silt or clay loams derived from metamorphic parent materials.

Classification Comments: Descriptive information is only from Yosemite National Park. Need to incorporate information from Sawyer et al. (2009).

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Riparian shrublands dominated by *Salix orestera* with >50% relative cover in the shrub layer (Manning and Padgett 1995, Keeler-Wolf et al. 2004, Potter 2005).

VEGETATION

Physiognomy and Structure: This vegetation forms a dense shrub canopy between 0.5 and 2 m in height, dominated by the tall willow *Salix orestera*.

Floristics: This vegetation forms a dense shrub canopy between 0.5 and 2 m in height, dominated by the tall willow *Salix orestera*. Other shrub species that may be present to codominant include *Ribes montigenum*, *Vaccinium cespitosum*, and *Phyllodoce breweri*. The herbaceous understory tends to be light cover dominated by graminoids such as *Calamagrostis breweri*, *Carex exserta*, *Carex fissuricola*, *Carex spectabilis*, *Juncus parryi*, *Luzula subcongesta*, *Phleum alpinum*, *Poa secunda*, *Poa stebbinsii*, and *Ptilagrostis kingii*. Forbs present may include *Achillea millefolium*, *Allium validum*, *Antennaria media*, *Antennaria rosea*, *Arnica mollis*, *Castilleja lemmonii*, *Chamerion angustifolium* (= *Epilobium angustifolium*), *Cirsium* sp., *Lupinus lepidus*, *Mimulus primuloides*, *Montia chamissoi*, *Muhlenbergia filiformis*, *Oreostemma alpigenum* var. *alpigenum*, *Pedicularis attollens*, *Penstemon rydbergii*, *Potentilla drummondii*, *Potentilla gracilis*, *Senecio scorzonella*, *Senecio triangularis*, and/or *Symphotrichum spathulatum* var. *spathulatum* (= *Aster occidentalis* var. *occidentalis*).

ENVIRONMENT & DYNAMICS

Environmental Description: This vegetation grows on low-gradient basin floors, streamsides, and wet meadows around 3050-3200 m (10,000-10,500 feet) elevation in the Sierra Nevada of California. Soils are silt or clay loams derived from metamorphic parent materials.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is found in the Sierra Nevada of California and in Oregon and Nevada.

Nations: US

States/Provinces: CA, NV, OR

TNC Ecoregions [optional]: 12:C

USFS Ecoregions (2007): M261E:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = *Salix orestera* (Sierra gray willow thickets) Alliance (Sawyer et al. 2009) [61.115.00]
- = *Salix orestera* Shrubland Alliance (CNPS 2017) [61.115.00]
- < Montane Riparian Scrub (#63500) (Holland 1986b)
- >< Montane wetland shrub habitat (Sawyer and Keeler-Wolf 1995)
- >< Subalpine wetland shrub habitat (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS

Associations:

- CEGL008700 *Salix orestera* / *Senecio triangularis* Wet Shrubland
- CEGL008701 *Salix orestera* / *Allium validum* Wet Shrubland
- CEGL008702 *Salix orestera* / *Calamagrostis breweri* Wet Shrubland

AUTHORSHIP

Primary Concept Source: J.O. Sawyer et al. (2009)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: CNPS 2017, Cheng 2004, Faber-Langendoen et al. 2017b, Holland 1986b, Keeler-Wolf et al. 2003a, Keeler-Wolf et al. 2004, Klikoff 1965, Major and Taylor 1977, Manning and Padgett 1995, Potter 2005, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G527. Western Montane-Subalpine Riparian & Seep Shrubland

A3770. *Salix wolfii* - *Salix brachycarpa* - *Betula glandulosa* Wet Shrubland Alliance

Type Concept Sentence: These are short (<1.5 m) *Salix*- or *Betula*-dominated shrublands of Intermountain West and Rocky Mountain high subalpine altitudes dominated by *Betula nana*, *Salix brachycarpa*, *Salix farriae*, *Salix planifolia*, and/or *Salix wolfii*. Canopy can be closed to open. Understory is usually fairly dense, graminoid-dominated herbaceous cover and occasionally forb-dominated, including several *Carex* spp. (e.g., *Carex aquatilis*, *Carex microptera*, *Carex scopulorum*, *Carex utriculata*), *Deschampsia cespitosa*, and others. Forb species may include *Caltha leptosepala*, *Fragaria virginiana*, *Pedicularis groenlandica*, *Swertia perennis*, and others.

OVERVIEW

Scientific Name: *Salix wolfii* - *Salix brachycarpa* - *Betula glandulosa* Wet Shrubland Alliance

Common Name (Translated Scientific Name): Wolf's Willow - Short-fruit Willow - Resin Birch Wet Shrubland Alliance

Colloquial Name: Rocky Mountain Short Willow Wet Shrubland

Type Concept: These are short (<1.5 m) *Salix*- or *Betula*-dominated shrublands of Intermountain West and Rocky Mountain high subalpine altitudes dominated by *Betula nana*, *Salix brachycarpa*, *Salix farriae*, *Salix planifolia*, and/or *Salix wolfii*. Canopy can be closed to open. Understory is usually fairly dense, graminoid-dominated herbaceous cover and occasionally forb-dominated, including several *Carex* spp. (e.g., *Carex aquatilis*, *Carex microptera*, *Carex scopulorum*, *Carex utriculata*), *Deschampsia cespitosa*, and others. Forb species may include *Caltha leptosepala*, *Fragaria virginiana*, *Pedicularis groenlandica*, *Swertia perennis*, and others. Communities within this alliance occur in moderately narrow to wide valleys and glacial basins on floodplains with lateral seepage of groundwater. Valley slopes range from 3-7%, and stream channels that run through the valleys vary from deep, narrow, and sinuous to shallow, broad, and gently meandering. Beavers are often active within the stands. Some stands occur on sideslope seeps, which remain wet throughout the growing season. Elevation ranges from 1950-3350 m. Soils are mineral. Soil textures include silty clay loams, silty loams, and sandy clay loams with mottling. Some stands occur on deep sandy clays, often with a high organic content, while other stands occur on shallow silty clays over gravels and rocks.

Classification Comments: This alliance covers low-statured (short <1.5 m) shrublands of subalpine altitudes in the Intermountain West and Rocky Mountains. *Salix commutata* occupies similar habitats but are regionally limited to the Cascade Range and Coast Ranges.

Internal Comments:

Other Comments:

Similar NVC Types:

- A1003 *Salix commutata* Wet Shrubland Alliance: occupies similar habitats with overlapping ranges but generally does not mix with *Salix* species in this alliance.

Diagnostic Characteristics: Short (<1.5 m) willow- or birch-dominated shrublands of high subalpine altitudes dominated by *Betula nana*, *Salix brachycarpa*, *Salix farriae*, *Salix planifolia*, and/or *Salix wolfii*.

VEGETATION

Physiognomy and Structure: This alliance is characterized by broad-leaved deciduous shrubs. The canopy consists of short (1-2 m), rounded shrubs that form a dense canopy. The herbaceous layer is dense with graminoids, especially rhizomatous sedges, and has a sparse to moderately dense forb layer.

Floristics: These are cold-deciduous, short-statured shrublands. The shrub layer is typically dominated by *Betula nana*, *Salix brachycarpa*, *Salix farriae*, *Salix planifolia*, and/or *Salix wolfii*. Stands can be monotypic, but are more often a mix of at least 2 species. *Salix brachycarpa* occupies the drier margins or raised hummocks. The herbaceous undergrowth is generally dense and rich, dominated by graminoids such as *Carex aquatilis*, *Carex microptera*, *Carex nebrascensis*, *Carex utriculata*, or *Deschampsia cespitosa*, or by forbs that may include *Caltha leptosepala*, *Ligusticum tenuifolium*, *Pedicularis groenlandica*, *Swertia perennis*, or *Thalictrum alpinum*.

ENVIRONMENT & DYNAMICS

Environmental Description: Communities within this alliance occur in moderately narrow to wide valleys and glacial basins on floodplains with lateral seepage of groundwater. Valley slopes range from 3-7%, and stream channels that run through the valleys vary from deep, narrow, and sinuous to shallow, broad, and gently meandering. Beavers are often active within the stands. Some stands occur on sideslope seeps, which remain wet throughout the growing season. Elevation ranges from 1950-3350 m. Soils are mineral. Soil textures include silty clay loams, silty loams, and sandy clay loams with mottling. Some stands occur on deep sandy clays, often with a high organic content, while other stands occur on shallow silty clays over gravels and rocks.

Dynamics: Browsing may weaken or eventually eliminate some willow species. With increasing levels of grazing, *Deschampsia cespitosa* will be replaced by *Juncus arcticus* ssp. *littoralis*, *Poa pratensis*, and *Taraxacum officinale*.

DISTRIBUTION

Geographic Range: This alliance is found in the Intermountain West and Rocky Mountains of Idaho, Montana, Wyoming, Colorado, Utah, and New Mexico, extending into eastern Oregon and Washington.

Nations: CA, US

States/Provinces: CO, ID, MT, NM, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Salix* spp. Series (Johnston 1987)

LOWER LEVEL UNITS

Associations:

- CEG002653 *Betula glandulosa* / Mesic Forbs - Mesic Graminoids Wet Shrubland
- CEG002064 *Salix wolfii* / *Calamagrostis canadensis* Wet Shrubland
- CEG001240 *Salix wolfii* / Mesic Forbs Wet Shrubland
- CEG001241 *Salix wolfii* / *Poa palustris* Wet Shrubland
- CEG001244 *Salix brachycarpa* / *Carex aquatilis* Wet Shrubland

- CEGLO01236 *Salix wolfii* / *Carex nebrascensis* Wet Shrubland
- CEGLO01242 *Salix wolfii* / *Swertia perennis* - *Pedicularis groenlandica* Wet Shrubland
- CEGLO01225 *Salix planifolia* / *Calamagrostis canadensis* Wet Shrubland
- CEGLO01135 *Salix brachycarpa* / Mesic Forbs Wet Shrubland
- CEGLO02665 *Salix planifolia* / *Caltha leptosepala* Wet Shrubland
- CEGLO01079 *Betula glandulosa* / *Carex utriculata* Wet Shrubland
- CEGLO01235 *Salix wolfii* / *Carex microptera* Wet Shrubland
- CEGLO01237 *Salix wolfii* / *Carex utriculata* Wet Shrubland
- CEGLO01230 *Salix planifolia* / *Deschampsia cespitosa* Wet Shrubland
- CEGLO05828 *Betula glandulosa* / *Salix brachycarpa* Wet Shrubland
- CEGLO01229 *Salix planifolia* / *Carex scopulorum* Wet Shrubland
- CEGLO01238 *Salix wolfii* / *Deschampsia cespitosa* Wet Shrubland
- CEGLO01227 *Salix planifolia* / *Carex aquatilis* Wet Shrubland
- CEGLO01136 *Salix glauca* Wet Shrubland
- CEGLO01228 *Salix (farriae, planifolia)* / *Carex utriculata* Wet Shrubland
- CEGLO01234 *Salix wolfii* / *Carex aquatilis* Wet Shrubland
- CEGLO05887 *Betula glandulosa* / *Carex* spp. Wet Shrubland
- CEGLO01239 *Salix wolfii* / *Fragaria virginiana* Wet Shrubland

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Cooper 1986a, Cooper and Cottrell 1990, Dorn 1997, Faber-Langendoen et al. 2017b, Girard et al. 1997, Hansen et al. 1991, Hansen et al. 1995, Heifner 1974, Hess 1981, Hess and Wasser 1982, Hitchcock et al. 1964, Jensen and Tuhy 1981, Johnston 1987, Jones 1992b, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996, Kittel et al. 1999a, Kittel et al. 1999b, Komarkova 1986, Lewis 1970, Mattson 1984, Mutz and Graham 1982, Mutz and Queiroz 1983, Norton et al. 1981, Olson and Gerhart 1982, Padgett et al. 1988b, Padgett et al. 1989, Phillips 1977, Sanderson and Kettler 1996, Tuhy 1981, Tuhy and Jensen 1982, Youngblood et al. 1985a, Youngblood et al. 1985b

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

2.C.4.Nb.2.f. M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland

G528. Western North American Boreal Wet Meadow & Marsh

Type Concept Sentence: This wetland group occurs in boreal Alaska and Canada on mineral soils and is characterized by graminoid species such as *Calamagrostis canadensis*, *Carex aquatilis*, *Carex lasiocarpa*, *Carex utriculata*, *Equisetum palustre*, *Eriophorum angustifolium*, and others. It may include shrub cover (<25%) such as *Myrica gale*, *Alnus incana ssp. tenuifolia*, and *Salix* spp.

OVERVIEW

Scientific Name: *Carex aquatilis* - *Carex utriculata* Boreal Wet Meadow & Marsh Group

Common Name (Translated Scientific Name): Water Sedge - Northwest Territory Sedge Boreal Wet Meadow & Marsh Group

Colloquial Name: Boreal Sedge Wet Meadow

Type Concept: This group is widespread in the boreal and boreal transitional areas of Alaska and British Columbia, extending east into Alberta, Saskatchewan, and Manitoba and south into Idaho, Montana, North Dakota and Minnesota. Vegetation is largely graminoid-dominated. Common species include *Calamagrostis canadensis*, *Carex aquatilis*, *Carex lasiocarpa*, *Carex utriculata*, *Equisetum palustre*, and *Eriophorum angustifolium*. Shrubs may be a minor component of the canopy cover (less than 25%) and include *Myrica gale*, *Alnus incana ssp. tenuifolia*, and *Salix* spp. It occurs on floodplains, depressions, pond and lake margins, oxbows and abandoned channels. Frequent river channel migration and associated flooding and fluvial processes constitute the major disturbances. Wetland succession and species composition are variable due to diverse environmental conditions such as water depth, substrate, and nutrient input. Floodplain wetland vegetation includes freshwater marsh and wet low shrub. Patch size is small to large and often linear. Moisture regime varies from saturated to semipermanently flooded.

Classification Comments:

Similar NVC Types:

Diagnostic Characteristics: This group is characterized principally by hydrophytic herbaceous vegetation and less commonly low-shrub marshes that are saturated to semipermanently flooded on boreal and boreal transition areas.

VEGETATION

Physiognomy and Structure: This group is defined by hydrophytic graminoids.

Floristics: Freshwater marsh vegetation may be dominated by emergent sedges, forbs, or grasses. Species that often dominate or codominate include *Calamagrostis canadensis*, *Carex aquatilis*, *Carex lasiocarpa*, *Carex utriculata*, *Equisetum palustre*, and *Eriophorum angustifolium*. Shrubs may be a minor component of the canopy cover (less than 25% cover) and include *Myrica gale*, *Alnus incana ssp. tenuifolia*, and *Salix* spp.

ENVIRONMENT & DYNAMICS

Environmental Description: Freshwater marshes are found throughout the boreal transition and boreal regions of Alaska and British Columbia, extending east into Alberta, Saskatchewan, and Manitoba and south into Idaho, Montana, North Dakota and Minnesota. They are characterized by emergent herbaceous vegetation. Freshwater marshes typically occur with other wetland groups. They occur on the margins of abandoned channels, floodplains, ponds, lakes, and riparian systems and on inland deltas where rivers drain into large lakes. Inland marshes are mostly small-patch, confined to limited areas in suitable floodplain or basin topography. They are typically saturated or semipermanently flooded, but some marshes have seasonal flooding. Water is at or above the surface for most of the growing season (typically 10 cm above the surface). Soils are muck or mineral, and water is nutrient-rich. These systems are highly productive and have high rates of decomposition.

Dynamics: This group requires a source of freshwater. Seasonal flooding is characteristic of inland deltas. Marsh zonation is related to water depth and duration of flooding. A typical sequence progresses from open water to emergent deep marsh to shallow marsh to wet meadow or fen. Floating marsh mats may be seral to fens. River channel migration, flooding and other fluvial processes constitute the major disturbance in this group.

DISTRIBUTION

Geographic Range: This group occurs throughout the boreal transition and boreal regions of Alaska and British Columbia, extending east into Alberta, Saskatchewan, and Manitoba and south into Idaho, Montana, North Dakota and Minnesota.

Spatial Scale & Pattern [optional]: Large patch, Small patch, Linear

Nations: CA, US

States/Provinces: AB, AK, BC, ID, MB, MN, ND, SK, YT

TNC Ecoregions [optional]: 71:C, 72:C, 73:C, 74:C, 75:?, 76:C, 77:C, 78:C, 79:C, 134:P, 135:C, 139:C, 140:C, 141:C, 144:C

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: NPS (Katmai)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Alliances:

- A3824 *Typha* spp. - *Schoenoplectus* spp. Boreal Marsh Alliance
- A3825 *Myrica gale* - *Alnus incana ssp. tenuifolia* - *Salix* spp. Boreal Wet Shrubland Alliance
- A3823 *Carex aquatilis* - *Carex utriculata* Boreal Wet Meadow Alliance

AUTHORSHIP

Primary Concept Source: G. Kittel, K. Boggs, P. Comer, M. Reid, D. Faber-Langendoen, in Faber-Langendoen et al. (2011)

Author of Description: M.E. Hall, G. Kittel and T. Boucher

Acknowledgments:

Version Date: 01/19/2016

Classif Resp Region: West

Internal Author: MEH 10-11, mod. GK 10-11, 9-13, 11-15, mod. TB 1-16

REFERENCES

References: Boggs 2002, Boggs et al. 2003, Comer et al. 2003, Faber-Langendoen et al. 2017a, Fleming and Spencer 2007, Gracz et al. 2005, Jorgenson 1999, Lawrence et al. 2005, National Wetlands Working Group 1997, Shiflet 1994, Stone et al. 2007, Thompson and Hansen 2003, Viereck et al. 1992, Willoughby 2007, Willoughby et al. 2006

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G528. Western North American Boreal Wet Meadow & Marsh

M301. Western North American Ruderal Marsh, Wet Meadow & Shrubland

This macrogroup includes disturbed natural wetland habitats of temperate western North America that are now strongly dominated by non-native and sometimes weedy or generalist native species.

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

2.C.4.Nb.90.a. M301 Western North American Ruderal Marsh, Wet Meadow & Shrubland

G524. Western North American Ruderal Marsh, Wet Meadow & Shrubland

Type Concept Sentence: This group contains wet meadows dominated by non-native species such as *Agrostis gigantea*, *Agrostis stolonifera*, *Alopecurus pratensis*, *Conyza canadensis*, *Cirsium arvense*, *Sonchus* spp., *Lactuca serriola*, *Phalaris arundinacea*, *Phragmites australis* ssp. *australis*, *Poa palustris*, and/or *Poa pratensis* that occur in the same physical settings as native wet meadows found throughout the western U.S. and Canada.

OVERVIEW

Scientific Name: *Poa pratensis* - *Conyza canadensis* - *Cirsium arvense* Ruderal Marsh, Wet Meadow & Shrubland Group

Common Name (Translated Scientific Name): Kentucky Bluegrass - Canadian Horseweed - Canada Thistle Ruderal Marsh, Wet Meadow & Shrubland Group

Colloquial Name: Western Ruderal Forb Wet Meadow

Type Concept: This group contains disturbed wet meadows found in lowland, montane and subalpine elevations, occasionally reaching into the lower edges of the alpine elevations (sea level to 3600 m) throughout the western U.S. and Canada. Vegetation is dominated by non-native species such as *Agrostis gigantea*, *Agrostis stolonifera*, *Alopecurus pratensis*, *Bromus inermis*, *Conyza canadensis*, *Cirsium arvense*, *Sonchus* spp., *Lactuca serriola*, *Phalaris arundinacea*, *Phragmites australis* ssp. *australis*, *Poa bulbosa*, *Poa palustris*, and *Poa pratensis*. Native species may be present but are so low in abundance that the original native plant association is impossible to determine. These can be wet meadows, wet emergent marshes, coastal backwater dunes, sloughs, open wet depressions, basins and flats with low-velocity surface and subsurface flows. They can be large meadows in montane or subalpine valleys, or occur as narrow strips bordering ponds, lakes, and streams, and along toeslope seeps. They are typically found on flat areas or gentle slopes, but may also occur on subirrigated sites with slopes up to 10%. Sites are usually seasonally wet, often drying by late summer, and many occur in a tension zone between perennial wetlands and uplands, where water tables fluctuate in response to long-term climatic cycles. They may have surface water for part of the year, but depths rarely exceed a few centimeters. Soils are mostly mineral and show typical hydric soil characteristics such as low chroma and redoximorphic features; some areas may have high organic content as inclusions or pockets. Due to disturbance, soils may be compacted.

Classification Comments: This group may be difficult to tease apart from its native counterpart. The test is that the non-native species far outweigh native species in abundance and richness, such that a well-trained observer cannot tell what the native counterpart may have been or to do so is only speculation. This group does not include actively managed irrigated hay meadows that have been historically seeded. Those belong under 7 Agricultural & Developed Vegetation Class (CCL01).

Similar NVC Types:

- G517 Vancouverian Freshwater Wet Meadow & Marsh: is dominated by native species.
- G521 Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh: is dominated by native species.
- G531 Arid West Interior Freshwater Marsh
- G819 North American Warm Desert Ruderal Scrub
- G677 North American Warm Desert Ruderal Grassland
- G600 Great Basin-Intermountain Ruderal Dry Shrubland & Grassland

Diagnostic Characteristics: Wet graminoid and forb meadow or marsh dominated by non-native species.

VEGETATION

Physiognomy and Structure: Herbaceous wet meadow dominated by perennial herbs introduced to North America.

Floristics: Vegetation of this group is dominated by non-native species such as *Agrostis gigantea*, *Agrostis stolonifera*, *Alopecurus pratensis*, *Bromus inermis*, *Conyza canadensis*, *Lactuca serriola*, *Cirsium arvense*, *Iris pseudacorus*, *Phalaris arundinacea*, *Phragmites australis*, *Poa bulbosa*, *Poa palustris*, *Poa pratensis*, *Poa trivialis*, and *Scirpus cyperinus*. Native species may be present but are so low in abundance that the original native plant association is impossible to determine. Floristic information was compiled from Whitson et al. (1996), Rondeau (2001), Faber-Langendoen et al. (2008), and Sawyer et al. (2009).

ENVIRONMENT & DYNAMICS

Environmental Description: *Soil/substrate/hydrology:* These wet meadows occur in open wet depressions, basins and flats with low-velocity surface and subsurface flows. They can be large meadows in montane or subalpine valleys, or occur as narrow strips bordering ponds, lakes, and streams, and along toeslope seeps. They are typically found on flat areas or gentle slopes, but may also occur on subirrigated sites with slopes up to 10%. Sites are usually seasonally wet, often drying by late summer, and many occur in a tension zone between perennial wetlands and uplands, where water tables fluctuate in response to long-term climatic cycles. Some sites occur under an agricultural management regime of seasonal sheet irrigation for grazing or haying purposes, and may bear no resemblance to historical types of the area. They may have surface water for part of the year, but depths rarely exceed a few centimeters. Soils are mostly mineral and show typical hydric soil characteristics such as low chroma and redoximorphic features; some areas may have high organic content as inclusions or pockets. Due to disturbance, soils may be compacted.

This group occurs in the same environmental settings as Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh Group (G521), Vancouverian Freshwater Wet Meadow & Marsh Group (G517), and Arid West Interior Freshwater Marsh Group (G531).

Dynamics: This group is a product of disturbance such as continuous heavy grazing by domestic livestock, soil disturbance/compactions, significant change in hydrologic regime, invasion after natural disturbance such as fire, floods or landslides, and are a combination of infestation by non-native invasive plants, and by diminished or lack of competition by native plants.

DISTRIBUTION

Geographic Range: This group is found throughout the entire western U.S. and Canada.

Spatial Scale & Pattern [optional]: Small patch

Nations: CA, US

States/Provinces: AB, AK, BC, CA, CO, ID, MT, NM, NV, OR, SD, TX, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

LOWER LEVEL UNITS

Alliances:

- A2020 *Sorghum halepense* Ruderal Desert Grassland Alliance
- A3848 *Poa pratensis* - *Agrostis gigantea* - *Agrostis stolonifera* Ruderal Marsh Alliance
- A4217 *Salix* spp. - *Artemisia cana* Ruderal Understory Wet Shrubland Alliance
- A3847 *Phragmites australis* ssp. *australis* - *Arundo donax* - *Typha angustifolia* Ruderal Marsh Alliance
- A3849 *Conyza canadensis* - *Cirsium arvense* - *Lactuca serriola* Ruderal Wet Meadow Alliance
- A3846 *Phalaris arundinacea* Western Ruderal Marsh Alliance

AUTHORSHIP

Primary Concept Source: D. Faber-Langendoen, in Faber-Langendoen et al. (2011)

Author of Description: G. Kittel

Acknowledgments: Associate Editor: F.J. Triepke. Peer review by J. Rocchio.

Version Date: 09/29/2016

Classif Resp Region: West

Internal Author: GK 12-10, 3-11, 6-12, 9-13, 12-15, 9-16, 10-16, 8-17

REFERENCES

References: Buck-Diaz et al. 2012, Faber-Langendoen et al. 2008a, Faber-Langendoen et al. 2017a, Rondeau 2001, Sawyer et al. 2009, Whitson et al. 2000

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G524. Western North American Ruderal Marsh, Wet Meadow & Shrubland

A3849. *Conyza canadensis* - *Cirsium arvense* - *Lactuca serriola* Ruderal Wet Meadow Alliance

Type Concept Sentence: This alliance covers those non-native forb-dominated waste and other disturbed places of the western U.S. dominated by such species as *Conyza canadensis*, *Cirsium arvense*, or *Lactuca serriola* (other species may be present to dominant).

OVERVIEW

Scientific Name: *Conyza canadensis* - *Cirsium arvense* - *Lactuca serriola* Ruderal Wet Meadow Alliance

Common Name (Translated Scientific Name): Canadian Horseweed - Canada Thistle - Prickly Lettuce Ruderal Wet Meadow Alliance

Colloquial Name: Western Ruderal Forb Wet Meadow

Type Concept: This alliance covers herbaceous areas dominated by non-native forb species such as *Conyza canadensis*, *Cirsium arvense*, or *Lactuca serriola*. Many other facultative wet forbs may be present or dominant, such as *Chenopodium album*, *Dipsacus fullonum*, *Lepidium perfoliatum*, *Rumex crispus*, *Sisymbrium altissimum*, *Sonchus arvensis*, and many others. These disturbed places are generally seasonally or intermittently flooded, usually drying completely between wet episodes. They are generally not alkaline but may be mildly so. It is found throughout the western U.S.

Classification Comments: This alliance covers western U.S. mesic to seasonally wet to moist areas, not dry upland areas.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Disturbed areas dominated by one or a mix of non-native wetland or facultative forb species such as *Chenopodium album*, *Cirsium arvense*, *Conyza canadensis*, *Dipsacus fullonum*, *Lactuca serriola*, *Lepidium perfoliatum*, *Rumex crispus*, *Sisymbrium altissimum*, or *Sonchus arvensis*.

VEGETATION

Physiognomy and Structure: Broad-leaved annual or perennial herbaceous stands <2 m in height.

Floristics: These stands are dominated by non-native forb species such as *Conyza canadensis*, *Cirsium arvense*, or *Lactuca serriola*. Many other facultative wet forbs may be present or dominant, such as *Chenopodium album*, *Cirsium arvense*, *Conyza canadensis*, *Dipsacus fullonum*, *Lactuca serriola*, *Lepidium perfoliatum*, *Rumex crispus*, *Sisymbrium altissimum*, *Sonchus arvensis*, and many others. Other commonly associated forbs present and contributing low to moderate cover include *Melilotus officinalis*, *Rorippa palustris* ssp. *hispida*, *Salsola tragus*, and *Verbascum thapsus*. Some graminoids such as *Hordeum jubatum* may also be present, but these tend to be not as abundant as the total forb cover.

ENVIRONMENT & DYNAMICS

Environmental Description: These alliance occur in mesic areas that are somehow disturbed, and are common throughout western North America. Stands occur in reservoir drawdown zones, disturbed areas near streams or old fields, and heavily damaged soils near open water.

Dynamics: This alliance is generally a product of serious soil disturbance in areas that are periodically wet, such as abandoned fields within flood zones or high water areas or drawn down reservoirs, or rings around stock ponds.

DISTRIBUTION

Geographic Range: This alliance is found throughout the western U.S.

Nations: US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY**LOWER LEVEL UNITS****Associations:**

- CEGL002800 *Conyza canadensis* Ruderal Wet Meadow

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/01/07

REFERENCES

References: Faber-Langendoen et al. 2017b

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G524. Western North American Ruderal Marsh, Wet Meadow & Shrubland

A3846. Phalaris arundinacea Western Ruderal Marsh Alliance

Type Concept Sentence: Stands are dominated by *Phalaris arundinacea*, which tends to occur in monocultures and is known to occur in mesic to wet disturbed areas and along rivers that no longer flood throughout the western U.S.

OVERVIEW

Scientific Name: *Phalaris arundinacea* Western Ruderal Marsh Alliance

Common Name (Translated Scientific Name): Reed Canarygrass Western Ruderal Marsh Alliance

Colloquial Name: Western Ruderal Reed Canarygrass Marsh

Type Concept: This herbaceous alliance covers stands dominated by *Phalaris arundinacea*, which tends to occur in monocultures. Stands are found along riparian areas, pond and lake margins, wet meadows, and intermittent drainages, and is known from throughout the western U.S.

Classification Comments: This alliance covers non-native strains of the nominal species. Extensive planting as a forage crop has led to the spread of this semi-natural type (Hansen et al. 1995, Hall and Hansen 1997). *Phalaris arundinacea* is native and widespread in Alberta, although some introduced genotypes may be present. Further work is required to resolve the natural versus introduced nature of this type in western North America. Midwest and eastern North American stands are covered by groups and alliances for those geographic areas.

Internal Comments: mjr 2-15: CA added based on Buck-Diaz et al. (2012).

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Stands dominated by *Phalaris arundinacea*, which tends to occur in monocultures.

VEGETATION

Physiognomy and Structure: Tall herbaceous perennial graminoid that can reach heights >2 m tall.

Floristics: Stands are dominated by non-native strains of *Phalaris arundinacea*, which tends to occur in monocultures or associated with *Calamagrostis canadensis* in northern areas.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance occurs in wet areas, primarily riparian, occurring along rivers and streams, as well as shallow lakeshores (MacKenzie and Moran 2004, Willoughby et al. 2004). Elevations range from near sea level to 2307 m. The poorly drained alluvial soils are commonly fine-textured (occasionally coarse-textured) and may be flooded for brief to extended periods.

Dynamics:

DISTRIBUTION

Geographic Range: This herbaceous alliance occurs throughout the western U.S. It also occurs in Canada, in the southern two-thirds of British Columbia, in areas with warm and relatively dry summers and in Alberta. Its distribution as a natural type is complicated because this native species is widely cultivated as a forage crop and has escaped and established in wetlands and riparian areas, displacing the local flora.

Nations: CA, US

States/Provinces: AB, BC, CA, CO, ID, MT, NM, NV, OR, UT, WA

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Phalaris arundinacea* Provisional Semi-Natural Stands (Reed canary grass grassland) (Buck-Diaz et al. 2012)

LOWER LEVEL UNITS

Associations:

- CEG001474 *Phalaris arundinacea* Western Marsh

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/01/08

REFERENCES

References: Boggs et al. 1990, Buck-Diaz et al. 2012, Crawford 2001, Faber-Langendoen et al. 2017b, Hall and Hansen 1997, Hansen et al. 1991, Hansen et al. 1995, MacKenzie and Moran 2004, Muldavin et al. 2000a, Willoughby et al. 2004

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G524. Western North American Ruderal Marsh, Wet Meadow & Shrubland

A3847. *Phragmites australis* ssp. *australis* - *Arundo donax* - *Typha angustifolia* Ruderal Marsh Alliance [Low - Poorly Documented]

Type Concept Sentence: This common reed marsh alliance is dominated by introduced *Phragmites australis* ssp. *australis*, *Arundo donax*, *Typha angustifolia* or other invasive wetland graminoid species, and is found across the west-temperate regions of the United States and Canada.

OVERVIEW

Scientific Name: *Phragmites australis* ssp. *australis* - *Arundo donax* - *Typha angustifolia* Ruderal Marsh Alliance

Common Name (Translated Scientific Name): European Common Reed - Giant Reed - Narrowleaf Cattail Ruderal Marsh Alliance

Colloquial Name: Western Ruderal Common Reed Marsh

Type Concept: This common reed-dominated marsh alliance is found across the west-temperate regions of the United States and Canada. *Phragmites australis* ssp. *australis*, *Arundo donax*, or *Typha angustifolia* will often invade into existing natural or semi-natural communities present on the site, and once established, this alliance is usually strongly dominated with few or no other vascular plants present. Stands occur in semipermanently flooded marshes, ditches, impoundments, etc. that have often been disturbed by human activity.

Classification Comments: This alliance is limited to the western U.S. and is intended to cover the non-native stands of introduced *Phragmites australis* ssp. *australis*, *Arundo donax*, or *Typha angustifolia*. Compare with similar monotypic stands in Great Plains and eastern U.S. alliances.

Internal Comments: DFL 8-17: AB added. mjr 8-15: MX added based on members.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Stands strongly dominated by non-native *Phragmites australis ssp. australis*, *Arundo donax*, or *Typha angustifolia*.

VEGETATION

Physiognomy and Structure: Tall perennial graminoid herbaceous that is <3 m in height.

Floristics: Stands are monocultures of introduced *Phragmites australis ssp. australis*, *Arundo donax*, or *Typha angustifolia*. Some stands may have minor cover of associates such as *Agrostis stolonifera*, *Carex spp.*, *Conyza canadensis*, *Glycyrrhiza lepidota*, *Iva axillaris*, *Mentha arvensis*, *Schoenoplectus acutus (= Scirpus acutus)*, and *Typha spp.* Other species present may include *Ambrosia psilostachya*, *Anemopsis californica*, *Baccharis douglasii*, *Distichlis spicata*, *Juncus arcticus*, *Juncus cooperi*, *Lepidium latifolium*, *Schoenoplectus americanus*, *Schoenoplectus californicus*, and *Xanthium strumarium*.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance is found in non-tidal marshes with semipermanently or, rarely, seasonally flooded hydrology, either in depressions or along rivers with seasonal fluctuation in water level throughout the western United States and adjacent Canada. This includes semipermanently flooded marshes, ditches, impoundments, etc.

Dynamics: Stands are generally a product of human-induced disturbance, either through direct habitat manipulation or through passive introduction of reproductive material to naturally disturbed substrates (Marks et al. 1994).

DISTRIBUTION

Geographic Range: West-temperate regions of the United States and Canada.

Nations: CA, MX, US

States/Provinces: AB, AZ, CA, CO, ID, MT, NM, NV, TX, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Lake Mead, Mojave); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

- > *Arundo donax* (Giant reed breaks) Semi-natural Stands (Sawyer et al. 2009) [42.080.00]
- > *Arundo donax* Herbaceous Alliance (Keeler-Wolf and Evens 2006)
- > *Arundo donax* Semi-Natural Stands (Giant reed breaks) (Buck-Diaz et al. 2012)
- > *Phragmites australis* (Common reed marshes) Alliance (Sawyer et al. 2009) [41.061.00]
- = *Phragmites australis* Herbaceous Alliance (Evens et al. 2014)

LOWER LEVEL UNITS

Associations:

- CEG001475 *Phragmites australis ssp. australis* Western Ruderal Wet Meadow
- CEG004101 *Arundo donax* Riverbank Ruderal Wet Meadow

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2017/08/14

REFERENCES

References: Buck-Diaz et al. 2012, Evens et al. 2014, Faber-Langendoen et al. 2017b, Hickson and Keeler-Wolf 2007, Keeler-Wolf and Evens 2006, Keeler-Wolf and Vaghti 2000, Marks et al. 1994, Niering and Warren 1977, Overholt et al. 2015, Sawyer et al. 2009, Sproul et al. 2011, Swearingen and Saltonstall 2010, Swearingen and Saltonstall 2012, VegCAMP and AIS 2013

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G524. Western North American Ruderal Marsh, Wet Meadow & Shrubland

A3848. *Poa pratensis* - *Agrostis gigantea* - *Agrostis stolonifera* Ruderal Marsh Alliance

Type Concept Sentence: This alliance includes grasslands dominated by introduced grasses such as *Agrostis gigantea*, *Agrostis stolonifera*, *Alopecurus pratensis*, or *Poa pratensis*, and is a very common and widespread in the western U.S. where it has invaded natural meadows, wetlands and riparian areas.

OVERVIEW

Scientific Name: *Poa pratensis* - *Agrostis gigantea* - *Agrostis stolonifera* Ruderal Marsh Alliance

Common Name (Translated Scientific Name): Kentucky Bluegrass - Redtop - Creeping Bentgrass Ruderal Marsh Alliance

Colloquial Name: Ruderal Kentucky Bluegrass - Redtop - Creeping Bentgrass Marsh

Type Concept: This alliance includes mesic grasslands and wetlands dominated by introduced grasses such as *Agrostis gigantea*, *Agrostis stolonifera*, *Alopecurus pratensis*, or *Poa pratensis*. This semi-natural grassland is widespread in the western U.S. where it has invaded natural meadows, wetlands and riparian areas. *Agrostis stolonifera* and *Poa pratensis* have been widely planted for forage and have invaded native communities from hay fields, especially more mesic areas such as riparian floodplains and seasonally flooded wetlands in the semi-arid western U.S.

Classification Comments: This alliance covers areas invaded by these non-native grasses and does not include irrigated hay meadows or other actively managed areas.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Grasslands dominated by *Agrostis gigantea*, *Agrostis stolonifera*, *Alopecurus pratensis*, or *Poa pratensis*.

VEGETATION

Physiognomy and Structure: Low-statured perennial herbaceous graminoid, generally <1 m in height.

Floristics: This widespread, semi-natural alliance is characterized by a moderate to dense herbaceous canopy that is strongly dominated by *Agrostis gigantea*, *Agrostis stolonifera*, *Alopecurus pratensis*, or *Poa pratensis*. Associate species are often those early-seral and weedy species that tolerate historic heavy livestock grazing or other disturbance well, such as *Achillea millefolium*, *Cirsium arvense*, *Elymus repens*, *Equisetum* spp., *Fragaria virginiana*, *Hordeum* spp., *Juncus balticus*, *Linaria vulgaris*, *Potentilla gracilis*, *Taraxacum officinale*, and introduced forage species such as *Agrostis stolonifera*, *Bromus inermis*, and *Phleum pratense*. Remnant native species present may include *Ambrosia psilostachya*, *Amorpha canescens*, *Andropogon gerardii*, *Artemisia ludoviciana*, *Carex* spp., *Deschampsia cespitosa*, *Pascopyrum smithii*, and *Psoraleidum tenuiflorum*.

ENVIRONMENT & DYNAMICS

Environmental Description: Sites are generally flat to moderately sloping and occur on all aspects. Stands typically occur on pastures found in the plains, montane meadows, stream benches and terraces. In the semi-arid region it is restricted to relatively mesic sites. Stands with *Alopecurus pratensis* are the wettest of this alliance that tolerates very high water table throughout the growing season. Stands can also tolerate mildly alkaline and saline soils, and some drought (Kovalchik 1987, Padgett et al. 1989, Hansen et al. 1995, Manning and Padgett 1995, Hall and Hansen 1997).

Dynamics: *Poa pratensis* is tolerant of heavy grazing and increases at the expense of less tolerant native species (Volland 1978, Hansen et al. 1995). It is also adapted to burning and quickly resprouts after fire, except when burned during growing periods (Volland and Dell 1981).

DISTRIBUTION

Geographic Range: This alliance is found throughout western U.S.

Nations: US

States/Provinces: AZ, CA, CO, ID, MT, NV, OR, SD, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- > *Agrostis (gigantea, stolonifera) - Festuca arundinacea* (Bent grass - tall fescue meadows) Semi-natural Stands (Sawyer et al. 2009) [45.106.00]
- > *Agrostis (gigantea, stolonifera)-Festuca arundinacea* Herbaceous Semi-Natural Alliance (CNPS 2017) [45.106.00]
- > *Poa pratensis* (Kentucky blue grass turf) Semi-natural Stands (Sawyer et al. 2009) [42.060.00]
- > *Poa pratensis* Herbaceous Semi-Natural Alliance (CNPS 2017) [42.060.00]

LOWER LEVEL UNITS**Associations:**

- CEGLO01558 *Agrostis (gigantea, stolonifera)* Ruderal Marsh
- CEGLO05615 *Echinochloa crus-galli* Ruderal Wet Meadow
- CEGLO05209 *Alopecurus pratensis* Western Ruderal Wet Meadow
- CEGLO03081 *Poa pratensis* Ruderal Marsh

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/01/08

REFERENCES

References: CNPS 2017, Carsey et al. 2003a, Faber-Langendoen et al. 2017b, Franklin and Dyrness 1973, Hall and Hansen 1997, Hansen et al. 1991, Hansen et al. 1995, Kauffman et al. 1983, Kauffman et al. 1985, Kittel et al. 1999b, Kovalchik 1987, Manning and Padgett 1995, Padgett et al. 1989, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Tuhy and Jensen 1982, Volland 1978, Volland and Dell 1981, Youngblood et al. 1985a

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G524. Western North American Ruderal Marsh, Wet Meadow & Shrubland

A4217. *Salix* spp. - *Artemisia cana* Ruderal Understory Wet Shrubland Alliance [Low - Poorly Documented]

Type Concept Sentence: Stands of native willows and/or native *Artemisia cana* sagebrush with non-native grasses and forbs dominant in the understory, found in western U.S. streams and floodplains.

OVERVIEW

Scientific Name: *Salix* spp. - *Artemisia cana* Ruderal Understory Wet Shrubland Alliance

Common Name (Translated Scientific Name): Willow species - Silver Sagebrush Ruderal Understory Wet Shrubland Alliance

Colloquial Name: Ruderal Willow - Silver Sagebrush Wet Shrubland

Type Concept: These riparian shrublands are dominated by native willows such as *Salix exigua*, *Salix monticola*, *Salix geyeriana*, *Salix drummondiana*, *Salix commutata*, and others, as well as shrublands dominated by *Artemisia cana* (*ssp. viscidula* and *ssp. bolanderi*) where the understory herbaceous layer has been completely replaced by non-native invasive species such as *Bromus tectorum*, *Poa pratensis*, *Dactylis glomerata*, *Bromus inermis*, *Elymus repens*, *Medicago sativa*, *Trifolium repens*, *Melilotus officinalis*, and *Phragmites australis*. This alliance occurs in relatively moist environments, including riparian areas and alkaline or saline playa lakes of the western U.S.

Classification Comments:

Internal Comments: GK 9-16: CO confirmed and AZ, CA, NV, WA added.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Stands lack an abundance of native herbaceous species such as *Danthonia intermedia*, *Deschampsia cespitosa*, *Eleocharis palustris*, *Elymus elymoides*, *Festuca idahoensis*, *Festuca ovina*, *Festuca thurberi*, *Leymus cinereus*, *Muhlenbergia richardsonis*, *Poa cusickii*, and *Poa secunda*.

VEGETATION**Physiognomy and Structure:**

Floristics: These riparian shrublands are dominated by native willows such as *Salix exigua*, *Salix monticola*, *Salix geyeriana*, *Salix drummondiana*, *Salix commutata*, and others, as well as shrublands dominated by *Artemisia cana* (*ssp. viscidula* and *ssp. bolanderi*) where the understory herbaceous layer has been completely replaced by non-native invasive species such as *Bromus tectorum*, *Poa pratensis*, *Dactylis glomerata*, *Bromus inermis*, *Elymus repens*, *Medicago sativa*, *Trifolium repens*, *Melilotus officinalis*, and *Phragmites australis*.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance occurs in relatively moist environments, including riparian areas and alkaline or saline playa lakes.

Dynamics: Stands have been disturbed by chronic grazing (by native ungulates or livestock), recreational use, or other heavy use that disturbs the soil surface and makes it possible for invasive species to become dominant.

DISTRIBUTION

Geographic Range: This alliance is found throughout the western U.S. in riparian areas, especially near populated areas.

Nations: US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEG001199 *Salix exigua* / *Agrostis stolonifera* Ruderal Wet Shrubland
- CEG005623 *Salix exigua* / *Phalaris arundinacea* Ruderal Wet Shrubland
- CEG002988 *Artemisia cana* (*ssp. bolanderi*, *ssp. viscidula*) / *Poa pratensis* Ruderal Wet Shrubland

AUTHORSHIP

Primary Concept Source: M. Reid, in Faber-Langendoen et al. (2015)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2016/09/28

REFERENCES

References: Faber-Langendoen et al. 2017b, Manning and Padgett 1995, Padgett et al. 1989

2. Shrub & Herb Vegetation

2.C.4.Nb. Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland

G524. Western North American Ruderal Marsh, Wet Meadow & Shrubland

A2020. *Sorghum halepense* Ruderal Desert Grassland Alliance

Type Concept Sentence: This semi-natural alliance is dominated by the non-native grass *Sorghum halepense* and occurs in northern Mexico, Arizona and elsewhere in the desert southwestern U.S.

OVERVIEW

Scientific Name: *Sorghum halepense* Ruderal Desert Grassland Alliance

Common Name (Translated Scientific Name): Johnson Grass Ruderal Desert Grassland Alliance

Colloquial Name: Ruderal Johnson Grass Desert Grassland

Type Concept: The vegetation is characterized by a relatively sparse to dense herbaceous layer dominated or codominated by the exotic perennial forage grass *Sorghum halepense*. The native annual forb *Amaranthus palmeri* often codominates. Associated species are sometimes many and include scattered *Prosopis velutina* shrubs and grasses and forbs such as *Chenopodium berlandieri*, *Chloris virgata*, *Eragrostis cilianensis*, *Eragrostis pectinacea*, *Eriochloa acuminata*, *Ipomoea* spp., *Kallstroemia grandiflora*, *Leptochloa panicea* *ssp. brachiata* (= *Leptochloa filiformis*), *Salsola kali*, and *Solanum elaeagnifolium*. This semi-natural alliance occurs in northern Mexico, Arizona and elsewhere in the desert southwestern U.S. where disturbance by sorghum cultivation for forage

CBR alliances

production has converted what was likely natural desert grasslands. Sites are typically flat to gently sloping basins and flats that may be intermittently flooded. Soils are variable but typically finer-textured silt loam or clays.

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Edges of fields, roadsides, and disturbed or formerly cultivated areas dominated by *Sorghum halepense*.

VEGETATION

Physiognomy and Structure: This alliance is characterized by a relatively sparse to dense herbaceous layer dominated or codominated by an exotic perennial forage grass.

Floristics: The vegetation is characterized by a relatively sparse to dense herbaceous layer dominated or codominated by the exotic perennial forage grass *Sorghum halepense*. The native annual forb *Amaranthus palmeri* often codominates. Associated species are sometimes many and include scattered *Prosopis velutina* shrubs and grasses and forbs such as *Chenopodium berlandieri*, *Chloris virgata*, *Eragrostis cilianensis*, *Eragrostis pectinacea*, *Eriochloa acuminata*, *Ipomoea* spp., *Kallstroemia grandiflora*, *Leptochloa panicea* ssp. *brachiata* (= *Leptochloa filiformis*), *Salsola kali*, and *Solanum elaeagnifolium*.

ENVIRONMENT & DYNAMICS

Environmental Description: Sites are typically flat to gently sloping basins and flats that may be intermittently flooded. Soils are variable but typically finer-textured silt loam or clays.

Dynamics: This alliance occurs in old fields and along the edges of roads and fields. *Sorghum halepense* is kept out of agricultural fields with herbicides but can colonize after cultivation ceases. *Sorghum halepense* is considered to be one of the ten worst invasive weeds in the world (Holm et al. 1977).

DISTRIBUTION

Geographic Range: This alliance is described from Arizona and New Mexico and is presumably widespread in agricultural regions of the southeastern U.S.

Nations: MX?, US

States/Provinces: AZ, MXCH?, MXSO?, NM?, TX?

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEGL005327 *Amaranthus palmeri* Ruderal Grassland
- CEGL005328 *Sorghum halepense* - (*Amaranthus palmeri*) Ruderal Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Faber-Langendoen et al. 2017b, Holm et al. 1977

2.C.5. Salt Marsh

Salt Marsh is a wetland that has shallow water and levels that usually fluctuate due primarily to tides along the coast or changes in water depth in depressions. Coastal salt marshes are primarily intertidal; that is, they are found in areas at least occasionally inundated by high tide but not flooded during low tide, including estuaries, lagoons, and the lee side of barrier islands. The vegetation comprises emergent shrubs and herbs with at least 10% cover, especially saline or halophytic species. They occur at all latitudes around the globe, but are concentrated in the temperate mid-latitudes (23-70°N and S).

2.C.5.Nd. North American Western Interior Brackish Marsh, Playa & Shrubland

Interior saline-alkaline wetlands of North American interior west, including salt flats, marshes and seeps, whose species composition is driven by water chemistry and duration and seasonality of wetness. Stands range from sparse cover of shrubs and/or herbs to productive marshes dominated by tall emergent graminoids.

M082. Warm & Cool Desert Alkali-Saline Marsh, Playa & Shrubland

This macrogroup consists of alkaline and saline wetlands with salt-tolerant plant growth where dominant and characteristic plant species include *Atriplex* spp., *Distichlis spicata*, *Salicornia* spp., *Sarcobatus vermiculatus*, *Sesuvium verrucosum*, *Sporobolus* spp., *Suaeda moquinii*, and *Triglochin maritima*. These are located in playas, washes, mudflats and depressional wetlands where evaporation far exceeds precipitation and/or where bedrock and soil properties contribute to alkaline/saline conditions. Sites are found throughout the western U.S. and southwestern Canada.

2. Shrub & Herb Vegetation

2.C.5.Nd. North American Western Interior Brackish Marsh, Playa & Shrubland

2.C.5.Nd.1.a. M082 Warm & Cool Desert Alkali-Saline Marsh, Playa & Shrubland

G538. North American Desert Alkaline-Saline Marsh & Playa

Type Concept Sentence: This group contains alkaline-saline marshes found in non-coastal and non-tidal areas of the Intermountain West. Marshes can be densely vegetated emergent or barren and sparsely vegetated playas where soils and water (if present) are alkaline. Characteristic species may include *Allenrolfea occidentalis*, *Atriplex* spp., *Distichlis spicata*, *Grayia spinosa*, *Leymus cinereus*, *Leymus triticooides*, *Muhlenbergia* spp., *Poa secunda*, *Puccinellia lemmonii*, *Salicornia* spp., *Sarcobatus vermiculatus*, and *Triglochin maritima*.

OVERVIEW

Scientific Name: *Distichlis spicata* - *Puccinellia lemmonii* - *Salicornia* spp. Alkaline-Saline Marsh & Playa Group

Common Name (Translated Scientific Name): Saltgrass - Lemmon's Alkali Grass - Saltwort species Alkaline-Saline Marsh & Playa Group

Colloquial Name: Saltgrass Alkaline Wet Meadow

Type Concept: This group is found in the intermountain western U.S. Associations are composed of densely vegetated seasonal wetlands, saltwater emergent marshes to barren and sparsely vegetated playas (generally <10% plant cover). Characteristic species may include *Allenrolfea occidentalis*, *Atriplex* spp., *Distichlis spicata*, *Grayia spinosa*, *Leymus cinereus*, *Leymus triticooides* (= *Elymus triticooides*), *Muhlenbergia* spp., *Poa secunda*, *Puccinellia lemmonii*, *Salicornia* spp., *Sarcobatus vermiculatus*, and *Triglochin maritima*. Soils and standing water (if present) are alkaline. Salt crusts are common where there are actively drying ponds, that can have saltgrass beds in depressions and sparse shrubs around the margins. Playa flats are intermittently, seasonally to semipermanently flooded, usually retaining water into the growing season and drying completely only in drought years. Many are associated with hot and cold springs, located in basins with internal drainage. Soils are alkaline to saline clays with hardpans. Seasonal drying exposes mudflats colonized by annual wetland vegetation. Water is prevented from percolating through the soil by an impermeable soil subhorizon and is left to evaporate. Soil salinity varies greatly with soil moisture and greatly affects species composition. During exceptionally wet years, increased precipitation can dilute soil salt concentrations which may allow less salt-tolerant species to become established or more abundant. Some stands occur on floodplains, along the margins of perennial lakes, and in alkaline closed basins, with extremely low-gradient shorelines.

Classification Comments:

Similar NVC Types:

- G531 Arid West Interior Freshwater Marsh
- G324 Great Plains Saline Wet Meadow & Marsh: also includes salt-tolerant herbaceous wetlands, but occurs east of the Continental Divide on the Great Plains.
- G537 North American Desert Alkaline-Saline Wet Scrub: also occurs in cold desert regions but is dominated by shrub species.

Diagnostic Characteristics: Salt-tolerant herbs that are seasonally or intermittently wet on barren to sparsely vegetated playas, lake margins, closed basins, and low-gradient shorelines.

VEGETATION

Physiognomy and Structure: Open shrub and/or herb vegetation.

Floristics: Characteristic species may include *Allenrolfea occidentalis*, *Atriplex* spp., *Distichlis spicata*, *Grayia spinosa*, *Leymus cinereus*, *Leymus triticoides* (= *Elymus triticoides*), *Muhlenbergia* spp., *Poa secunda*, *Puccinellia lemmonii*, *Salicornia* spp., *Schoenoplectus americanus*, *Bolboschoenus maritimus* (= *Schoenoplectus maritimus*), and *Triglochin maritima*.

ENVIRONMENT & DYNAMICS

Environmental Description: *Climate:* Cold desert. *Soil/substrate/hydrology:* This group is found on barren and sparsely vegetated playas (generally <10% plant cover). Salt crusts are common throughout, with small saltgrass beds in depressions and sparse shrubs around the margins. The flats are intermittently, seasonally to semipermanently flooded, usually retaining water into the growing season and drying completely only in drought years. Many are associated with hot and cold springs, located in basins with internal drainage. Soils are alkaline to saline clays with hardpans. Seasonal drying exposes mudflats colonized by annual wetland vegetation. Water is prevented from percolating through the soil by an impermeable soil subhorizon and is left to evaporate. Soil salinity varies greatly with soil moisture and greatly affects species composition. During exceptionally wet years, increased precipitation can dilute soil salt concentrations which may allow less salt-tolerant species to become established or more abundant. Some stands occur on floodplains, along the margins of perennial lakes, and in alkaline closed basins, with extremely low-gradient shorelines. Environmental information compiled from individual associations and Knight (1994).

Dynamics: Playas are shallow, seasonal wetlands that lie in the lowest point of a closed watershed. Their basins are lined with clay soils, which collect and hold water from rainfall and runoff events. Water evaporates, leaving high salt concentrations in the soils. Some playas will only flood with water during years with high precipitation, sometimes only once or twice in a decade. Others will have standing water every spring, except in the driest of years. During flooded years, some salt-tolerant marsh plant species may grow, such as cattails (*Typha* spp.) or bulrush (*Scirpus* and/or *Schoenoplectus* spp.) (Knight 1994).

DISTRIBUTION

Geographic Range: This group is found throughout the intermountain western U.S.

Spatial Scale & Pattern [optional]: Large patch, Small patch

Nations: CA, MX, US

States/Provinces: CA, CO, ID, MT, NM, NV, OR, TX, UT, WA?, WY

TNC Ecoregions [optional]: 6:C, 10:C, 11:C, 19:C

USFS Ecoregions (2007): 313A:CP, 313B:CP, 313D:CC, 322A:??, 331J:CC, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CP, 342F:CC, 342G:CC, 342H:CC, 342I:C?, 342J:CC, M242C:CC, M261D:P?, M261G:PP, M313A:CC, M331D:??, M331E:??, M332G:CC, M341A:CC, M341B:C?, M341D:CC

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: High.

SYNONYMY

LOWER LEVEL UNITS

Alliances:

- A1334 *Sporobolus airoides* - *Muhlenbergia asperifolia* - *Spartina gracilis* Alkaline Wet Meadow Alliance
- A4241 *Frankenia salina* Salt Marsh & Playa Alliance
- A4164 *Cladium californicum* Alkaline Seep Alliance
- A3930 *Eleocharis palustris* - *Eleocharis rostellata* Alkaline-Saline Marsh Alliance
- A3932 *Hordeum jubatum* Alkaline Wet Meadow Alliance
- A1332 *Distichlis spicata* Alkaline Wet Meadow Alliance
- A1329 *Leymus cinereus* - *Leymus triticoides* Alkaline Wet Meadow Alliance
- A4247 *Anemopsis californica* - *Helianthus nuttallii* - *Solidago spectabilis* Alkaline Wet Meadow Alliance

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al.

Author of Description: G. Kittel

Acknowledgments: J. Kagan and P. Comer

Version Date: 12/02/2015

Classif Resp Region: West

Internal Author: GK 10-10, 9-13, 12-15

REFERENCES

References: Faber-Langendoen et al. 2017a, Knight 1994, Rodriguez et al. 2017, Shiflet 1994, Stout et al. 2013

2. Shrub & Herb Vegetation

2.C.5.Nd. North American Western Interior Brackish Marsh, Playa & Shrubland

G538. North American Desert Alkaline-Saline Marsh & Playa

A1332. *Distichlis spicata* Alkaline Wet Meadow Alliance

Type Concept Sentence: This wetland herbaceous alliance consists of playas and ephemeral streams with sparse to dense herbaceous cover dominated by *Distichlis spicata* on deep, saline, alkaline and fine-textured soils. This alliance occurs throughout much of the semi-arid and arid western U.S. in lowland sites such as playas, swales and terraces along washes that are seasonally, temporarily or intermittently flooded.

OVERVIEW

Scientific Name: *Distichlis spicata* Alkaline Wet Meadow Alliance

Common Name (Translated Scientific Name): Saltgrass Alkaline Wet Meadow Alliance

Colloquial Name: Saltgrass Alkaline Wet Meadow

Type Concept: This alkaline or saline wetland herbaceous alliance covers grasslands of playas and ephemeral streams. Cover may be a sparse or dense herbaceous layer dominated by *Distichlis spicata*, sometimes occurring in nearly pure stands, or with any of the following as a codominant: *Carex filifolia*, *Hordeum jubatum*, *Juncus arcticus* ssp. *littoralis* (= *Juncus balticus*), *Pascopyrum smithii*, *Puccinellia nuttalliana*, and/or *Sporobolus airoides*. Forb cover is generally low and may include Asteraceae spp., *Helianthus* spp., *Salicornia rubra*, *Suaeda calceoliformis* (= *Suaeda depressa*), and *Triglochin maritima*. Occasionally *Suaeda* may be the dominant species and *Distichlis* may be completely absent. This alliance occurs throughout much of the semi-arid and arid western U.S. on saline or alkaline soils in lowland sites such as playas, swales and terraces along washes that are seasonally, temporarily or intermittently flooded. Soils are deep, saline, alkaline and fine-textured. They generally have an impermeable layer and therefore are poorly drained. When the soil is dry, the surface usually has salt accumulations.

Classification Comments: These are highly alkaline or saline sites.

Internal Comments: mjr 1-17: CNPS recommends a rank of G5/S4.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Diagnostic of this alliance is the *Distichlis spicata*- or *Suaeda calceoliformis*-dominated herbaceous layer.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a sparse to moderately dense graminoid layer dominated by rhizomatous mid grasses less than 0.5 m tall.

Floristics: Cover is sparse to dense and is dominated by *Distichlis spicata*, occurring in nearly pure stands. Associates from sites with higher soil salinity may include the graminoid *Puccinellia nuttalliana* and the forbs *Salicornia rubra*, *Triglochin maritima*, and *Suaeda calceoliformis* (= *Suaeda depressa*). Species from sites with lower salinity include the graminoids *Carex filifolia*, *Juncus balticus*, *Hordeum jubatum*, *Pascopyrum smithii*, and *Sporobolus airoides*, and the forbs *Helianthus* spp. and Asteraceae spp. (Ungar 1974c). Forb cover is generally low. Shrubs are rare but may include scattered *Atriplex canescens* and *Sarcobatus vermiculatus*.

ENVIRONMENT & DYNAMICS

Environmental Description: Grasslands in this western alliance occur in lowland habitats such as playas, swales and terraces along washes that are intermittently flooded. The flooding is usually the result of highly localized thunderstorms which can flood one basin and leave the next dry. It also occurs along California coastal areas, and the Channel Islands, where it is sometimes found in a tidal wetland or riparian situation. Climate is semi-arid to arid. Soil texture ranges from clay loam to sandy clay (Redmann 1972, Johnston 1987). These soils are deep, saline and alkaline. They generally have an impermeable layer and therefore are poorly drained. When the soil is dry, the surface usually has salt accumulations.

Dynamics: Stands have higher diversity and cover during wet years and near boundaries with other vegetation types. Higher soil salinity favors *Distichlis spicata* over less salt-tolerant species. However, very high salinity will dwarf the *Distichlis spicata* and reduce cover. Generally, vegetation height and cover and species diversity tend to vary inversely with salinity (Ungar 1967, Steinauer 1989). Associated species may be restricted by the level of salinity in the soil. This osmotic stress of growing in alkaline and saline soils is compensated by the accumulation of proline by some halophytic species including *Distichlis spicata*. This aids the plants' water uptake by increasing the osmotic potential of the plant (Shupe et al. 1986). Vegetation forms zones at some saline sites, where species abundance is stratified by salt tolerance (Ungar et al. 1969, Shupe et al. 1986). In playas, the soil salinity at field capacity generally increases from the edge to the center allowing for several different vegetation stands to co-occur (Ungar 1967, 1970, Ungar et al. 1969). Microtopography can also affect vegetation structure. Where soil accumulates to form hummocks, less salt- and alkali-tolerant plants can occur (Ungar 1972, Johnson 1987).

Distichlis spicata is rhizomatous and tolerant of moderate grazing and its roots resist trampling. Although relatively unpalatable, it can provide valuable winter forage for livestock if needed. If grazed heavily, *Distichlis spicata* will decline and may be replaced by less desirable warm-season grasses such as *Schedonnardus paniculatus* (Costello 1944b). Weeds are generally not a problem because few grow well in saline soils.

DISTRIBUTION

Geographic Range: This alliance occurs throughout much of the semi-arid and arid western U.S. It also occurs along California coastal areas, and the Channel Islands.

Nations: CA, MX?, US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, OR, SK, UT, WA, WY

TNC Ecoregions [optional]: 6:C, 8:C, 9:C, 10:C, 11:C, 15:C, 16:C, 17:C, 18:C, 19:C, 20:C, 23:C, 24:C, 26:C, 27:C, 28:C

USFS Ecoregions (2007): 261A:CC, 261B:CC, 321A:CC, 322Ab:CCC, 322Ai:CCC, 322B:CC, 341A:CC, 341B:CC, 341D:CC, 341E:CC, 341F:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Channel Islands, Death Valley); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Distichlis spicata* (Salt grass flats) Alliance (Sawyer et al. 2009) [41.200.00]
- = *Distichlis spicata* Alkaline Flats Alliance (Rodriguez et al. 2017)
- = *Distichlis spicata* Alliance (Salt grass flats) (Buck-Diaz et al. 2012)
- = *Distichlis spicata* Herbaceous Alliance (Evens et al. 2014)
- ? *Distichlis spicata* Series (Johnston 1987)
- = *Distichlis spicata* Herbaceous Alliance (CNPS 2017) [41.200.00]
- >< Alkali Meadow (#45310) (Holland 1986b)
- >< Northern Coastal Salt Marsh (#52110) (Holland 1986b)
- ? Overland Flow # 36 (Soil Conservation Service n.d.)
- ? Salt Flat # 34 (Soil Conservation Service n.d.)
- = Saltgrass Series (Sawyer and Keeler-Wolf 1995)
- >< Southern Coastal Salt Marsh (#52120) (Holland 1986b)
- ? Wet Meadow # 38 (Soil Conservation Service n.d.)

LOWER LEVEL UNITS

Associations:

- CEGLO01771 *Distichlis spicata* - Mixed Herb Wet Meadow
- CEGLO01770 *Distichlis spicata* Alkaline Wet Meadow
- CEGLO01772 *Distichlis spicata* - *Lepidium perfoliatum* Wet Meadow
- CEPP006701 *Distichlis spicata* - *Juncus cooperi* Alkaline Wet Meadow
- CEPP005679 *Distichlis spicata* - *Bromus diandrus* Ruderal Saline/Alkaline Grassland
- CEPP006700 *Distichlis spicata* - *Juncus arcticus* ssp. *littoralis* Alkaline Wet Meadow
- CEPP005715 *Distichlis spicata* - (*Baccharis douglasii*, *Equisetum hyemale*) Wet Meadow
- CEPP005716 *Distichlis spicata* - *Leymus triticoides* Wet Meadow
- CEPP006712 *Juncus cooperi* Alkaline Wet Meadow
- CEGLO03462 *Distichlis spicata* - *Frankenia salina* - *Jaumea carnosa* Salt Marsh
- CEGLO01773 *Distichlis spicata* - (*Scirpus nevadensis*) Alkaline Wet Meadow
- CEGLO05417 *Suaeda calceoliformis* Wet Meadow

AUTHORSHIP

Primary Concept Source: K.A. Schulz and J. Evens, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel, K.A. Schulz, J. Evens

Acknowledgments:

Version Date: 2016/11/10

REFERENCES

References: Baker 1984a, Beatley 1976, Bradley 1970, Brotherson 1987, Buck-Diaz et al. 2012, Bunin 1985, CNPS 2017, Copeland 1979, Costello 1944b, Crouch 1961a, Daniels 1911, Daubenmire 1970, Evens et al. 2014, Faber-Langendoen et al. 2017b, Ferren and Davis 1991, Franklin and Dyrness 1973, Graham 1937, Griffiths 1902, Hansen et al. 1991, Hansen et al. 1995, Henrickson 1974, Hickson and Keeler-Wolf 2007, Holland 1986b, Hyder et al. 1966, Johnston 1987, Jones and Walford 1995, Junak et al. 2007, Keeler-Wolf and Evens 2006, Keeler-Wolf and Vaghti 2000, Keeler-Wolf et al. 2003b, Keeler-Wolf et al. 2005, Kittel and Lederer 1993, Kittel et al. 1994, Klipple and Costello 1960, Macdonald 1977, Odion et al. 1992, Osborn 1974, Peinado et al. 1994b, Pickart 2006, Ralston 1969, Ramaley 1942, Redmann 1972, Rodriguez et al. 2017, Rogers 1953, Saul 1974, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shanks 1977, Shupe et al. 1986, Soil Conservation Service 1978, Soil Conservation Service n.d., Solomeshch and Barbour 2006, Sproul et al. 2011, Stearns-Roger, Inc. 1978, Steinauer 1989, Thorne 1976, Tuhy and Jensen 1982, Ungar 1967, Ungar 1968, Ungar 1970, Ungar 1972, Ungar 1974b, Ungar 1974c, Ungar et al. 1969, VegCAMP and AIS 2013, Vestal 1914, Weaver and Albertson 1956, Zedler et al. 1992

2. Shrub & Herb Vegetation

2.C.5.Nd. North American Western Interior Brackish Marsh, Playa & Shrubland

G538. North American Desert Alkaline-Saline Marsh & Playa

A3930. *Eleocharis palustris* - *Eleocharis rostellata* Alkaline-Saline Marsh Alliance

Type Concept Sentence: This alliance is characterized by a sparse to dense herbaceous layer that is dominated or codominated by *Eleocharis palustris*, a facultative wetland species, or *Eleocharis rostellata*. Other salt-tolerant species may also be present to codominant, such as *Carex aquatilis*, *Distichlis spicata*, *Glaux maritima*, *Juncus arcticus ssp. littoralis*, and *Muhlenbergia asperifolia*. Stands occur adjacent to salt waterbodies or on the margins of high-evaporation playas of central Intermountain West basins. Surface water, if present, is highly saline and may or may not be present during the entire growing season.

OVERVIEW

Scientific Name: *Eleocharis palustris* - *Eleocharis rostellata* Alkaline-Saline Marsh Alliance

Common Name (Translated Scientific Name): Common Spikerush - Beaked Spikerush Alkaline-Saline Marsh Alliance

Colloquial Name: Common Spikerush Alkaline-Saline Marsh

Type Concept: This herbaceous wetland alliance occurs in shallow, mostly still water. The vegetation is characterized by a sparse to dense herbaceous layer that is dominated or codominated by *Eleocharis palustris*, a facultative wetland species, or *Eleocharis rostellata*. Other salt-tolerant species may also be present to codominant, such as *Carex aquatilis*, *Distichlis spicata*, *Glaux maritima*, *Juncus arcticus ssp. littoralis* (= *Juncus balticus*), and *Muhlenbergia asperifolia*. Stands occur adjacent to salt waterbodies or on the margins of high-evaporation playas. Surface water, if present, is highly saline and may or may not be present during the entire growing season. Known locations are near the Great Salt Lake, playas, and springs of the central Intermountain West.

Classification Comments: These are very salty conditions, and much more than the mild alkalinity freshwater *Eleocharis palustris* associations experience near the end of the growing season as water sources dwindle.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Highly saline wetlands (perennial or ephemeral) dominated by *Eleocharis palustris*.

VEGETATION

Physiognomy and Structure: This alliance is characterized by a rhizomatous perennial that dominates the graminoid stratum (up to 70% cover). The forb layer is sparse (0-20%) and contains both aquatic and terrestrial species.

Floristics: *Eleocharis palustris* or *Eleocharis rostellata* dominates the graminoid stratum. Other salt-tolerant species may also be present to codominant, such as *Carex aquatilis*, *Distichlis spicata*, *Glaux maritima*, *Juncus arcticus ssp. littoralis* (= *Juncus balticus*), and *Muhlenbergia asperifolia*. Cover ranges from sparse to quite dense (10-80%).

ENVIRONMENT & DYNAMICS

Environmental Description: These conspicuous, common emergent communities occur in shallow, mostly still water. Stands occur on a variety of landforms, including lake margins, stream terraces, floodplains, gravel bars, and wet basins (ciénegas) or meadows. Soil reaction is alkaline (Hansen et al. 1988). All sites are saturated throughout much of the growing season.

Dynamics:**DISTRIBUTION**

Geographic Range: This alliances is found in the central Intermountain West basins of Utah, Wyoming and possibly Nevada.

Nations: US

States/Provinces: NV?, UT, WY

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- ? *Carex* spp. Series (Johnston 1987)
- = *Eleocharis (palustris, rostellata)* Herbaceous Alliance (Evens et al. 2014)
- > *Eleocharis rostellata* - *Schoenus nigricans* community (Sada and Cooper 2012)
- ? Montane, Plains, and Great Basin Marshlands (Brown 1982a)

LOWER LEVEL UNITS**Associations:**

- C EGL001834 *Eleocharis palustris* - *Distichlis spicata* Marsh
- C EGL003428 *Eleocharis rostellata* Marsh
- C EGL001835 *Eleocharis palustris* - *Juncus arcticus* ssp. *littoralis* Marsh

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Baker and Kennedy 1985, Brotherson 1987, Brotherson and Barnes 1984, Brown 1982a, Cronquist et al. 1977, Evens et al. 2014, Faber-Langendoen et al. 2017b, Hendrickson and Minckley 1984, Johnston 1987, Kovalchik 1987, Manning and Padgett 1995, Mutel and Marr 1973, Padgett et al. 1988b, Padgett et al. 1989, Reid et al. 1994, Sada and Cooper 2012, Shupe et al. 1986, Sturges 1968, Youngblood et al. 1985a

2. Shrub & Herb Vegetation

2.C.5.Nd. North American Western Interior Brackish Marsh, Playa & Shrubland

G538. North American Desert Alkaline-Saline Marsh & Playa

A4241. Frankenia salina Salt Marsh & Playa Alliance [Provisional (Not Submitted)]

Type Concept Sentence: This is a short subshrub-dominated salt marsh and playa alliance of coastal marshes, interior alkaline meadows and playas of central and southern California. It is dominated by the subshrub *Frankenia salina* often codominant with *Distichlis spicata* and/or other salt-tolerant species.

OVERVIEW

Scientific Name: *Frankenia salina* Salt Marsh & Playa Alliance

Common Name (Translated Scientific Name): Alkali Sea-heath Salt Marsh & Playa Alliance

Colloquial Name: Alkali Sea-heath Salt Marsh & Playa

Type Concept: This alliance is found in coastal salt to brackish marshes, alkaline meadows and playas of central and southern California. It is dominated by *Frankenia salina*, a short (<60 cm) subshrub, often codominant with *Distichlis spicata* or other salt-tolerant herbs and subshrubs. Other species present include *Arthrocnemum subterminale*, *Atriplex* spp., *Agrostis avenacea*, *Batis maritima*, *Cressa truxillensis*, *Atriplex californica* (= *Extriplex californica*), *Hordeum murinum*, *Lasthenia* spp., *Lepidium* spp., *Limonium*

CBR alliances

californicum, *Monanthochloe littoralis*, *Sarcocornia pacifica*, and *Suaeda taxifolia*. There is a sparse to dense herbaceous layer and a true shrub layer can be sparse to open, for example *Isocoma menziesii* is sometimes an emergent in the shrub layer with sparse to open cover. A tree layer is typically absent.

Classification Comments:

Internal Comments: mjr 1-17: CNPS recommends a rank of G4/S3.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: This alliance is characterized by a sparse to open herbaceous layer of *Frankenia salina*, usually with other salt-tolerant species. The overall herbaceous cover ranges from 5 to 70% cover. The alliance may be sparsely vegetated.

VEGETATION

Physiognomy and Structure:

Floristics: On the coast in salt marshes, stands are codominated by *Frankenia salina* and *Distichlis spicata*, along with *Monanthochloe littoralis*, *Sarcocornia pacifica*, and *Suaeda taxifolia*. In the interior alkaline salt flats, *Frankenia salina* can be found with *Atriplex* species. Alkali clay sinks and playas may have *Lasthenia* spp., *Lepidium dictyotum* var. *acutidens*, and *Arthrocnemum subterminale*. On the Channel Islands, stands occur in coastal wetlands and are dominated by *Frankenia salina*, with companion species such as *Sarcocornia pacifica*, *Atriplex* spp., *Distichlis spicata*, *Atriplex californica* (= *Extriplex californica*), *Suaeda calceoliformis*, and/or *Suaeda taxifolia*. *Isocoma menziesii* can be an emergent in the shrub layer with sparse cover. *Frankenia salina* salt marsh found on Santa Rosa Island has high (>70%) relative importance of native species (Johnson et al. 2001, as cited in Junak et al. 2007).

ENVIRONMENT & DYNAMICS

Environmental Description: Stands occur in seasonally moist or intermittently flooded, clayey, saline soils within salt marshes and, when on the coast, are a part of the high marsh vegetation. When inland, stands occur on alkaline flats, playas and saline vernal pools. Salinity concentrates in the upper regions of the soil due to capillary action of drying for long periods in the hot sun.

Dynamics:

DISTRIBUTION

Geographic Range: The alliance occurs on the Channel Islands of Anacapa, Santa Barbara, Santa Rosa, San Nicolas, and San Miguel, as well as the California mainland, along the central and southern coasts, and the interior marshes of the San Francisco Bay, and interior alkaline flats of the Central Valley and the central Mojave Desert.

Nations: US

States/Provinces: CA

TNC Ecoregions [optional]: 13:C, 15:C, 16:C, 17:C

USFS Ecoregions (2007): 261A:CC, 261B:CC, 262A:CC, 322A:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Channel Islands)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Provisional (Not Submitted).

SYNONYMY

- = *Frankenia salina* (Alkali heath marsh) Alliance (Sawyer et al. 2009) [52.500.00]
- = *Frankenia salina* Herbaceous Alliance (Rodriguez et al. 2017)

LOWER LEVEL UNITS

Associations:

- CEPP005735 *Suaeda taxifolia* - *Hordeum murinum* Grassland
- CEPP005680 *Frankenia salina* - *Distichlis spicata* Coastal Alkaline Grassland

AUTHORSHIP

Primary Concept Source: J.O. Sawyer, T. Keeler-Wolf, and J. Evens (2009)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2016/08/11

REFERENCES

References: Faber-Langendoen et al. 2017b, HDR 2014, Junak et al. 2007, Keeler-Wolf and Evens 2006, Keeler-Wolf and Vaghti 2000, Rodriguez et al. 2017, Sawyer et al. 2009

2. Shrub & Herb Vegetation

2.C.5.Nd. North American Western Interior Brackish Marsh, Playa & Shrubland

G538. North American Desert Alkaline-Saline Marsh & Playa

A3932. *Hordeum jubatum* Alkaline Wet Meadow Alliance

Type Concept Sentence: This alliance consists of grasslands dominated by *Hordeum jubatum* found in lowlands with moderately to strongly saline or alkaline soils within the western U.S. and Canada.

OVERVIEW

Scientific Name: *Hordeum jubatum* Alkaline Wet Meadow Alliance

Common Name (Translated Scientific Name): Foxtail Barley Alkaline Wet Meadow Alliance

Colloquial Name: Foxtail Barley Alkaline Wet Meadow

Type Concept: This alkaline grassland alliance contains stands dominated by *Hordeum jubatum*. Vegetation is dominated by short and medium-tall graminoids with a total cover of nearly 100%. Shrubs are often absent, and forbs are present but not usually abundant. Other common species include *Distichlis spicata*, *Elymus trachycaulus*, *Pascopyrum smithii*, *Poa arida*, *Poa compressa*, *Rumex crispus*, and *Sonchus arvensis*. *Hordeum jubatum* is a native increaser species that responds to disturbance, and with time since disturbance, sites will grade into other alkaline alliances. This alliance is found throughout the interior western U.S., including California's Central Valley, and Alberta, Canada. Stands are located in lowlands with moderately to strongly saline or alkaline soils. The topography is flat and the soils are often briefly flooded or saturated in the spring.

Classification Comments: This combines temporarily and intermittently flooded alliances, and often grades into other alliances with time since disturbance, and therefore may be difficult to classify when *Hordeum jubatum* is codominant with other species. This alliance is limited to the western U.S. and Canada.

Internal Comments:

Other Comments:

Similar NVC Types:

- A1341 *Distichlis spicata* - *Hordeum jubatum* Wet Meadow Alliance: is restricted to the Great Plains.

Diagnostic Characteristics: Bottomland alkaline grasslands dominated by *Hordeum jubatum*. Stands are often monotypic, or with 1-3 dominants.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a sparse to dense graminoid layer dominated by perennial bunch grasses less than 0.5 m tall. Forbs are infrequent.

Floristics: Grasslands included in this alliance have vegetation that is a sparse to dense layer of short and medium-tall graminoids dominated by the cool-season, short-lived, perennial bunchgrass *Hordeum jubatum*. It often occurs in nearly pure stands. Ungar et al. (1969) described one stand that was dominated by *Hordeum jubatum* in the spring and early summer, which then became dominated by *Iva annua* in the late summer. Total vegetation cover is usually high but can range from 20% to nearly 100% (Barnes and Tieszen 1978, Hansen et al. 1995). Shrubs are often absent, and forbs are present but not usually abundant. Species diversity is typically low. Other species include *Chenopodium* spp., *Distichlis spicata*, *Eleocharis* spp., *Elymus trachycaulus*, *Iva annua*, *Pascopyrum smithii*, *Poa arida*, *Poa compressa*, *Puccinellia nuttalliana*, *Rumex crispus*, *Salicornia rubra*, and *Bolboschoenus maritimus* (= *Scirpus paludosus*).

ENVIRONMENT & DYNAMICS

Environmental Description: The topography is flat, and the soils are often briefly flooded or saturated in the spring (Redmann 1972). It is also found in the drawdown zone of ponds with moderately saline water (Hansen et al. 1995). Soils are clay loam to clay and poor to very poorly drained. Soil salinity is somewhat variable. In the field with competition, this grass grows best in moderately saline conditions (up to 0.7% salinity) (Wilson 1967). The soil surface may be covered with white salt crusts with moderately to strongly saline soils (Wilson 1967, Ungar et al. 1969, Barnes and Tieszen 1978, Hansen et al. 1995).

Dynamics: *Hordeum jubatum* is a common, short-lived pioneer species of mesic habitats where permanent grass cover has been destroyed (Dodd and Coupland 1966). It may represent a seral stage that will be taken over by more permanent grasses (Hansen et

al. 1995). It is moderately salt-tolerant and can densely colonize areas disturbed by flooding along drainages, around playas and more permanent ponds. *Hordeum jubatum* is moderately tolerant of salinity. Often on playas, these grasslands occupy a zone of intermediate salinity between halophytic vegetation dominated by *Distichlis spicata*, *Puccinellia nuttalliana*, or *Salicornia rubra*, and non-saline, mesic prairie vegetation dominated by *Pascopyrum smithii*, *Poa* spp. or *Elymus* spp. Total vegetation cover (density and height), species composition and soil salinity depend on the amount and timing of precipitation and flooding. Growth-inhibiting salt concentrations are diluted when the soil is saturated, allowing the growth of less salt-tolerant species and more robust growth (Ungar 1967).

DISTRIBUTION

Geographic Range: This alliance is found in the interior west of California, Oregon, and Washington east to Colorado, Idaho, Montana, south into New Mexico, and north into Alberta.

Nations: CA, US

States/Provinces: AB, CA, CO, ID, MT, NM, NV, OR, WA

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Hordeum brachyantherum* (Meadow barley patches) Alliance (Sawyer et al. 2009) [42.052.00]
- ? *Hordeum jubatum* Community Type (Hansen et al. 1995)
- ? *Hordeum jubatum* Dominance Type (Hansen et al. 1988b)
- ? *Hordeum jubatum* Plains Grassland (Baker 1984a)
- ? *Hordeum brachyantherum* Herbaceous Alliance (CNPS 2017) [42.052.00]
- >< *Hordeum* Type (Redmann 1972)

LOWER LEVEL UNITS

Associations:

- CEGLO05285 *Hordeum jubatum* Great Basin Wet Meadow

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz, L. Allen, and G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Airphoto Analysis Associates 1979, Baker 1984a, Barnes and Tieszen 1978, Bunin 1985, CNPS 2017, Dodd and Coupland 1966, Faber-Langendoen et al. 1996, Faber-Langendoen et al. 2017b, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Redmann 1972, Reid 1974, Sawyer et al. 2009, Thompson and Hansen 2002, Ungar 1967, Ungar et al. 1969, Vestal 1914, Wilson 1967

2. Shrub & Herb Vegetation

2.C.5.Nd. North American Western Interior Brackish Marsh, Playa & Shrubland

G538. North American Desert Alkaline-Saline Marsh & Playa

A1329. *Leymus cinereus* - *Leymus triticoides* Alkaline Wet Meadow Alliance

Type Concept Sentence: This alliance is of *Leymus cinereus*- and *Leymus triticoides*-dominated grasslands of alkaline/saline wet meadows that occur throughout much of the Intermountain West, including the Great Basin and Columbia River Basin, as well as and California's Central Valley and coastal plains.

OVERVIEW

Scientific Name: *Leymus cinereus* - *Leymus triticoides* Alkaline Wet Meadow Alliance

Common Name (Translated Scientific Name): Basin Wildrye - Beardless Wildrye Alkaline Wet Meadow Alliance

Colloquial Name: Western Wildrye Alkaline Wet Meadow

Type Concept: This grassland alliance is of alkaline wetlands where tall bunchgrasses *Leymus cinereus* and/or *Leymus triticoides* are the dominant species. Other graminoids present may include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Achnatherum*

thurberianum (= *Stipa thurberiana*), *Carex praegracilis*, *Distichlis spicata*, *Elymus elymoides*, *Hesperostipa comata* (= *Stipa comata*), *Hordeum brachyantherum ssp. californicum* (= *Hordeum californicum*), *Hordeum jubatum*, *Juncus arcticus ssp. littoralis* (= *Juncus balticus*), *Lolium perenne ssp. multiflorum* (= *Lolium multiflorum*), *Onopordum acanthium*, *Pascopyrum smithii*, *Poa secunda*, *Pseudoroegneria spicata*, *Schoenoplectus* spp., and/or *Scirpus* spp. It is rarely without several introduced annual plants such as *Avena fatua*, *Brassica nigra*, *Bromus diandrus*, *Bromus hordeaceus*, *Carduus pycnocephalus*, *Lactuca serriola*, *Lolium perenne ssp. multiflorum* (= *Lolium multiflorum*), *Polypogon monspeliensis*, *Sonchus* spp., or *Vulpia myuros*. This alliance occurs throughout much of the Intermountain West, including the Great Basin and Columbia River Basin, as well as California's Central Valley and coastal plains. Elevations range from sea level to 3000 m. Stands are restricted to intermittently flooded habitats such as playas, intermittent streams, dry washes, poorly drained floodplains, margins of marshes, and historic lake basins. Soils are saline or alkaline with a shallow water table. Soils are typically moderately deep silts and clays, and the soil surface often has high cover of bare ground.

Classification Comments:

Internal Comments: mjr 1-17: CNPS recommends a rank of G4/S3.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Diagnostic of this alliance is the medium-tall grassland dominated by *Leymus cinereus* or *Leymus triticoides* that is restricted to lowland sites that are flooded intermittently.

VEGETATION

Physiognomy and Structure: Perennial bunch grasses less than 1.5 m tall.

Floristics: The tall bunchgrasses *Leymus cinereus* or *Leymus triticoides* (= *Elymus triticoides*) are the sole or dominant grasses. Other graminoids may include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Achnatherum thurberianum* (= *Stipa thurberiana*), *Carex praegracilis*, *Distichlis spicata*, *Elymus elymoides*, *Hesperostipa comata* (= *Stipa comata*), *Hordeum brachyantherum ssp. californicum* (= *Hordeum californicum*), *Hordeum jubatum*, *Juncus balticus*, *Lolium perenne ssp. multiflorum* (= *Lolium multiflorum*), *Pascopyrum smithii*, *Poa secunda*, *Pseudoroegneria spicata*, *Schoenoplectus* spp., and/or *Scirpus* spp. There is often sparse to moderate cover of forbs such as *Achillea millefolium*, *Agoseris glauca*, *Claytonia perfoliata* (= *Montia perfoliata*), *Crepis runcinata*, *Iris missouriensis*, *Lactuca serriola*, *Nitrophila occidentalis*, *Potentilla gracilis var. fastigiata* (= *Potentilla gracilis var. nuttallii*), *Sonchus* spp., *Suaeda* spp., and *Triglochin maritima*. Shrubs such as *Ericameria nauseosa* (= *Chrysothamnus nauseosus*) may be scattered within the stand.

ENVIRONMENT & DYNAMICS

Environmental Description: Elevations range from 0-3000 m. Sites are nearly level to gently sloping (to 18%) occurring on all aspects. Stands are restricted to intermittently flooded habitats such as playas, intermittent streams, drainage bottoms, poorly drained floodplains, margins of marshes, historic lake basins, and dry washes. Flooding is not predictable to a given season and is dependent upon localized rainstorms. Soils are typically poorly drained, alkaline, deep silts, clays, sandy loam to clay loam in texture. The soil surface often has high cover of bare ground. The water table is generally shallow.

Dynamics: *Leymus cinereus* is considered fire-adapted and generally resprouts after fire and recovers quite rapidly on most sites (FEIS 1998).

DISTRIBUTION

Geographic Range: This alliance is found in the Intermountain West of Montana, Wyoming, Idaho, Washington, southeastern Oregon; northwestern Nevada; and interior central Coast Ranges, southern coastal Transverse Ranges, Central Valley and Sierra Nevada foothills of California.

Nations: US

States/Provinces: CA, CO, ID, NV, OR, UT, WA, WY

TNC Ecoregions [optional]: 4:C, 6:C, 8:C, 9:C, 10:C, 11:C, 12:C, 13:C, 15:C, 16:C, 19:C, 20:C, 26:C

USFS Ecoregions (2007): 261A:CC, 261B:CC, 313A:CC, 331A:CC, 341F:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CC, M261F:CC, M261G:CC, M262A:CC, M262B:CC, M331D:CC, M331E:CC, M331G:CC, M331H:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M341A:CC, M341B:C?

Omernik Ecoregions:

Federal Lands [optional]: NPS (Channel Islands); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Elymus cinereus* - *Elymus triticoides* Herbaceous Alliance (Rodriguez et al. 2017)
- ? *Elymus cinereus*/*Distichlis stricta* habitat type (Daubenmire 1970)
- > *Leymus cinereus* (Ashy ryegrass meadows) Alliance (Sawyer et al. 2009) [41.020.00]
- > *Leymus cinereus* Alliance (Ashy rye grass meadows) (Buck-Diaz et al. 2012)
- > *Leymus triticoides* (Creeping rye grass turfs) Alliance (Sawyer et al. 2009) [41.080.00]
- > *Leymus triticoides* Alliance (Creeping rye grass turfs) (Buck-Diaz et al. 2012)
- > *Leymus triticoides* Herbaceous Alliance (Keeler-Wolf and Evens 2006)
- >< Alkali Grassland and Wetlands (Chappell et al. 1997)
- >< Ashy Ryegrass Series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS**Associations:**

- CEGLO01479 *Leymus cinereus* Alkaline Wet Meadow
- CEGLO01480 *Leymus cinereus* Bottomland Wet Meadow
- CEGLO01571 *Leymus triticoides* Wet Meadow
- CEPP005717 *Leymus triticoides* - *Bromus* spp. - *Avena* spp. Wet Meadow
- CEGLO01481 *Leymus cinereus* - *Distichlis spicata* Alkaline Wet Meadow
- CEGLO05306 *Muhlenbergia rigens* Wet Meadow
- CEGLO01572 *Leymus triticoides* - *Poa secunda* Wet Meadow

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel, K.A. Schulz, and J. Evens

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: AIS 2007, Blackburn et al. 1969a, Blackburn et al. 1969d, Buck-Diaz et al. 2012, Chappell et al. 1997, Christensen 1963, Cooper et al. 1995, Copeland 1979, Daubenmire 1970, Daubenmire 1992, Easterday and Mamone 1980, Evens and San 2004, Evens et al. 2006, FEIS 1998, Faber-Langendoen et al. 2017b, Franklin and Dyrness 1973, Hamilton 1997, Holstein 2001, Hull and Hull 1974, Johnson and Simon 1985, Johnson and Simon 1987, Junak et al. 2007, Keeler-Wolf and Evens 2006, Keeler-Wolf and Vaghti 2000, Mueggler and Stewart 1980, Peterson pers. comm., Poulton 1955, Rodriguez et al. 2017, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Seyer 1984, Solomeshch and Barbour 2006, Sproul et al. 2011, Stoddart 1941, Stout et al. 2013, Walker and Brotherson 1982

2. Shrub & Herb Vegetation

2.C.5.Nd. North American Western Interior Brackish Marsh, Playa & Shrubland

G538. North American Desert Alkaline-Saline Marsh & Playa

A1334. Sporobolus airoides - Muhlenbergia asperifolia - Spartina gracilis Alkaline Wet Meadow Alliance

Type Concept Sentence: This alliance is characterized by sparse to dense grasslands and meadows dominated by *Muhlenbergia asperifolia*, *Poa secunda*, *Puccinellia lemmonii*, *Puccinellia nuttalliana*, *Spartina gracilis*, and/or *Sporobolus airoides*, any of which may form nearly pure stands. It occurs in lowland habitats such as playas, swales, terraces along intermittently flooded washes, and flats that are alkaline or moderately saline. This alliance is found on plains, in mountain parks and valleys, and in canyons and plateaus of the western U.S.

OVERVIEW

Scientific Name: *Sporobolus airoides* - *Muhlenbergia asperifolia* - *Spartina gracilis* Alkaline Wet Meadow Alliance

Common Name (Translated Scientific Name): Alkali Sacaton - Scratchgrass - Alkali Cordgrass Alkaline Wet Meadow Alliance

Colloquial Name: Alkali Sacaton - Scratchgrass - Alkali Cordgrass Alkaline Wet Meadow

Type Concept: Vegetation included in this alliance is characterized by grasslands and meadows dominated by *Muhlenbergia asperifolia*, *Poa secunda*, *Puccinellia lemmonii*, *Puccinellia nuttalliana*, *Spartina gracilis*, and/or *Sporobolus airoides*, any of which may form monotypic stands. Other species that co-occur include *Carex microptera*, *Distichlis spicata*, *Elymus elymoides*, *Hordeum brachyantherum*, *Juncus arcticus* ssp. *littoralis* (= *Juncus balticus*), *Juncus ensifolius*, *Muhlenbergia richardsonis*, *Pascopyrum smithii*, and/or *Pseudoroegneria*. Forb cover is generally low with *Achillea millefolium*, *Arnica longifolia*, *Iris missouriensis*, *Stellaria longipes*, the annuals *Montia linearis* and *Trifolium cyathiferum*, and may include species of *Atriplex*, *Polygonum*, and *Rumex*. Shrubs are rare, but because of the patchy distribution of these stands, scattered *Atriplex canescens* and *Sarcobatus vermiculatus* may be present.

Sites are found in lowland habitats such as playas, swales, terraces along intermittently flooded washes, and alkali flats. Any flooding that occurs tends to be the result of localized thunderstorms in the summer. Soils are variable, ranging from deep, fine-textured soil to shallow sand deposits. They are alkaline and may be moderately saline and poorly drained due to an impermeable layer. Stands are documented from eastern Oregon, Washington, California, Nevada, Colorado, Utah, and New Mexico.

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

- A3186 *Sporobolus airoides* - *Sporobolus wrightii* - *Panicum obtusum* Lowland Desert Grassland Alliance

Diagnostic Characteristics: Bottomland alkaline grasslands dominated by *Muhlenbergia asperifolia*, *Puccinellia lemmonii*, *Puccinellia nuttalliana*, *Spartina gracilis*, and/or *Sporobolus airoides*. Stands are often monotypic, or with 1-3 dominants, with any combination of these species.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a sparse to dense herbaceous layer dominated by medium-tall bunch grasses.

Floristics: Dominant graminoids include *Muhlenbergia asperifolia*, *Poa secunda*, *Puccinellia lemmonii*, *Puccinellia nuttalliana*, and/or *Sporobolus airoides*. Other graminoids present to codominant may include *Agrostis gigantea*, *Carex douglasii*, *Carex microptera*, *Distichlis spicata*, *Elymus elymoides*, *Hordeum brachyantherum*, *Juncus balticus*, *Juncus ensifolius*, *Muhlenbergia richardsonis*, *Pascopyrum smithii*, *Pseudoroegneria spicata*, *Bolboschoenus maritimus* (= *Scirpus paludosus*), and *Spartina gracilis*. Forb cover is generally low but may include *Achillea millefolium*, *Arnica longifolia*, *Atriplex argentea*, *Iris missouriensis*, *Montia linearis*, *Plantago eriopoda*, *Polygonum* spp., *Rumex* spp., *Stellaria longipes*, and *Trifolium cyathiferum*. Shrubs may be present as well with very low cover (<3%) and include *Atriplex canescens* and *Sarcobatus vermiculatus*. Exotic annual grasses such as *Bromus tectorum* and *Polypogon monspeliensis* are often abundant on disturbed sites.

ENVIRONMENT & DYNAMICS

Environmental Description: Sites occur in lowland habitats such as playas, swales, terraces along intermittently flooded washes, and alkali flats. Soils are variable, ranging from deep, fine-textured soil to shallow sand deposits. They are alkaline and may be moderately saline and poorly drained due to an impermeable layer. When dry the soil may have salt accumulations on the soil surface. Stands are typically flooded in the spring and have a shallow water table that may drop below 1 m by the early summer. Elevation ranges from low interior valleys of eastern Oregon to high-elevation mountain parks of Colorado (Reid 1974).

Dynamics: Total vegetation abundance (density and height), species composition and soil salinity depend on the amount and timing of precipitation and flooding. Growth inhibiting salt concentrations are diluted when the soil is saturated allowing the growth of less salt-tolerant species. As the saturated soils dry, the salt concentrates until it precipitates out on the soil surface (Dodd and Coupland 1966, Ungar 1968). Higher salinity favors some species over others, and may influence changes in species composition from year to year. For example, higher soil salinity favors *Distichlis spicata*, *Hordeum jubatum*, and *Sporobolus airoides* over the less salt-tolerant *Muhlenbergia asperifolia*. Ungar (1965) lists *Muhlenbergia asperifolia* as significantly less salt-tolerant than *Sporobolus airoides* and much less tolerant than *Distichlis spicata*. The special configuration (often concentric rings) of salt-tolerant species may also change with microtopography and degree of ponded water (Ungar 1967, 1970, 1972, Ungar et al. 1969).

DISTRIBUTION

Geographic Range: This alliance is found in the interior west of California, Oregon, and Washington east to Colorado, south into New Mexico, and north into Alberta.

Nations: CA, US

States/Provinces: AB, AZ, CA, CO, NM, NV, OR, UT, WA

TNC Ecoregions [optional]: 17:C

USFS Ecoregions (2007): 322Ab:CCC, 322Al:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Muhlenbergia asperifolia* salt marsh (Baker 1984a)
- > *Poa secunda* (Curly blue grass grassland) Alliance (Sawyer et al. 2009) [41.180.00]
- > *Poa secunda* Alliance (Curly blue grass grassland) (Buck-Diaz et al. 2012)
- > *Spartina gracilis* (Alkali cordgrass marsh) Alliance (Sawyer et al. 2009) [52.030.00]
- > *Sporobolus airoides* (Alkali sacaton grassland) Alliance (Sawyer et al. 2009) [41.010.00]
- > *Sporobolus airoides* Alliance (Alkali sacaton grassland) (Buck-Diaz et al. 2012)
- > *Sporobolus airoides* Herbaceous Alliance (Evens et al. 2014)
- >< *Sporobolus cryptandrus* - *Aristida purpurea* var. *longiseta* Grasslands (Chambers et al. 1997)
- >< One-sided Bluegrass Series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS**Associations:**

- CEGLO01688 *Sporobolus airoides* Monotype Wet Meadow
- CEGLO01685 *Sporobolus airoides* Southern Plains Wet Meadow
- CEGLO01658 *Puccinellia lemmonii* - *Poa secunda* Wet Meadow
- CEGLO01588 *Spartina gracilis* Wet Meadow
- CEGLO01779 *Muhlenbergia asperifolia* Wet Meadow
- CEGLO01799 *Puccinellia nuttalliana* Salt Marsh
- CEGLO01687 *Sporobolus airoides* - *Distichlis spicata* Wet Meadow
- CEGLO05809 *Tiquilia latior* / *Sporobolus airoides* Dwarf-shrub Wet Meadow
- CEGLO01476 *Spartina pectinata* Western Wet Meadow

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel and K.A. Schulz

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Baker 1984a, Blackburn et al. 1969b, Bolen 1964, Borgais unpubl. data 1990, Buck-Diaz et al. 2012, Chambers et al. 1997, Dodd and Coupland 1966, Evens et al. 2014, Faber-Langendoen et al. 2017b, Keeler-Wolf and Thomas 2000, Kittel and Lederer 1993, Manning 1988, Reid 1974, Reid et al. 1994, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shupe et al. 1986, Stout et al. 2013, USBOR 1976, Ungar 1972, Ungar et al. 1969, VegCAMP and AIS 2013

2. Shrub & Herb Vegetation

2.C.5.Nd. North American Western Interior Brackish Marsh, Playa & Shrubland

2.C.5.Nd.1.b. M082 Warm & Cool Desert Alkali-Saline Marsh, Playa & Shrubland

G537. North American Desert Alkaline-Saline Wet Scrub

Type Concept Sentence: This group consists of saline scrub wetlands of the Intermountain West. Characteristic species include *Atriplex* spp., *Allenrolfea occidentalis*, *Salicornia rubra*, *Sarcobatus vermiculatus*, *Sesuvium verrucosum*, and/or *Suaeda moquinii*.

OVERVIEW

Scientific Name: *Sarcobatus vermiculatus* - *Atriplex* spp. Alkaline-Saline Wet Scrub Group

Common Name (Translated Scientific Name): Greasewood - Saltbush species Alkaline-Saline Wet Scrub Group

Colloquial Name: Iodinebush Wet Shrubland

Type Concept: This group occurs throughout much of the western U.S. in intermountain basins. Stands typically occur near drainages on stream terraces and flats or may form rings around more sparsely vegetated playas. Sites typically have saline soils, a shallow water table and flood intermittently, but remain dry for most growing seasons. The water table remains high enough to maintain vegetation, despite salt accumulations. This group consists of open to moderately dense shrublands dominated by *Atriplex lentiformis*, *Atriplex parryi*, *Atriplex polycarpa*, *Atriplex spinifera*, *Allenrolfea occidentalis*, *Salicornia rubra*, *Sarcobatus vermiculatus*, *Sesuvium verrucosum*, and/or *Suaeda moquinii*. Stands may be monotypic or have lesser abundance of other shrubs such as *Atriplex canescens*, *Atriplex confertifolia*, *Atriplex gardneri*, *Artemisia tridentata* ssp. *wyomingensis*, *Artemisia tridentata* ssp. *tridentata*, *Artemisia cana* ssp. *cana*, *Baccharis* spp., *Krascheninnikovia lanata*, and others. The herbaceous layer, if present, is usually dominated by graminoids. There may be inclusions of *Calamovilfa longifolia*, *Distichlis spicata* (where water remains ponded the longest), *Eleocharis palustris*, *Pascopyrum smithii*, *Poa pratensis*, *Puccinellia nuttalliana*, or *Sporobolus airoides* herbaceous types.

Classification Comments:

Similar NVC Types:

- G534 Western Great Plains Saline Wet Meadow: occurs in the northern and western Great Plains and is also dominated by *Sarcobatus vermiculatus* with more Great Plains herbaceous species.
- G538 North American Desert Alkaline-Saline Marsh & Playa: includes salt communities in the cold desert that are dominated by herbaceous species.

Diagnostic Characteristics: Salt-tolerant shrublands with a shallow water table.

VEGETATION

Physiognomy and Structure: Shrubland.

Floristics: These shrublands are dominated by *Atriplex lentiformis*, *Atriplex parryi*, *Atriplex polycarpa*, *Atriplex spinifera*, *Allenrolfea occidentalis*, *Salicornia rubra*, *Sarcobatus vermiculatus*, *Sesuvium verrucosum*, and/or *Suaeda moquinii*. Codominant shrubs include *Ambrosia dumosa*, *Artemisia californica*, *Atriplex canescens*, *Baccharis pilularis*, *Baccharis salicifolia*, *Encelia californica*, *Eriogonum fasciculatum*, *Gutierrezia sarothrae*, *Hymenoclea salsola*, *Bassia americana* (= *Kochia americana*), *Larrea tridentata*, *Malosma laurina*, *Myoporum laetum*, *Pluchea sericea*, *Prosopis glandulosa*, *Rhus integrifolia*, and/or *Suaeda taxifolia* plus several others. The herbaceous layer, if present, is usually dominated by graminoids. There may be inclusions of *Calamovilfa longifolia*, *Distichlis spicata* (where water remains ponded the longest), *Eleocharis palustris*, *Pascopyrum smithii*, *Poa pratensis*, *Puccinellia nuttalliana*, or *Sporobolus airoides* herbaceous types (West 1983b, Knight 1994).

ENVIRONMENT & DYNAMICS

Environmental Description: *Climate:* Cold interior desert. *Soil/substrate/hydrology:* Sites are generally flat to gently sloping and moderately saline, but some sites do occur on rolling to hilly fans and slopes. Sites typically have saline soils, a shallow water table and flood intermittently, on margins of intermittently flooded desert playas, and usually remain dry for most growing seasons. The water table remains high enough to maintain vegetation, despite salt accumulations, often with fine soils such as clays (West 1983b, Knight 1994).

Dynamics:

DISTRIBUTION

Geographic Range: This group occurs throughout much of the western U.S. in intermountain basins.

Spatial Scale & Pattern [optional]: Large patch

Nations: US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, OR, TX, UT, WA, WY

TNC Ecoregions [optional]: 4:C, 6:C, 8:C, 9:C, 10:C, 11:C, 19:C, 20:C, 26:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313D:CC, 315A:CC, 315H:CC, 321A:??, 322A:CC, 331B:CC, 331C:CP, 331D:CP, 331F:CC, 331G:CC, 331H:CC, 331I:CC, 331J:CC, 331K:CP, 331L:C?, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342A:CC, 342B:CC, 342C:CC, 342D:CC, 342F:CC, 342G:CC, 342H:CC, 342I:C?, 342J:CC, M242C:??, M261D:CC, M261E:CP, M261G:CC, M313A:CC, M313B:CC, M331A:C?, M331B:CP, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CP, M331J:C?, M332A:C?, M332D:CP, M332E:C?, M332G:CC, M341A:CC, M341B:CC, M341C:CC, M341D:CC

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- < Salt Desert Shrub (414) (Shiflet 1994)
- >< Saltbush - Greasewood (501) (Shiflet 1994)

LOWER LEVEL UNITS

Alliances:

- A0798 *Pluchea sericea* Wet Shrubland Alliance
- A3173 *Atriplex lentiformis* Wet Shrubland Alliance
- A1046 *Sarcobatus vermiculatus* Intermountain Wet Shrubland Alliance
- A0866 *Allenrolfea occidentalis* Wet Shrubland Alliance
- A3880 *Suaeda moquinii* - *Salicornia rubra* - *Isocoma acradenia* Alkaline Wet Scrub Alliance
- A2507 *Atriplex parryi* Wet Shrubland Alliance

CBR alliances

- A0865 *Atriplex spinifera* Wet Shrubland Alliance
- A3879 *Sesuvium verrucosum* Desert Salt Mudflat Scrub Alliance

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2011)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 12/02/2015

Classif Resp Region: West

Internal Author: GK 10-10, 9-13, 5-15, 12-15

REFERENCES

References: Comer et al. 2003, Faber-Langendoen et al. 2017a, Knight 1994, Shiflet 1994, West 1983b

2. Shrub & Herb Vegetation

2.C.5.Nd. North American Western Interior Brackish Marsh, Playa & Shrubland

G537. North American Desert Alkaline-Saline Wet Scrub

A0866. *Allenrolfea occidentalis* Wet Shrubland Alliance

Type Concept Sentence: This alliance consists of herbaceous flats dominated by *Allenrolfea occidentalis* known from saline habitats throughout the arid intermountain western United States, such as alkaline flats along the margins of salt lakes, in depressions among gypsum ridges, and along washes in saline overflow areas.

OVERVIEW

Scientific Name: *Allenrolfea occidentalis* Wet Shrubland Alliance

Common Name (Translated Scientific Name): Iodinebush Wet Shrubland Alliance

Colloquial Name: Iodinebush Wet Shrubland

Type Concept: This herbaceous alliance consists of vegetation dominated by *Allenrolfea occidentalis*. Associated species include *Atriplex canescens*, *Atriplex gardneri*, *Distichlis spicata*, *Suaeda suffrutescens*, *Sporobolus airoides*, and/or *Sporobolus wrightii*. Stands occur in alkaline flats along the margins of salt lakes, in depressions among gypsum ridges, and along washes in saline overflow areas. In all cases, it occurs at sites that are seasonally moist or flooded and where evaporation concentrates transported salts, leaving visible mineral crusts at the soil surface. The nominal species can cover large acreages, with little else except barren soil. This alliance occurs throughout the arid intermountain western United States.

Classification Comments: This alliance can form landscape mosaics with other saline communities in saline marshes or gyp-influenced habitats.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: *Allenrolfea occidentalis* >2% absolute cover in the shrub canopy, and no other species with greater or equal cover (Keeler-Wolf et al. 1998a, Thomas et al. 2004).

VEGETATION

Physiognomy and Structure: These are sparse to moderately dense (15-45% cover) xeromorphic, evergreen, succulent shrublands. Shrubs are generally less than 1 m in height. These stands are usually monotypic and harbor a depauperate understory and abundant bare ground. When present, the herbaceous layer consists of a sparse cover of mat-forming or cespitose graminoids and/or salt-tolerant annual forbs.

Floristics: Stands are usually strongly dominated by *Allenrolfea occidentalis* and may cover large areas of excessively salty soils. Stands of this alliance may be monotypic. Associated species are all halophytic, and other shrub species may occur. Such species include *Atriplex canescens*, *Atriplex gardneri*, *Atriplex lentiformis*, *Atriplex polycarpa*, *Frankenia salina*, and *Sarcobatus vermiculatus*. Common graminoid associates include *Distichlis spicata*, *Eleocharis palustris*, *Kalinia obtusiflora* (= *Eragrostis obtusiflora*), and *Sporobolus airoides*. Succulent halophytic annuals, such as *Salicornia rubra*, *Salicornia bigelovii*, and *Suaeda* spp., are typical forb associates. Additional associated species from stands in western Texas include *Suaeda suffrutescens* var. *detonsa* and *Sporobolus wrightii*.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance occurs in topographic depressions usually without surface drainage (playas) and stream terraces from sea level to 1800 m (5900 feet) elevation. In all cases, it occurs at sites that are seasonally moist or flooded and where evaporation concentrates transported salts, leaving visible mineral crusts at the soil surface. *Allenrolfea occidentalis* is tolerant of extreme salinities and heavy soils which tend to exclude other species, and usually forms the lowest ring of perennial vegetation around desert salt flats. This vegetation is also associated with hummocks scattered over barren salt flats. These hummocks are formed by eolian deposition of sands within the individual shrubs. Although *Allenrolfea* occurs at sites with up to 3% soil salinity, optimum growth occurs at about 1% (Mozingo 1987).

Dynamics: Fluvial processes rather than fire primarily disturb stands. Plants sprout after fire and other disturbances, but information on fire characteristics is lacking. Because of the harsh environment and succulent nature of the plants, fire is unlikely in all but the densest and driest stands.

DISTRIBUTION

Geographic Range: Vegetation included in this widespread western alliance occurs in saline habitats in the deserts of the southwestern U.S. and northern Mexico, from the Chihuahuan Desert of western Texas and New Mexico, across the Sonoran and Mojave deserts to Baja California and north into the Central Valley of California. It also occurs in the Colorado Plateau, Great Basin and Columbia Plateau regions of Nevada, Oregon, and Utah from Death Valley to Petrified Forest national parks.

Nations: MX, US

States/Provinces: AZ, CA, MXBC, NM, NV, OR, TX, UT, WY

TNC Ecoregions [optional]: 11:C, 13:C, 15:C, 17:C, 23:C

USFS Ecoregions (2007): 262A:CC, 322Ab:CCC, 322Ai:CCC, 322B:CC, 322C:CC, 341D:CC, 341Fc:CCC, 341Ff:CCC, 342B:CC, M262A:CC

Omernik Ecoregions:

Federal Lands [optional]: BLM (Carrizo Plain); NPS (Death Valley, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Allenrolfea occidentalis* (Iodine bush scrub) Alliance (Sawyer et al. 2009) [36.120.00]
- = *Allenrolfea occidentalis* Alliance (Iodine bush scrub) (Buck-Diaz et al. 2012)
- = *Allenrolfea occidentalis* Shrubland Alliance (Evens et al. 2014)
- ? Iodine Bush Series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS**Associations:**

- CEG000988 *Allenrolfea occidentalis* Wet Shrubland
- CEPP005788 *Allenrolfea occidentalis* / *Distichlis spicata* Wet Shrubland
- CEPP005787 *Allenrolfea occidentalis* - *Suaeda moquinii* Wet Shrubland
- CEG000989 *Allenrolfea occidentalis* / *Atriplex gardneri* Wet Shrubland

AUTHORSHIP

Primary Concept Source: D. Sarr and K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel, D. Sarr, K.A. Schulz

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Barbour and Major 1977, Bradley 1970, Buck-Diaz et al. 2012, Burgess and Klein n.d., Burgess and Northington 1977, Burk 1977, Diamond 1993, Dick-Peddie 1993, Evens and Hartman 2007, Evens et al. 2014, Faber-Langendoen et al. 2017b, Fautin 1946, Griffiths 1902, Henrickson 1974, Holland 1986b, Keeler-Wolf and Thomas 2000, MacMahon 1988, MacMahon and Wagner 1985, McHargue 1973, Mozingo 1987, Nelson 1976, ORNHP unpubl. data, Odion et al. 1992, Paysen et al. 1980, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Stout et al. 2013, Thomas et al. 2004, Thorne 1982, Vasek and Barbour 1988, VegCAMP and AIS 2013, Vest 1962b, Young et al. 1977

2. Shrub & Herb Vegetation

2.C.5.Nd. North American Western Interior Brackish Marsh, Playa & Shrubland

G537. North American Desert Alkaline-Saline Wet Scrub

A3173. *Atriplex lentiformis* Wet Shrubland Alliance [Low - Poorly Documented]

Type Concept Sentence: *Atriplex lentiformis* is dominant or codominant in the shrub canopy occurring on southeast- and southwest-facing slopes.

OVERVIEW

Scientific Name: *Atriplex lentiformis* Wet Shrubland Alliance

Common Name (Translated Scientific Name): Big Saltbush Wet Shrubland Alliance

Colloquial Name: Big Saltbush Wet Shrubland

Type Concept: This shrubland occurs from the central California coast into southern Nevada and extreme southwestern Utah and south through western and central Arizona into Baja California and Sonora, Mexico. The dominant or codominant shrub is *Atriplex lentiformis* in association with *Artemisia californica*, *Atriplex canescens*, *Baccharis pilularis*, *Baccharis salicifolia*, *Encelia californica*, *Bassia americana* (= *Kochia americana*), *Malosma laurina*, *Myoporum laetum*, *Pluchea sericea*, *Prosopis glandulosa*, *Rhus integrifolia*, *Suaeda taxifolia*, and *Tamarix* spp. It occurs on southeast- and southwest-facing slopes on clay soils.

Classification Comments: This alliance has been segregated from the previously defined *Atriplex lentiformis*-*A. polycarpa* alliance (Sawyer and Keeler-Wolf 1995). Based on plot data collected over the past 10 years, both of these species apparently segregate and form their own alliances with frequently different environmental and species characteristics.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: *Atriplex lentiformis* is >60% relative cover in the shrub canopy (Keeler-Wolf et al. 1998, Keeler-Wolf and Evens 2006).

VEGETATION

Physiognomy and Structure: This alliance is characterized by tall, fast-growing drought-deciduous shrubs.

Floristics: *Atriplex lentiformis* dominates or is codominant in associations within this alliance. Codominant or associated shrubs include *Artemisia californica*, *Atriplex canescens*, *Baccharis pilularis*, *Baccharis salicifolia*, *Encelia californica*, *Bassia americana* (= *Kochia americana*), *Malosma laurina*, *Myoporum laetum*, *Pluchea sericea*, *Prosopis glandulosa*, *Rhus integrifolia*, *Suaeda taxifolia*, and *Tamarix* spp.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance occurs on southeast- and southwest-facing slopes on clay soils. Stands occur in coastal sage scrub to alkali sinks and alkali meadows, desert washes, oases, and saline intermittently flooded wetlands in some cases. Occurrences are often in disturbed areas.

Dynamics: *Atriplex lentiformis* has the ability to retain substantial amounts of moisture and has been studied as a fire-retardant species. Processes other than fire, such as shifts in ground water availability, tend to affect occurrences.

DISTRIBUTION

Geographic Range: This alliance occurs from central California east into southern Nevada and extreme southwestern Utah and south through western and central Arizona into Baja California and Sonora, Mexico.

Nations: MX, US

States/Provinces: AZ, CA, MXBC, MXSO, NV, UT

TNC Ecoregions [optional]: 11:C, 13:C, 15:C, 16:C, 17:C, 23:C

USFS Ecoregions (2007): 261A:CC, 261B:CC, 262A:CC, 322Ay:CCC, 322Az:CCC, 322C:CC, 341D:CC, M262A:CC, M262B:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Lake Mead)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

- = *Atriplex lentiformis* (Quailbush scrub) Alliance (Sawyer et al. 2009) [36.370.00]
- = *Atriplex lentiformis* Alliance (Quailbush scrub) (Buck-Diaz et al. 2012)
- = *Atriplex lentiformis* Shrubland Alliance (Keeler-Wolf and Evens 2006)

- = *Atriplex lentiformis* Shrubland Alliance (Evens et al. 2014)
- = *Atriplex lentiformis* Shrubland Alliance (CNPS 2017) [36.370.00]
- >< Alkali Meadow (#45310) (Holland 1986b)
- >< Desert Saltbush Scrub (#36110) (Holland 1986b)
- >< Desert Sink Scrub (#36120) (Holland 1986b)
- < Mixed saltbush series (Sawyer and Keeler-Wolf 1995)
- >< Valley Saltbush Scrub (#36220) (Holland 1986b)
- >< Venturan Coastal Sage Scrub (#32300) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEPP005799 *Atriplex lentiformis* Wet Shrubland

AUTHORSHIP

Primary Concept Source: T. Keeler-Wolf, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/01/08

REFERENCES

References: Buck-Diaz et al. 2012, CNPS 2017, Charlton 2000a, Evens et al. 2014, Faber-Langendoen et al. 2017b, Holland 1986b, Keeler-Wolf and Evens 2006, Keeler-Wolf and Vaghti 2000, Keeler-Wolf et al. 1998a, Manning 1994, Meyer 2005, Pearcy and Harrison 1974, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, VegCAMP and AIS 2013

2. Shrub & Herb Vegetation

2.C.5.Nd. North American Western Interior Brackish Marsh, Playa & Shrubland

G537. North American Desert Alkaline-Saline Wet Scrub

A2507. *Atriplex parryi* Wet Shrubland Alliance [Low - Poorly Documented]

Type Concept Sentence: This alliance, currently described only from Death Valley, California, forms an open shrub layer of dominant and characteristic shrub *Atriplex parryi*. Other shrubs that are often present include *Atriplex canescens*, *Atriplex confertifolia*, *Cylindropuntia echinocarpa*, *Psoralea polydenius*, and *Stephanomeria pauciflora*. The herb layer is sparse to open.

OVERVIEW

Scientific Name: *Atriplex parryi* Wet Shrubland Alliance

Common Name (Translated Scientific Name): Parry's Saltbush Wet Shrubland Alliance

Colloquial Name: Parry's Saltbush Wet Shrubland

Type Concept: This alliance is currently described from Death Valley, California. It forms an open shrub layer and the overall shrub cover ranges from approximately 7 to 15%. The tree layer, if present, is sparse, and the herb layer is sparse to open. Nonvascular plants, if present, are sparse. The dominant and characteristic shrub is *Atriplex parryi*, and those that are often present include *Atriplex canescens*, *Atriplex confertifolia*, *Cylindropuntia echinocarpa*, *Psoralea polydenius*, and *Stephanomeria pauciflora*. Herbs that are often present are *Achnatherum hymenoides*, *Cleome obtusifolia*, *Dicoria canescens*, *Distichlis spicata*, *Salsola* spp., and *Sporobolus airoides*. The alliance occurs at low to high elevations (550-1300 m) in alkaline basins, adjacent sand dunes, and alkaline spring sites of variable slope and aspect. Soils are sand and silt loam derived from conglomerate and dune sand.

Classification Comments:

Internal Comments: mjr 1-17: CNPS recommends a rank of G4?/G3?. mjr 12-14: CA added for MOJN.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure:

Floristics: The alliance forms an open shrub layer and the overall shrub cover ranges from approximately 7 to 15%. The tree layer, if present, is sparse, and the herb layer is sparse to open. Nonvascular plants, if present, are sparse. The dominant and characteristic shrub is *Atriplex parryi*, and those that are often present include *Atriplex canescens*, *Atriplex confertifolia*, *Cylindropuntia*

echinocarpa, *Psorothamnus polydenius*, and *Stephanomeria pauciflora*. Herbs that are often present are *Achnatherum hymenoides*, *Cleomella obtusifolia*, *Dicoria canescens*, *Distichlis spicata*, *Salsola* spp., and *Sporobolus airoides* (Evens et al. 2014).

ENVIRONMENT & DYNAMICS

Environmental Description: The alliance occurs at low to high elevations in alkaline basins, adjacent sand dunes, and alkaline spring sites of variable slope and aspect. Soils are sand and silt loam derived from conglomerate and dune sand (Evens et al. 2014).

Dynamics: *Atriplex parryi* stands are uncommon in the Mojave Desert and Great Basin in alkaline/saline areas also occupied by other *Atriplex* spp. and *Distichlis spicata*.

DISTRIBUTION

Geographic Range: This alliance is currently known from Nevada.

Nations: US

States/Provinces: CA, NV

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007): 322Ab:CCC, 341Fc:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Mojave Network)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

- = *Atriplex parryi* (provisional) Shrubland Alliance (Evens et al. 2014)

LOWER LEVEL UNITS

Associations:

- CEGLO02711 *Atriplex parryi* Wet Shrubland

AUTHORSHIP

Primary Concept Source: M.E. Hall, in Faber-Langendoen et al. (2013)

Author of Description: J. Evens et al. (2014)

Acknowledgments:

Version Date: 2017/01/10

REFERENCES

References: Evens et al. 2014, Faber-Langendoen et al. 2017b, VegCAMP and AIS 2013

2. Shrub & Herb Vegetation

2.C.5.Nd. North American Western Interior Brackish Marsh, Playa & Shrubland

G537. North American Desert Alkaline-Saline Wet Scrub

A0865. *Atriplex spinifera* Wet Shrubland Alliance [Low - Poorly Documented]

Type Concept Sentence: This saltbush shrubland of the American Southwest occurs in intermittently flooded habitats and is dominated by *Atriplex spinifera*.

OVERVIEW

Scientific Name: *Atriplex spinifera* Wet Shrubland Alliance

Common Name (Translated Scientific Name): Spinescale Saltbush Wet Shrubland Alliance

Colloquial Name: Spinescale Saltbush Wet Shrubland

Type Concept: This saltbush shrubland of the American Southwest occurs in intermittently flooded habitats with saline soils and is dominated by *Atriplex spinifera*. Other species of *Atriplex* and other salt-tolerant shrubs may be present. These may include *Atriplex polycarpa*, *Atriplex confertifolia*, *Atriplex canescens*, *Frankenia salina*, *Ephedra californica*, *Hymenoclea salsola*, and *Distichlis spicata*. The herbaceous layer is variable. Annuals are seasonally present. Dry lakebeds, lakeplains and old lakebeds perched above the current water table are favorable environments. The soils associated with this alliance may be carbonate-rich.

Classification Comments: Stands of the various saltbush alliances are assigned to alliances based upon which species of saltbush is dominant. Only stands dominated by *Atriplex spinifera* are assigned to this alliance. This is a rare type. The California Natural Diversity Database has some plot data on file.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Short shrublands occupying saline, intermittently flooded areas dominated by *Atriplex spinifera* often in association with other saline-tolerant species.

VEGETATION

Physiognomy and Structure: This is a shrubland, less than 2 m in height, with an open canopy. The herbaceous layer is highly variable.

Floristics: This desert shrubland alliance is dominated by *Atriplex spinifera*. Other species of *Atriplex* and other salt-tolerant shrubs may be present. These may include *Atriplex polycarpa*, *Atriplex confertifolia*, *Atriplex canescens*, *Frankenia salina*, *Ephedra californica*, *Hymenoclea salsola*, and *Distichlis spicata*. The herbaceous layer is variable. Annuals are seasonally present.

ENVIRONMENT & DYNAMICS

Environmental Description: This saltbush shrubland of the American Southwest occurs in intermittently flooded habitats with saline soils. Dry lakebeds, plains and old lakebeds perched above the current water table are favorable environments. The soils associated with this alliance may be carbonate-rich.

Dynamics: The lowland habitats where this alliance occurs are intermittently flooded and saturated. Water chemistry is mixosaline.

DISTRIBUTION

Geographic Range: Occurs in California in the inner central Coast Ranges, the San Joaquin Valley and throughout the Mojave Desert into Arizona, Nevada, and extreme southwestern Utah.

Nations: US

States/Provinces: AZ, CA, NV, UT

TNC Ecoregions [optional]: 13:C, 15:C, 17:C, 23:C

USFS Ecoregions (2007): 262A:CC, 322A:CC, 322B:CC, M262A:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

- = *Atriplex spinifera* (Spinescale scrub) Alliance (Sawyer et al. 2009) [36.350.00]
- = *Atriplex spinifera* Alliance (Spinescale scrub) (Buck-Diaz et al. 2012)
- = *Atriplex spinifera* Shrubland Alliance (CNPS 2017) [36.350.00]
- >< Desert Saltbush Scrub (#36110) (Holland 1986b)
- >< Interior Coast Range Saltbush Scrub (#36320) (Holland 1986b)
- >< Sierra-Tehachapi Saltbush Scrub (#36310) (Holland 1986b)
- = Spinescale series (Sawyer and Keeler-Wolf 1995)
- >< Valley Saltbush Scrub (#36220) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEG003015 *Atriplex spinifera* Wet Shrubland [Placeholder]

AUTHORSHIP

Primary Concept Source: M. Schindel, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/01/08

REFERENCES

References: Barbour and Billings 1988, Barrows 1989, Buck-Diaz et al. 2012, Burk 1977, CNPS 2017, Charlton 2000a, Charlton 2000b, Cheatham and Haller 1975, Evens and Hartman 2007, Evens et al. 2006, Faber-Langendoen et al. 2017b, Holland 1986b, Johnson 1976, Keeler-Wolf 2007, MacMahon 1988, MacMahon and Wagner 1985, McHargue 1973, Paysen et al. 1980, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Vasek and Barbour 1988

2. Shrub & Herb Vegetation

2.C.5.Nd. North American Western Interior Brackish Marsh, Playa & Shrubland

G537. North American Desert Alkaline-Saline Wet Scrub

A0798. *Pluchea sericea* Wet Shrubland Alliance

Type Concept Sentence: *Pluchea sericea* is dominant or codominant in an open to continuous shrub layer with *Allenrolfea occidentalis*, *Atriplex canescens*, *Atriplex lentiformis*, *Atriplex torreyi*, *Baccharis salicifolia*, *Baccharis sergiloides*, *Salix exigua*, *Suaeda moquinii*, and *Tamarix* spp. The alliance is found in the Great Central Valley and desert areas of California, Nevada, Utah and Arizona on playas, basin floors, channel beds, spring-fed slopes, springs, seeps, irrigation ditches, canyon bottoms, stream borders, and seasonally flooded washes.

OVERVIEW**Scientific Name:** *Pluchea sericea* Wet Shrubland Alliance**Common Name (Translated Scientific Name):** Arrow-weed Wet Shrubland Alliance**Colloquial Name:** Arrow-weed Wet Shrubland

Type Concept: *Pluchea sericea* is dominant or codominant in an open to continuous shrub layer with *Allenrolfea occidentalis*, *Atriplex canescens*, *Atriplex lentiformis*, *Atriplex torreyi*, *Baccharis salicifolia*, *Baccharis sergiloides*, *Salix exigua*, *Suaeda moquinii*, and *Tamarix* spp. Emergent trees may be present at low cover, including *Populus fremontii*, *Populus balsamifera* ssp. *trichocarpa* (= *Populus trichocarpa*), or *Prosopis glandulosa*. The herbaceous layer is sparse to continuous and often includes *Phragmites australis* and sometimes includes *Distichlis spicata*. The alliance is found in the Great Central Valley and desert areas of California, Nevada, Utah and Arizona. It occurs on playas, basin floors, channel beds, spring-fed slopes, springs, seeps, irrigation ditches, canyon bottoms, stream borders, and seasonally flooded washes. Soils are alluvial- or eolian-derived sands or clay loams from a variety of substrates that are usually alkaline or saline. Textures are variable.

Classification Comments:**Internal Comments:****Other Comments:****Similar NVC Types:**

Diagnostic Characteristics: *Pluchea sericea* =2% absolute cover; no other species with greater than or equal cover in the shrub canopy (Thomas et al. 2004).

VEGETATION

Physiognomy and Structure: The alliance forms an open to continuous shrub layer and the overall shrub cover ranges from 2.5 to 92%. The tree layer is typically sparse to open, and the herb layer is sparse to continuous. Nonvascular plants are typically sparse to open.

Floristics: *Pluchea sericea* is dominant and characteristic in the shrub layer, which is sometimes accompanied by *Allenrolfea occidentalis*. Other shrubs may include *Atriplex canescens*, *Atriplex lentiformis*, *Atriplex torreyi*, *Baccharis salicifolia*, *Baccharis sergiloides*, *Salix exigua*, *Suaeda moquinii*, and *Tamarix* spp. Emergent trees may be present at low cover, including *Populus fremontii*, *Populus balsamifera* ssp. *trichocarpa* (= *Populus trichocarpa*), or *Prosopis glandulosa*. The herbaceous layer often includes *Phragmites australis* and sometimes includes *Distichlis spicata*.

ENVIRONMENT & DYNAMICS

Environmental Description: The alliance occurs from low to mid elevations on playas, basin floors, channel beds, spring-fed slopes, springs, seeps, irrigation ditches, canyon bottoms, stream borders, and seasonally flooded washes that have subterranean water. Access to moisture is essential, in which groundwater is available year-round and typically within 1-3 m of the ground surface. Aspect is variable. Soils are alluvial and derived from a variety of substrates, and soil textures are variable.

Dynamics: *Pluchea sericea* stands form thickets along permanent springs and slow-flowing streams or occur in vegetation mosaics surrounding alkali springs and marshes. It can tolerate strongly alkaline/saline conditions, and invasion by *Tamarix* is a concern since it and *Pluchea sericea* have similar water requirements as phreatophytes.

Stands occur as dense, narrow thickets along permanent springs and slow-flowing streams or as part of vegetation mosaics that surround alkali springs and marshes involving the *Distichlis spicata*, *Prosopis glandulosa*, *Salix exigua*, *Schoenoplectus americanus*, and *Sporobolus airoides* alliances (Sawyer et al. 2009). Stands can also exist with a "cornstalk" or "cornfield"-like appearance on extensive flats and playas that have strongly alkaline crusts. Groundwater is typically available a few feet below the surface but is rarely present at the surface. The cornfield and spring types have different ecological regimes. The cornfield type

appears to establish under abnormally wet conditions, and it persists by tapping into the subterranean water supplies. Once established, wind-induced deflation and accretion isolate the shrubs, and they build up fine sandy soil mounds around the shrub bases. The spring type experiences occasional flooding events and dieback from fluctuations in the water table.

DISTRIBUTION

Geographic Range: The alliance is found in the Great Central Valley and desert areas of California, Nevada, Utah and Arizona, and possibly extending into Mexico.

Nations: MX?, US

States/Provinces: AZ, CA, NV, UT

TNC Ecoregions [optional]: 11:C, 12:C, 13:C, 15:C, 16:C, 17:C, 23:C

USFS Ecoregions (2007): 262A:CC, 322A:CC, 322B:CC, 322C:CC, 341F:CC, M261E:CC, M261F:CC, M262A:CC, M262B:CC

Omernik Ecoregions:

Federal Lands [optional]: BLM (Carrizo Plain); NPS (Death Valley, Lake Mead)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = *Pluchea sericea* (Arrow weed thickets) Alliance (Sawyer et al. 2009) [63.710.00]
- = *Pluchea sericea* Shrubland Alliance (CNPS 2017) [63.710.00]
- = *Pluchea sericea* Shrubland Alliance (Evens et al. 2014)
- = Arrow weed series (Sawyer and Keeler-Wolf 1995)
- = Arrowweed Scrub (#63820) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEPP006734 *Pluchea sericea* / *Phragmites australis* Wet Shrubland
- CEGLO03080 *Pluchea sericea* Wet Shrubland

AUTHORSHIP

Primary Concept Source: J.O. Sawyer et al. (2009)

Author of Description: M.J. Russo after Sawyer et al. (2009)

Acknowledgments:

Version Date: 2015/03/20

REFERENCES

References: CNPS 2017, Cogan et al. 2004, Evens et al. 2014, Faber-Langendoen et al. 2017b, Holland 1986b, Keeler-Wolf 2007, Keeler-Wolf and Thomas 2000, Keeler-Wolf et al. 1998a, Paysen et al. 1980, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Schoenherr and Burk 2007, Stout et al. 2013, Thomas et al. 2004

2. Shrub & Herb Vegetation

2.C.5.Nd. North American Western Interior Brackish Marsh, Playa & Shrubland

G537. North American Desert Alkaline-Saline Wet Scrub

A1046. *Sarcobatus vermiculatus* Intermountain Wet Shrubland Alliance

Type Concept Sentence: Shrublands included in this alliance are dominated or codominated by *Sarcobatus vermiculatus*. They occur on lowland sites in plains, mountain valleys and intermountain basins throughout the arid and semi-arid western United States, on generally flat, poorly drained, seasonally, temporarily or intermittently flooded sites with a shallow or perched water table often within 1 m depth such as alkali flats around playas and floodplains along stream channels.

OVERVIEW

Scientific Name: *Sarcobatus vermiculatus* Intermountain Wet Shrubland Alliance

Common Name (Translated Scientific Name): Greasewood Intermountain Wet Shrubland Alliance

Colloquial Name: Intermountain Greasewood Wet Shrubland

Type Concept: Shrublands included in this alliance are dominated or codominated by *Sarcobatus vermiculatus*. Other shrubby codominants include *Artemisia cana*, *Artemisia tridentata*, *Atriplex confertifolia*, *Atriplex gardneri*, *Chrysothamnus* spp., *Collomia linearis*, *Grayia spinosa*, or *Picrothamnus desertorum* (= *Artemisia spinescens*). In more saline environments, *Nitrophila occidentalis* and *Suaeda moquinii* may be present. If present, the sparse to moderate herbaceous layer is dominated by perennial grasses, such as *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Bouteloua gracilis*, *Distichlis spicata*, *Elymus elymoides*, *Hordeum jubatum*, *Leymus cinereus*, *Nassella viridula*, *Pascopyrum smithii*, *Poa secunda* (= *Poa juncifolia*), and *Sporobolus airoides*. Forbs are generally

sparse except on disturbed weedy sites. The native perennial forbs include *Achillea millefolium*, *Artemisia ludoviciana*, *Astragalus* spp., *Chenopodium fremontii*, *Glycyrrhiza lepidota*, and *Opuntia polyacantha*. Perennial forbs are typically sparse and often include *Grindelia squarrosa*, *Iva axillaris*, and *Sphaeralcea coccinea*. Annual grasses, especially the exotic *Bromus* spp., may be present to abundant. Forbs are common on disturbed sites. Weedy annual forbs may include the exotics *Descurainia* spp., *Helianthus annuus*, *Halogeton glomeratus*, *Lactuca serriola*, and *Lepidium perfoliatum*. This alliance occurs throughout the arid and semi-arid western United States. Sites are generally flat, poorly drained, seasonally, temporarily or intermittently flooded with a shallow or perched water table often within 1 m depth such as alkali flats around playas and floodplains along stream channels. Substrates are generally shallow, calcareous, fine-textured soils derived from alluvium. Soils are alkaline and typically moderately saline.

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Diagnostic of this alliance is the *Sarcobatus vermiculatus*-dominated shrub layer in a shrubland that has a relatively shallow water table and may be flooded at any time.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a moderate to dense layer of microphyllous, deciduous xeromorphic shrubs 0.5-2 m tall. The herbaceous layer is sparse to moderately dense and dominated by tall to medium-tall bunch grasses or rhizomatous mid grasses. Perennial forbs are sparse. Scattered cacti and perennial forbs may be present. Annual grasses and forbs may be seasonally present to abundant.

Floristics: This alliance has shrublands dominated or codominated by the deciduous, facultative halophytic shrub *Sarcobatus vermiculatus*. Other shrubby codominants include *Artemisia cana*, *Artemisia tridentata*, *Atriplex confertifolia*, *Atriplex gardneri*, *Chrysothamnus* spp., *Collomia linearis*, *Grayia spinosa*, *Nitrophila occidentalis*, *Picrothamnus desertorum* (= *Artemisia spinescens*), and/or *Suaeda moquinii*. Herbaceous layers range from absent to a moderately dense canopy of medium-tall to short bunchgrasses or sod grasses (0-25% cover) such as *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Bouteloua gracilis*, *Distichlis spicata*, *Elymus elymoides*, *Hordeum jubatum*, *Leymus cinereus*, *Nassella viridula*, *Pascopyrum smithii*, *Poa secunda* (= *Poa juncifolia*), and/or *Sporobolus airoides*. Perennial forbs are typically sparse and often include *Achillea millefolium*, *Artemisia ludoviciana*, *Astragalus* spp., *Chenopodium fremontii*, *Glycyrrhiza lepidota*, *Grindelia squarrosa*, *Iva axillaris*, *Opuntia polyacantha*, and/or *Sphaeralcea coccinea*. Exotic species can be abundant on disturbed weedy sites and include such species as *Bassia scoparia* (= *Kochia scoparia*), *Bromus arvensis* (= *Bromus japonicus*), *Bromus rubens*, *Bromus tectorum*, *Descurainia* spp., *Halogeton glomeratus*, *Helianthus annuus*, *Lactuca serriola*, and/or *Lepidium perfoliatum*.

ENVIRONMENT & DYNAMICS

Environmental Description: Elevations range from 100-2400 m. Sites are generally flat, poorly drained and intermittently flooded with a shallow or perched water table often within 1 m depth (West 1983b). Sites may receive overland flow during intense summer thunderstorms. Some sites are well-drained and do not have a shallow water table. Substrates are generally shallow, calcareous, fine-textured soils (clays to silt-loams), derived from alluvium. Soils are alkaline and typically moderately saline (West 1983b). Summers are hot. Winters are generally cold, but are mild in subtropical regions. Precipitation varies with geography but is generally low and infrequent.

Dynamics: *Sarcobatus vermiculatus* is often found on sites with high water tables that are intermittently flooded. Hansen et al. (1995) reported that it can tolerate saturated soil conditions for up to 40 days. Hansen et al. (1995) also reported browsing damage with heavy spring and summer grazing, but noted that *Sarcobatus vermiculatus* is moderately poisonous to livestock especially in the fall, and supplemental feed is recommended to avoid livestock loss. Hanson (1929) states that *Sarcobatus vermiculatus* can form an important part of winter forage for sheep. Fire will top-kill *Sarcobatus vermiculatus*, but the shrub will promptly resprout from the root crown (Daubenmire 1970).

DISTRIBUTION

Geographic Range: This alliance is found throughout the interior arid west from California, eastern Oregon and Washington, Idaho, Montana, Wyoming, Colorado, Nevada, Utah, northern Arizona, and New Mexico, not dropping into the warm desert provinces.

Nations: US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]: 4:C, 6:C, 11:C, 17:C

USFS Ecoregions (2007): 322Ai:CCC, 341D:CC, 341Fc:CCC, 342B:CC, M261G:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Mojave); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Sarcobatus vermiculatus* (Greasewood scrub) Alliance (Sawyer et al. 2009) [36.400.00]
- ? *Sarcobatus vermiculatus*/*Sporobolus airoides* plant association (Johnston 1987) [included within the *Sarcobatus vermiculatus* Series.]
- ? *Sarcobatus vermiculatus* Association (152.171) (Brown 1982a) [included within Great Basin Desertscrub, Saltbush Series.]
- >< *Sarcobatus vermiculatus* Series (Johnston 1987)
- ? *Sarcobatus vermiculatus* Series (Mueggler and Stewart 1980) [includes both *Sarcobatus vermiculatus*/*Elymus cinereus* and *Sarcobatus vermiculatus*/*Agropyron smithii* habitat types.]
- >< *Sarcobatus vermiculatus* Series (Francis 1986)
- = *Sarcobatus vermiculatus* Shrubland Alliance (Evens et al. 2014)
- >< *Sarcobatus vermiculatus* habitat type (Daubenmire 1970)
- = *Sarcobatus vermiculatus* Shrubland Alliance (CNPS 2017) [36.400.00]
- >< Desert Greasewood Scrub (#36130) (Holland 1986b)
- >< Desert Sink Scrub (Holland 1986b)
- >< Greasewood Series (Sawyer and Keeler-Wolf 1995)
- ? Greasewood-Desert Shrub Series (Dick-Peddie 1993) [within the Arroyo Riparian Habitat Type.]
- >< Northern Plains: Saline lowland (Soil Conservation Service n.d.)
- ? Saltbush Series (Dick-Peddie 1993) [within the Great Basin Desert Scrub.]

LOWER LEVEL UNITS

Associations:

- C EGL001362 *Sarcobatus vermiculatus* / *Ericameria nauseosa* Wet Shrubland
- C EGL001368 *Sarcobatus vermiculatus* / *Sporobolus airoides* Wet Shrubland
- C EGL001369 *Sarcobatus vermiculatus* / *Nitrophila occidentalis* - *Suaeda moquinii* Wet Shrubland
- C EGL001370 *Sarcobatus vermiculatus* / *Suaeda moquinii* Wet Shrubland
- C EGL001373 *Sarcobatus vermiculatus* / *Achnatherum hymenoides* Wet Shrubland
- C EGL001371 *Sarcobatus vermiculatus* / *Atriplex confertifolia* - (*Picrothamnus desertorum*, *Suaeda moquinii*) Wet Shrubland
- C EGL002919 *Sarcobatus vermiculatus* / *Juncus arcticus* ssp. *littoralis* Sparse Vegetation
- C EGL001366 *Sarcobatus vermiculatus* / *Leymus cinereus* Wet Shrubland
- C EGL001360 *Sarcobatus vermiculatus* / *Atriplex gardneri* Wet Shrubland
- C EGL001359 *Sarcobatus vermiculatus* / *Artemisia tridentata* Wet Shrubland
- C EGL001365 *Sarcobatus vermiculatus* / *Elymus elymoides* - *Pascopyrum smithii* Wet Shrubland
- C EGL001357 *Sarcobatus vermiculatus* Disturbed Wet Shrubland
- C EGL002763 *Sarcobatus vermiculatus* - *Psoralea polydenius* Wet Shrubland
- C EGL001361 *Sarcobatus vermiculatus* / *Bouteloua gracilis* Wet Shrubland
- C EGL001372 *Sarcobatus vermiculatus* / *Elymus elymoides* Wet Shrubland
- C EGL002764 *Sarcobatus vermiculatus* - *Atriplex parryi* / *Distichlis spicata* Wet Shrubland
- C EGL001364 *Sarcobatus vermiculatus* Dune Wet Shrubland
- C EGL001363 *Sarcobatus vermiculatus* / *Distichlis spicata* Wet Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz and G. Kittel

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Anderson 2004b, Baker 1984a, Barbour and Major 1977, Blackburn et al. 1969b, Blackburn et al. 1969c, Blackburn et al. 1969d, Blackburn et al. 1971, Branson and Owen 1970, Branson et al. 1976, Brotherson et al. 1986, Brown 1982a, Bundy et al. 1996, Burk 1977, CNPS 2017, Chappell et al. 1997, Charlton 2000a, Copeland 1979, Copeland and Greene 1982, Dastrup 1963, Daubenmire 1970, DeVelice and Lesica 1993, DeVelice et al. 1991, DeVelice et al. 1995, Dick-Peddie 1993, Evens et al. 2014, Faber-Langendoen et al. 2017b, Fenemore 1970, Ferren and Davis 1991, Francis 1986, Franklin and Dyrness 1973, Graham 1937, Hamner 1964, Hansen et al. 1995, Hanson 1929, Holland 1986b, Johnston 1987, Jones and Walford 1995, Knight et al. 1987, Lesica and DeVelice 1992, MacMahon 1988, Medicine Bow Mine Application n.d., Mueggler and Stewart 1980, Paysen et al. 1980, Paysen et al. 2000, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Soil Conservation Service n.d., Sweetwater Uranium Project 1978, Terwilliger and Smith

1978, Terwilliger et al. 1979a, Terwilliger et al. 1979b, Thomas et al. 2004, Thorne 1982, Tueller 1994, Tweit and Houston 1980, Ungar et al. 1969, Vasek and Barbour 1988, VegCAMP and AIS 2013, West 1983b, West 1988, Young et al. 1977, Young et al. 1986, Young et al. 2007b

2. Shrub & Herb Vegetation

2.C.5.Nd. North American Western Interior Brackish Marsh, Playa & Shrubland

G537. North American Desert Alkaline-Saline Wet Scrub

A3879. *Sesuvium verrucosum* Desert Salt Mudflat Scrub Alliance

Type Concept Sentence: This alliance has an open scrub canopy dominated by *Sesuvium verrucosum*, generally at low cover (<25% total vegetation). These alkaline wetlands occur on moist or seasonally dry flats and margins of intermittently flooded desert playas and coastal plains across the warm deserts of North America.

OVERVIEW

Scientific Name: *Sesuvium verrucosum* Desert Salt Mudflat Scrub Alliance

Common Name (Translated Scientific Name): Verrucose Sea-purslane Desert Salt Mudflat Scrub Alliance

Colloquial Name: Verrucose Sea-purslane Desert Salt Mudflat Scrub

Type Concept: Stands have an open scrub canopy characterized by saline wet species such as *Sesuvium verrucosum*. Other species present may include *Atriplex* spp., *Distichlis spicata*, *Eleocharis palustris*, *Sporobolus* spp., *Suaeda moquinii*, or *Tiquilia* spp. Ephemeral herbaceous species may have high cover periodically. Stands generally have low cover of vegetation and may be sparse (<10% total vegetation). Sites are moist or seasonally dry flats and margins of intermittently flooded desert playas, and may extend to coast. This desert scrub alkaline wetland alliance occurs across the warm deserts of North America, extending into the Central Valley and San Joaquin Valley in California south into Baja California and in the Trans-Pecos region of western Texas.

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: This alkaline, saline wet flats warm desert scrub is identified by an open scrub canopy characterized by saline wet species such as *Sesuvium verrucosum*.

VEGETATION

Physiognomy and Structure:

Floristics: Stands have an open scrub canopy characterized by saline wet species such as *Sesuvium verrucosum*. Other species present may include *Atriplex* spp., *Distichlis spicata*, *Eleocharis palustris*, *Sporobolus* spp., *Suaeda moquinii*, or *Tiquilia* spp. Ephemeral herbaceous species may have high cover periodically. Stands generally have low cover of vegetation and may be sparse (<10% total vegetation).

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance occurs on saline wet flats, hypersaline flats, seasonally moist and dry flats, and margins of intermittently flooded desert playas.

Dynamics:

DISTRIBUTION

Geographic Range: This saline wet scrub alliance is found in suitable sites across the warm deserts of North America, extending into the Central Valley and San Joaquin Valley in California south into Baja California and in the Trans-Pecos region of western Texas.

Nations: MX, US

States/Provinces: CA, MXBC, TX

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- > *Allenrolfea occidentalis* (Iodine bush scrub) Alliance (Sawyer et al. 2009) [36.120.00]
- > *Allenrolfea occidentalis* Alliance (Iodine bush scrub) (Buck-Diaz et al. 2012)
- > *Sesuvium verrucosum* (Western sea-purslane marshes) Alliance (Sawyer et al. 2009) [52.210.00]
- > *Sesuvium verrucosum* Alliance (Western sea-purslane marshes) (Buck-Diaz et al. 2012)

LOWER LEVEL UNITS**Associations:**

- C EGL004595 *Sesuvium verrucosum* Sparse Vegetation

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Buck-Diaz et al. 2012, Burgess and Klein n.d., Diamond 1993, Faber-Langendoen et al. 2017b, Henrickson 1974, Sawyer et al. 2009

2. Shrub & Herb Vegetation

2.C.5.Nd. North American Western Interior Brackish Marsh, Playa & Shrubland

G537. North American Desert Alkaline-Saline Wet Scrub

A3880. Suaeda moquinii - Salicornia rubra - Isocoma acradenia Alkaline Wet Scrub Alliance

Type Concept Sentence: This alliance is characterized by an open to dense canopy dominated by saline wet species *Suaeda moquinii* and/or *Salicornia rubra*. Sites include moist or seasonally dry flats, margins of intermittently flooded playas, and low coastal areas. Stands generally have low cover of vegetation and may be sparse (<10% total vegetation). It occurs in the Central Valley and San Joaquin Valley in California south into Baja California.

OVERVIEW

Scientific Name: *Suaeda moquinii* - *Salicornia rubra* - *Isocoma acradenia* Alkaline Wet Scrub Alliance

Common Name (Translated Scientific Name): Mojave Seablite - Red Swampfire - Alkali Goldenbush Alkaline Wet Scrub Alliance

Colloquial Name: Mojave Seablite - Red Swampfire Alkaline Wet Scrub

Type Concept: This alliance includes stands that are characterized by an open to dense canopy of *Suaeda moquinii* and/or *Salicornia rubra*. Other saline wetland species present may include *Anemopsis californica*, *Distichlis spicata*, *Eleocharis palustris*, *Juncus arcticus* ssp. *littoralis* (= *Juncus balticus*), *Schoenoplectus americanus* (= *Scirpus americanus*), *Tiquilia* spp., or *Triglochin maritima*. Stands generally have low cover of vegetation and may be sparse (<10% total vegetation). Sites are moist or seasonally dry flats, and margins of intermittently flooded desert playas and may extend to coast. This highly variable saline wet herbaceous vegetation alliance occurs across the warm deserts of North America, extending into the Central Valley and San Joaquin Valley in California south into Baja California.

Classification Comments:

Internal Comments: MSR 1-16: add CO, NM, NV, UT. mjr 1-15: AZ added for Lake Mead (MOJN). GK 4-14: Existing related alliances are included in G538.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: This alkaline, saline wet flats warm desert scrub is identified by an open scrub canopy characterized by saline wet species such as *Suaeda moquinii* and/or *Salicornia rubra*.

VEGETATION**Physiognomy and Structure:**

Floristics: This alliance includes stands that are characterized by an open to dense canopy of *Suaeda moquinii* and/or *Salicornia rubra*. Other saline wetland species present may include *Anemopsis californica*, *Distichlis spicata*, *Eleocharis palustris*, *Juncus*

CBR alliances

balticus, *Schoenoplectus americanus* (= *Scirpus americanus*), *Tiquilia* spp., or *Triglochin maritima*. Stands generally have low cover of vegetation and may be sparse (<10% total vegetation).

ENVIRONMENT & DYNAMICS

Environmental Description: Sites are moist or seasonally dry flats, and margins of intermittently flooded desert playas and may extend to coast.

Dynamics:

DISTRIBUTION

Geographic Range: This saline wet scrub alliance is found in suitable sites across the warm deserts of North America, extending into the Central Valley and San Joaquin Valley in California south into Baja California.

Nations: MX, US

States/Provinces: AZ, CA, CO, MXBC, NM, NV, UT

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007): 322Ab:CCC, 322Ae:CCC, 322Ai:CCC, 322Ay:CCC, 341Fc:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Lake Mead, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > *Suaeda moquinii* (Bush seepweed scrub) Alliance (Sawyer et al. 2009) [36.200.00]
- > *Suaeda moquinii* Shrubland Alliance (Evens et al. 2014)
- > *Suaeda nigra* Alliance (Bush seepweed scrub) (Buck-Diaz et al. 2012)

LOWER LEVEL UNITS

Associations:

- CEG001991 *Suaeda moquinii* Wet Shrubland
- CEPP006758 *Suaeda moquinii* - *Atriplex canescens* Alkaline Wet Shrubland
- CEG005465 *Isocoma acradenia* Desert Scrub
- CEG005395 *Isocoma acradenia* Wet Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Buck-Diaz et al. 2012, Evens and Hartman 2007, Evens et al. 2014, Faber-Langendoen et al. 2017b, Keeler-Wolf and Thomas 2000, Sawyer et al. 2009, VegCAMP and AIS 2013

3. DESERT & SEMI-DESERT

Cool and warm semi-deserts dominated by xeromorphic growth forms, including *succulent* (e.g., cacti, euphorbias) and *small-leaved shrubs* and *trees*, desert grasses and other xeromorphic growth forms, with an irregular horizontal canopy spacing that is often open to very sparse (1%) cover.

3.A. Warm Desert & Semi-Desert Woodland, Scrub & Grassland

Warm Desert & Semi-Desert Woodland, Scrub & Grassland occurs in dry warm-temperate, subtropical and tropical climates, uncommon near the equator to increasingly common between 15° and 35°N and S latitude.

3.A.2. Warm Desert & Semi-Desert Scrub & Grassland

Warm Desert & Semi-Desert Scrub & Grassland occurs in dry warm-temperate, subtropical and tropical climates, is uncommon near the equator to increasingly common between 15° and 35°N and S latitude.

3.A.2.Na. North American Warm Desert Scrub & Grassland

This division contains aridland shrublands and grasslands dominated by xerophytic woody shrubs, succulents and grasses that occur among the lowland intermountain basins and foothills of desert mountain ranges across the southwestern U.S. and northern Mexico.

M512. North American Warm Desert Ruderal Scrub & Grassland

This upland warm desert thornscrub and grassland macrogroup contains disturbed semi-arid grasslands and desert thornscrub that are dominated by non-native species and are found in the southwestern U.S. and northern Mexico.

3. Desert & Semi-Desert

3.A.2.Na. North American Warm Desert Scrub & Grassland

3.A.2.Na.90.a. M512 North American Warm Desert Ruderal Scrub & Grassland

G677. North American Warm Desert Ruderal Grassland

Type Concept Sentence: This broadly defined ruderal group occurs in Arizona and northern Mexico and includes all exotic-dominated herbaceous stands without a shrub layer. Characteristic understory species include *Brassica nigra*, *Brassica tournefortii*, *Bromus madritensis*, *Bromus rubens*, *Eragrostis lehmanniana*, *Erodium cicutarium*, and *Schismus barbatus*.

OVERVIEW

Scientific Name: *Eragrostis lehmanniana* - *Bromus rubens* - *Brassica tournefortii* Warm Desert Ruderal Grassland Group

Common Name (Translated Scientific Name): Lehmann's Lovegrass - Red Brome - Asian Mustard Warm Desert Ruderal Grassland Group

Colloquial Name: Ruderal Desert Forbs

Type Concept: This broadly defined ruderal group occurs in Arizona and northern Mexico and elsewhere in the Desert Southwest. It includes all desert scrub with an exotic species-dominated understory (>90% relative cover) in the herbaceous layer as well as exotic-dominated herbaceous stands. These open to dense grasslands and forblands are composed of either exotic annual or biennial grasses or forbs with low cover of perennial species (<10% absolute cover) or stands with a significant perennial herbaceous layer (>10% absolute cover) strongly dominated by exotics (>90% relative cover) with or without annuals and biennials present to dominant. Characteristic understory species include *Brassica nigra*, *Brassica tournefortii*, *Bromus madritensis*, *Bromus rubens*, *Cynodon dactylon*, *Eragrostis lehmanniana*, *Erodium cicutarium*, *Schismus arabicus*, *Schismus barbatus*, and *Sorghum halepense* with little native composition remaining. Other woody species may include *Calliandra eriophylla*, *Gutierrezia sarothrae*, or *Isocoma tenuisecta*. *Gutierrezia microcephala* is abundant in some stands. Remnant native desert grasses may be present with low cover. Other common herbaceous species include *Allionia incarnata*, *Ambrosia confertiflora*, *Boerhavia erecta*, *Mollugo verticillata*, *Cylindropuntia versicolor* (= *Opuntia versicolor*), *Panicum hirticaule*, *Polygala barbeyana*, *Proboscidea parviflora*, and *PheMERANTHUS aurantiacus* (= *Talinum aurantiacum*). The native annual forb *Amaranthus palmeri* often codominates. This desert grassland and shrubland group occurs in southeastern Arizona on alluvial fans, ridges, hills and valley floors. The elevation range is 960-1100 m (3150-3600 feet). Climate is warm, semi-arid to arid continental. Mean annual precipitation ranges from 22-28 cm, but can vary greatly from year to year. Drought is not uncommon. Sites occur on gentle to moderate slopes. Substrates are variable but are often well-drained sandy loam.

Classification Comments: Some of the characteristic species are shared with other ruderal types; however, this type is restricted to warm deserts and the transition zone with the southern Great Basin. *Sorghum halepense* and *Cynodon dactylon* grow best in mesic conditions. Stands dominated by these species that occur in riparian areas are not included in this group.

Similar NVC Types:

- G624 Western North American Interior Ruderal Grassland & Shrubland: has similar ruderal alliances but rather than occurring in cool, semi-arid sites, stands occur in cool, temperate regions and include montane, subalpine and alpine areas. Vegetation lacks obligate wetland species and is not dominated by facultative wetland species.
- G648 Southern Vancouverian Lowland Ruderal Grassland & Shrubland: may include similar alliances, but is restricted to lowlands west of the Cascade Range.
- G524 Western North American Ruderal Marsh, Wet Meadow & Shrubland: has similar ruderal alliances but occurs on mesic to wet sites and vegetation either includes obligate wetland species or is dominated by facultative wetland species.
- G600 Great Basin-Intermountain Ruderal Dry Shrubland & Grassland: may include similar alliances, but is restricted to cool, semi-arid desert regions.

Diagnostic Characteristics: This broadly defined upland ruderal group occurs in a warm, semi-arid climate in Arizona and northern Mexico and includes open to dense grasslands and forblands that are composed of either exotic annual or biennial grasses or forbs with low cover of perennial species (<10% absolute cover) or stands with a significant perennial herbaceous layer (>10% absolute cover) strongly dominated by exotics (>90% relative cover) with or without annuals and biennials present to dominant. Characteristic understory species include *Brassica nigra*, *Brassica tournefortii*, *Bromus madritensis*, *Bromus rubens*, *Cynodon dactylon*, *Eragrostis lehmanniana*, *Erodium cicutarium*, *Schismus arabicus*, *Schismus barbatus*, and *Sorghum halepense* with little native composition remaining. The ruderal native annual forb *Amaranthus palmeri* often dominates or codominates disturbed stands.

VEGETATION

Physiognomy and Structure: The physiognomy of this group includes grasslands and forblands with a sparse to dense, annual- or perennial-dominated herbaceous layer.

Floristics: This broadly defined ruderal group includes open to dense grasslands and forblands that are composed of either exotic annual or biennial grasses or forbs with low cover of perennial species (<10% absolute cover) or stands with a significant perennial herbaceous layer (>10% absolute cover) strongly dominated by exotics (>90% relative cover) with or without annuals and biennials present to dominant. Characteristic understory species include *Brassica nigra*, *Brassica tournefortii*, *Bromus madritensis*, *Bromus rubens*, *Cynodon dactylon*, *Eragrostis lehmanniana*, *Erodium cicutarium*, *Panicum antidotale*, *Schismus arabicus*, *Schismus barbatus*, and *Sorghum halepense* with little native composition remaining. Other woody species may include *Calliandra eriophylla*, *Gutierrezia sarothrae*, or *Isocoma tenuisecta*. *Gutierrezia microcephala* is abundant in some stands. Remnant desert grasses include *Aristida ternipes*, *Bouteloua chondrosioides*, *Bouteloua curtipendula*, *Bouteloua eriopoda*, *Bouteloua rothrockii*, *Digitaria californica*, and *Eragrostis intermedia*. Other common herbaceous species include *Allionia incarnata*, *Ambrosia confertiflora*, *Boerhavia erecta*, *Mollugo verticillata*, *Cylindropuntia versicolor* (= *Opuntia versicolor*), *Panicum hirticaule*, *Polygala barbeyana*, *Proboscidea parviflora*, and *Phemeranthus aurantiacus* (= *Talinum aurantiacum*). Other associated species such as *Chenopodium berlandieri*, *Chloris virgata*, *Eragrostis cilianensis*, *Eragrostis pectinacea*, *Eriochloa acuminata*, *Ipomoea* spp., *Kallstroemia grandiflora*, *Leptochloa panicea* ssp. *brachiata* (= *Leptochloa filiformis*), *Salsola kali*, and *Solanum elaeagnifolium* are often present. The ruderal native annual forb *Amaranthus palmeri* often dominates or codominates disturbed stands.

ENVIRONMENT & DYNAMICS

Environmental Description: This desert grassland group is found in Arizona in areas that were formerly mixed desert grasslands, in northern Mexico, and possibly in New Mexico and Texas. Elevations range from 960-1100 m (3150-3600 feet). Climate is arid to semi-arid with hot summers. Mean annual precipitation ranges from 22-28 cm, but can vary greatly from year to year. Drought is not uncommon. Annual precipitation has bimodal distribution with the proportion of summer precipitation decreasing westward (Barbour and Major 1977). At Tucson, Arizona, about half of the annual rain falls during July to October with the balance during the winter months. The most arid season is late spring and early summer. The summer rain often occurs as high-intensity convective storms. Stands occur on alluvial fans, ridges, hills and valley floors. Sites occur on gentle and moderate slopes to flats and basins that may be intermittently flooded. Substrates are variable and range from well-drained sandy loam to finer-textured silt loam or clays.

Dynamics:

DISTRIBUTION

Geographic Range: This ruderal desert grassland group occurs in Arizona and possibly New Mexico and Texas in areas that were formerly mixed desert grasslands. It likely occurs in northern Mexico and is presumably widespread in agricultural areas in this warm semi-arid region.

Spatial Scale & Pattern [optional]:

Nations: MX?, US

States/Provinces: AZ, CA, MXCH?, MXSO?, NM?, NV, TX?

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Alliances:

- A4081 *Cynodon dactylon* Ruderal Desert Grassland Alliance
- A0878 *Cylindropuntia imbricata* Ruderal Cacti Scrub Alliance
- A3873 *Pennisetum setaceum* - *Pennisetum ciliare* Ruderal Grassland Alliance
- A4166 *Brassica tournefortii* - *Malcolmia africana* Ruderal Desert Forbs Alliance
- A2687 *Eragrostis lehmanniana* - *Eragrostis curvula* Ruderal Desert Grassland Alliance
- A4121 *Bromus rubens* - *Schismus arabicus* - *Schismus barbatus* Ruderal Desert Grassland Alliance

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2015)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 11/06/2015

Classif Resp Region: West

Internal Author: DFL 10-12, 7-13, mod. KAS 4-15, 11-15

REFERENCES

References: Barbour and Major 1977, Faber-Langendoen et al. 2017a, Rodriguez et al. 2017

3. Desert & Semi-Desert

3.A.2.Na. North American Warm Desert Scrub & Grassland

G677. North American Warm Desert Ruderal Grassland

A4166. *Brassica tournefortii* - *Malcolmia africana* Ruderal Desert Forbs Alliance

Type Concept Sentence: This ruderal forb alliance is dominated by *Brassica nigra*, *Brassica tournefortii*, or *Malcolmia africana*. The alliance is found on low level bottoms at flat or variable aspects, typically on disturbed desert areas of California and Arizona.

OVERVIEW

Scientific Name: *Brassica tournefortii* - *Malcolmia africana* Ruderal Desert Forbs Alliance

Common Name (Translated Scientific Name): Asian Mustard - African Mustard Ruderal Desert Forbs Alliance

Colloquial Name: Ruderal Desert Forbs

Type Concept: This ruderal forb alliance forms an open herbaceous layer. Dominant herbs include *Brassica nigra*, *Brassica tournefortii*, or *Malcolmia africana*. Associated herbs in one sampled stand include *Antheropeas* spp., *Cryptantha* spp., *Erodium cicutarium*, *Gilia* spp., *Ipomopsis polycladon*, *Plantago ovata*, and *Schismus* spp. Associated emergent shrubs include *Gutierrezia sarothrae*. The shrub layer is open and the tree layer, when present, is sparse. The alliance is found on low level bottoms at flat or variable aspects, typically on disturbed desert areas of California and Arizona. Soils are clay loam derived from conglomerate.

Classification Comments: Stands of non-native mustards have been observed both in the warm deserts of Arizona and California and in Mediterranean California. For the latter, see *Avena fatua* - *Bromus* spp. Ruderal Annual Grassland Alliance (A3870).

Internal Comments:

Other Comments:

Similar NVC Types:

- A3870 *Avena fatua* - *Bromus* spp. Ruderal Annual Grassland Alliance

Diagnostic Characteristics: This alliance is characterized by an open herbaceous layer dominated by *Brassica nigra*, *Brassica tournefortii*, or *Malcolmia africana*.

VEGETATION

Physiognomy and Structure:

Floristics: The alliance forms an open herbaceous layer. The shrub layer is sparse to open. The tree layer and nonvascular plants, when present, are sparse. Dominant herbs include *Brassica nigra*, *Brassica tournefortii*, and *Malcolmia africana*. Other characteristic herbs include *Antheropeas* spp., *Cryptantha* spp., *Erodium cicutarium*, *Gilia* spp., *Ipomopsis polycladon*, *Plantago ovata*, and *Schismus* spp. The shrub layer is emergent and typically or often includes *Gutierrezia sarothrae*.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands of this alliance in the Mojave, Colorado, and Sonoran deserts are found in areas disturbed by fire, clearing, and roads. Recurrent disturbance magnifies the abundance of non-native mustards and other non-native annuals. The alliance was sampled once at mid elevation. Soil is clay loam derived from conglomerate. Stands have been observed in Mojave

National Preserve with *Brassica tournefortii* dominant along roadsides (J. Evens pers. obs. 2009), and invasion of *Malcolmia africana* has recently been observed in Death Valley along roadsides and road construction areas (J. Cipra pers. comm. 2013).

Dynamics: *Malcolmia africana* dominates the herbaceous layer particularly in disturbed areas, and emergent shrubs and trees may be present at low cover. Highly localized stands occur at Lake Mead, and individuals have been observed in Death Valley. Stands with *Brassica tournefortii* are beginning to expand into other desert areas, including at Mojave National Preserve and Joshua Tree National Park. Efforts to control and eradicate current extent are important for limiting the spread and impact of these non-native mustards in these desert parks.

DISTRIBUTION

Geographic Range: The alliance is localized at mid elevation in Lake Mead National Recreation Area in Arizona. It is likely to develop in other desert areas without efforts to control its spread.

Nations: US

States/Provinces: AZ, CA?

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: NPS (Lake Mead)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- < *Brassica nigra* and other mustards (Upland mustards) Semi-natural Stands (Sawyer et al. 2009) [42.011.00]
- >> *Brassica nigra* and Other Mustards Semi-natural Herbaceous Alliance (Evens et al. 2014)
- < *Brassica nigra* and other mustards Herbaceous Semi-Natural Alliance (CNPS 2017) [42.011.00]

LOWER LEVEL UNITS

Associations:

- CEPP006727 *Malcolmia africana* Ruderal Desert Forbs

AUTHORSHIP

Primary Concept Source: J. Evens and M.S. Reid, in Faber-Langendoen et al. (2015)

Author of Description: J. Evens

Acknowledgments:

Version Date: 2015/02/20

REFERENCES

References: CNPS 2017, Evens et al. 2014, Faber-Langendoen et al. 2017b, Sawyer et al. 2009, VegCAMP and AIS 2013

3. Desert & Semi-Desert

3.A.2.Na. North American Warm Desert Scrub & Grassland

G677. North American Warm Desert Ruderal Grassland

A4121. *Bromus rubens* - *Schismus arabicus* - *Schismus barbatus* Ruderal Desert Grassland Alliance [Low - Poorly Documented]

Type Concept Sentence: *Bromus rubens*, *Schismus arabicus*, and/or *Schismus barbatus* is dominant or codominant with other non-natives in the herbaceous layer. This alliance is found in California in all topographic settings and on soil textures.

OVERVIEW

Scientific Name: *Bromus rubens* - *Schismus arabicus* - *Schismus barbatus* Ruderal Desert Grassland Alliance

Common Name (Translated Scientific Name): Red Brome - Arabian Schismus - Common Mediterranean Grass Ruderal Desert Grassland Alliance

Colloquial Name: Ruderal Red Brome - Schismus Desert Grassland

Type Concept: This alliance consists of intermittent to continuous cover of herbs <75 cm in height. *Bromus rubens*, *Schismus arabicus*, and/or *Schismus barbatus* is dominant or codominant with other non-natives in the herbaceous layer. Emergent shrubs may be present at low cover. This alliance is found in California in all topographic settings and on soil textures.

Classification Comments: Stands of *Bromus rubens* and/or *Schismus* spp. appear abundantly in southern California from the Carrizo Plain National Monument and central San Joaquin Valley south and east to the Mojave and Colorado deserts. Stands also occur

further east into Nevada, occurring in stands together or separately. The abundance of these species in *Avena fatua* - *Bromus* spp. Ruderal Annual Grassland Alliance (A3870) (*Bromus (diandrus, hordeaceus)* - *Brachypodium distachyon* Semi-natural Stands in Sawyer et al. (2009)) may be both precipitation and temperature driven. Janes (1969) found that the dominance of non-native grasses was based on rainfall totals: *Bromus rubens* at <20 cm, *Bromus diandrus*, and *Bromus hordeaceus* together at 20-80 cm, and *Bromus hordeaceus* at >80 cm. *Bromus rubens* and *Schismus* spp. occur in areas where the other bromes do not grow. They invade native desert and semi-desert stands, and convert them to semi-natural grasslands with frequent fire.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: *Bromus rubens* >80% relative cover in the herbaceous layer (cf. Keeler-Wolf et al. 1998c, Evens and San 2006, Klein and Evens 2006); or *Schismus barbatus* >80% relative cover with *Bromus rubens* present or lacking in the herbaceous layer (cf. Keeler-Wolf et al. 1998c).

VEGETATION

Physiognomy and Structure:

Floristics:

ENVIRONMENT & DYNAMICS

Environmental Description:

Dynamics: *Bromus rubens* and *Schismus* spp. shorten fire-return intervals in warmer and drier portions of California by producing abundant and continuous cover of long-lasting fine fuels. They also promote fires that are hot and fast, in areas where fires previously were infrequent due to insufficient fuels. Fires may return every 10 years, when previously they were at >35- to >100-year cycles, and these short-return fires continue to promote establishment of grasses such as *Bromus rubens* (Simonin 2001c). Annual herbaceous vegetation in similar areas is less susceptible to these types of fires.

Stands have conservation value as habitat for wildlife and for native plants, which may be rare or regionally distributed. *Bromus rubens* and *Schismus* spp. can create carpets, produce abundant seed early in the growing season, and compete with native plants. Fire and livestock grazing promote their dominance. Herbicides, such as glyphosate, can be effective but difficult to apply (Brooks 2000a). Relatively dry winters and wet summers may slow *Bromus rubens* invasion (Betancourt 1996).

DISTRIBUTION

Geographic Range: The range of *Bromus rubens* is across California at lower elevations; the range of *Schismus* spp. is central and southern California.

Nations: US

States/Provinces: CA, NV

TNC Ecoregions [optional]: 4:C, 5:C, 12:C, 13:C, 14:C, 15:C, 16:C, 17:C

USFS Ecoregions (2007): 261A:CC, 261B:CC, 262A:CC, 263A:CC, 322Ac:CCC, 322Ad:CCC, 322Aj:CCC, 322Ay:CCC, 322Az:CCC, 322C:CC, 341F:CC, 342B:CC, M261A:CC, M261B:CC, M261C:CC, M261D:CC, M261E:CC, M261F:CC, M261G:CC, M262A:CC, M262B:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Joshua Tree, Lake Mead, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

- = *Bromus rubens* - *Schismus (arabicus, barbatus)* (Red brome or Mediterranean grass grasslands) Semi-natural Stands (Sawyer et al. 2009) [42.024.00]
- = *Bromus rubens* - *Schismus (arabicus, barbatus)* Semi-Natural Herbaceous Stands (Evens et al. 2012)
- = *Bromus rubens*-*Schismus (arabicus, barbatus)* Semi-Natural Stands (Red brome Mediterranean grass grasslands) (Buck-Diaz et al. 2012)
- = *Bromus rubens*-*Schismus (arabicus, barbatus)* Semi-natural Herbaceous Alliance (Evens et al. 2014)
- = *Bromus rubens*-*Schismus (arabicus, barbatus)* (Stout et al. 2013)
- = *Bromus rubens*-*Schismus (arabicus, barbatus)* Herbaceous Semi-Natural Alliance (CNPS 2017) [42.024.00]
- < California Annual Grassland Series (Sawyer and Keeler-Wolf 1995)
- >< Non-native Grassland (#42200) (Holland 1986b)
- >< Valley and Foothill Grassland (#42000) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEPP005876 *Bromus rubens* - *Erodium cicutarium* - *Chaenactis* spp. Ruderal Desert Grassland
- CEPP009691 *Schismus (arabicus, barbatus)* - (*Eriogonum deflexum*) Ruderal Grassland

AUTHORSHIP

Primary Concept Source: M.S. Reid, in Faber-Langendoen et al. (2014)

Author of Description: M.J. Russo after Sawyer et al. (2009)

Acknowledgments:

Version Date: 2015/02/24

REFERENCES

References: Betancourt 1996, Brooks 2000a, Brooks 2000b, Brooks and Pyke 2001, Brown and Minnich 1986, Buck-Diaz et al. 2012, CNPS 2005, CNPS 2017, DiTomaso and Healy 2007, Evens and San 2006, Evens et al. 2012, Evens et al. 2014, Faber-Langendoen et al. 2017b, Holland 1986b, Janes 1969, Keeler-Wolf et al. 1998a, Klein and Evens 2006, Newman 1991, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Simonin 2001b, Sproul et al. 2011, Stout et al. 2013, VegCAMP and AIS 2013

3. Desert & Semi-Desert

3.A.2.Na. North American Warm Desert Scrub & Grassland

G677. North American Warm Desert Ruderal Grassland

A0878. *Cylindropuntia imbricata* Ruderal Cacti Scrub Alliance [Low - Poorly Documented]

Type Concept Sentence:

OVERVIEW

Scientific Name: *Cylindropuntia imbricata* Ruderal Cacti Scrub Alliance

Common Name (Translated Scientific Name): Cane Cholla Ruderal Cacti Scrub Alliance

Colloquial Name: Ruderal Cane Cholla Cacti Scrub

Type Concept:

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure:

Floristics:

ENVIRONMENT & DYNAMICS

Environmental Description:

Dynamics:

DISTRIBUTION

Geographic Range:

Nations: MX, US

States/Provinces: MXCH, TX

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEGL004588 *Cylindropuntia imbricata* Ruderal Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz

Author of Description:

Acknowledgments:

REFERENCES

3. Desert & Semi-Desert

3.A.2.Na. North American Warm Desert Scrub & Grassland

G677. North American Warm Desert Ruderal Grassland

A4081. *Cynodon dactylon* Ruderal Desert Grassland Alliance

Type Concept Sentence: This alliance comprises improved pastures and disturbed riverbanks dominated by the non-native grass *Cynodon dactylon*.

OVERVIEW

Scientific Name: *Cynodon dactylon* Ruderal Desert Grassland Alliance

Common Name (Translated Scientific Name): Bermuda Grass Ruderal Desert Grassland Alliance

Colloquial Name: Ruderal Bermuda Grass Desert Grassland

Type Concept: This alliance comprises improved pastures and disturbed riverbanks of the southwest U.S. Sites are overwhelmingly dominated by *Cynodon dactylon*, with varying degrees of native composition remaining on a wide variety of soils and sites.

Classification Comments: This alliance was formally part of the *Cynodon dactylon* Herbaceous Alliance (A.1279) which was a concept that covered all of the southern U.S. This concept includes stands occurring only in the southwest U.S. Although originally planted, *Cynodon dactylon* maintains itself spontaneously and is considered weedy or "semi-natural" as opposed to cultivated.

Internal Comments: mjr 2-15: CA added from Buck-Diaz et al. (2014).

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: This alliance is characterized as occurring on improved pastures and disturbed riverbanks of the southwest U.S. and is overwhelmingly dominated by *Cynodon dactylon*, with varying degrees of native composition.

VEGETATION

Physiognomy and Structure: This alliance is characterized by a relatively sparse to dense herbaceous layer dominated or codominated by an exotic perennial forage grass.

Floristics: Vegetation is dominated by the introduced grass *Cynodon dactylon*, with various remnant native species. Although originally planted, *Cynodon dactylon* maintains itself spontaneously and is considered weedy or "semi-natural" as opposed to cultivated. Scattered shrubs often occur intermixed or around the periphery of these dense patches of grass. Along riverbanks, the tall non-native shrub *Tamarix ramosissima* is often present.

Species of Interest: The following species tracked by the CNPS Rare Plant Inventory (2015) occur in one out of three samples of this alliance: *Pinus torreyana* ssp. *insularis* (CRPR 1B.2) and *Suaeda taxifolia* (CRPR 4.2).

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance is known from improved pastures and disturbed riverbanks.

Dynamics: Although originally planted, *Cynodon dactylon* maintains itself spontaneously.

DISTRIBUTION

Geographic Range: This type is reported from Arizona at Grand Canyon National Park and Tuzigoot National Monument, but is likely more widespread. It's been documented on the Channel Islands of California.

Nations: US

CBR alliances

States/Provinces: AZ, CA

TNC Ecoregions [optional]: 16:C, 19:C

USFS Ecoregions (2007): 261B:CC, 313A:CC, 313D:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Channel Islands, Grand Canyon, Tuzigoot)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Cynodon dactylon* - *Crypsis* spp. - *Paspalum* spp. Moist Ruderal Herbaceous Alliance (Rodriguez et al. 2017)
- = *Cynodon dactylon* Provisional Stand Type (Buck-Diaz et al. 2012)

LOWER LEVEL UNITS

Associations:

- CEG005463 *Cynodon dactylon* Western Ruderal Grassland

AUTHORSHIP

Primary Concept Source: M.S. Reid, in Faber-Langendoen et al. (2014)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Buck-Diaz et al. 2012, Faber-Langendoen et al. 2017b, Newman 1992, Rodriguez et al. 2017

3. Desert & Semi-Desert

3.A.2.Na. North American Warm Desert Scrub & Grassland

G677. North American Warm Desert Ruderal Grassland

A2687. *Eragrostis lehmanniana* - *Eragrostis curvula* Ruderal Desert Grassland Alliance

Type Concept Sentence: This desert grassland/steppe alliance occurs in southeastern Arizona and is characterized by dominance or codominance of *Eragrostis lehmanniana*, an introduced perennial forage grass.

OVERVIEW

Scientific Name: *Eragrostis lehmanniana* - *Eragrostis curvula* Ruderal Desert Grassland Alliance

Common Name (Translated Scientific Name): Lehmann's Lovegrass - Weeping Lovegrass Ruderal Desert Grassland Alliance

Colloquial Name: Ruderal Lovegrass Desert Grassland

Type Concept: This semi-natural grassland is characterized by dominance or codominance of *Eragrostis lehmanniana*, an introduced perennial forage grass seeded and now naturalized throughout much of southern Arizona. This alliance is also variable in composition and cover and is defined by having 25% or more cover of *Eragrostis lehmanniana* or over a third of the total perennial graminoid cover for stands with a sparser herbaceous layer. *Eragrostis lehmanniana* also strongly dominates many stands with few native species remaining. Scattered shrubs and dwarf-shrubs may be present, typically totaling less 10% cover, but this alliance includes stands with up to 15% cover of the tall shrub *Prosopis velutina*. Other woody species may include *Calliandra eriophylla*, *Gutierrezia sarothrae*, or *Isocoma tenuisecta*. *Gutierrezia microcephala* is abundant in some stands. Remnant desert grasses include *Aristida ternipes*, *Bouteloua chondrosioides*, *Bouteloua curtipendula*, *Bouteloua eriopoda*, *Bouteloua rothrockii*, *Digitaria californica*, and *Eragrostis intermedia*. Other common herbaceous species include *Allionia incarnata*, *Ambrosia confertiflora*, *Boerhavia erecta*, *Mollugo verticillata*, *Cylindropuntia versicolor* (= *Opuntia versicolor*), *Panicum hirticaule*, *Polygala barbeyana*, *Proboscidea parviflora*, and *PheMERanthus aurantiacus* (= *Talinum aurantiacum*). This desert grassland/steppe alliance occurs in southeastern Arizona on alluvial fans, ridges, hills and valley floors. The elevation range is 960-1100 m (3150-3600 feet). Sites occur on gentle to moderate slopes. Substrates are variable but are often well-drained sandy loam.

Classification Comments: This grassland alliance replaces native desert grasslands where *Eragrostis lehmanniana* was planted and/or naturalized.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Naturalized stands are defined by having 25% or more cover of *Eragrostis lehmanniana* or over a third of the total perennial graminoid cover for stands with a sparser herbaceous layer.

VEGETATION

Physiognomy and Structure: This alliance is characterized by the dominance of a non-native perennial forage grass in association with other perennial grasses. The overall structure is shrub-steppe with scattered shrubs occurring throughout the community, but at typically less than 10% cover.

Floristics: This semi-natural grassland is characterized by dominance or codominance of *Eragrostis lehmanniana*, an introduced perennial forage grass seeded and now naturalized throughout much of southern Arizona. This association is also variable in composition and cover and is defined by having 25% or more cover of *Eragrostis lehmanniana* or over a third of the total perennial graminoid cover for stands with a sparser herbaceous layer. *Eragrostis lehmanniana* also strongly dominates many stands with few native species remaining. Scattered shrubs and dwarf-shrubs may be present typically totaling less 10% cover, but this alliance includes stands with up to 15% cover of the tall shrub *Prosopis velutina*. Other woody species may include *Calliandra eriophylla*, *Gutierrezia sarothrae*, or *Isocoma tenuisecta*. *Gutierrezia microcephala* is abundant in some stands. Remnant desert grasses include *Aristida ternipes*, *Bouteloua chondrosioides*, *Bouteloua curtipendula*, *Bouteloua eriopoda*, *Bouteloua rothrockii*, *Digitaria californica*, and *Eragrostis intermedia*. Other common herbaceous species include *Allionia incarnata*, *Ambrosia confertiflora*, *Boerhavia erecta*, *Mollugo verticillata*, *Cylindropuntia versicolor* (= *Opuntia versicolor*), *Panicum hirticaule*, *Polygala barbeyana*, *Proboscidea parviflora*, and *Phemeranthus aurantiacus* (= *Talinum aurantiacum*).

ENVIRONMENT & DYNAMICS

Environmental Description: This desert grassland/steppe alliance occurs in southeastern Arizona on alluvial fans, ridges, hills and valley floors. The elevation range is 960-1100 m (3150-3600 feet). Sites occur on gentle to moderate slopes. Substrates are variable but are often well-drained sandy loam.

Dynamics:

DISTRIBUTION

Geographic Range: This desert grassland/steppe alliance occurs in southern Arizona and possibly New Mexico in areas that were formerly mixed desert grasslands.

Nations: US

States/Provinces: AZ, NM?

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEG005331 *Calliandra eriophylla* / *Eragrostis lehmanniana* Ruderal Shrubland
- CEG005333 *Eragrostis lehmanniana* Ruderal Shrub Grassland
- CEG005337 *Panicum antidotale* Ruderal Grassland
- CEG005332 *Eragrostis lehmanniana* Ruderal Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Faber-Langendoen et al. 2017b

3. Desert & Semi-Desert
3.A.2.Na. North American Warm Desert Scrub & Grassland
G677. North American Warm Desert Ruderal Grassland

A3873. *Pennisetum setaceum* - *Pennisetum ciliare* Ruderal Grassland Alliance [Low - Poorly Documented]

Type Concept Sentence: This alliance consists of grasslands where *Pennisetum setaceum* and/or *Pennisetum ciliare* or other *Pennisetum* species are dominant or codominant with other non-native species in the herbaceous layer. It is found in California, in frost-free regions, primarily coastal, but extending east into the edges of the Colorado Desert. Habitats are steep coastal cliffs, bluffs, road-cuts, coastal dunes, coastal scrub, and desert scrub.

OVERVIEW

Scientific Name: *Pennisetum setaceum* - *Pennisetum ciliare* Ruderal Grassland Alliance

Common Name (Translated Scientific Name): Crimson Fountaingrass - Buffelgrass Ruderal Grassland Alliance

Colloquial Name: Ruderal Crimson Fountaingrass - Buffelgrass Grassland

Type Concept: This alliance consists of grasslands where *Pennisetum setaceum* and/or *Pennisetum ciliare* or other *Pennisetum* species are dominant or codominant with other non-native species in the herbaceous layer. Herbs are <3 m tall, and the canopy is open to intermittent. Emergent shrub and tree layers may occur at low cover. *Pennisetum setaceum* and especially *Pennisetum ciliare* are adapted to fire and increase following burns, contributing to their spread. Both grasses establish better than native plants after a fire, and as stands age, they raise fuel loads. This alliance occurs in California at elevations ranging from sea level to 35 m. Habitats are steep coastal cliffs, bluffs, road-cuts, coastal dunes, coastal scrub, and desert scrub in areas with mild, frost-free winters.

Classification Comments: All species of *Pennisetum* are highly invasive in the warm deserts of North America, from southern California, across the Colorado, Mojave, and Sonoran deserts into southern Texas. As described by Sawyer et al. (2009) for California, these are primarily coastal in California, with some occurring in the deserts of that state.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure: Perennial herbaceous graminoids <3 m in height.

Floristics: These grasslands are dominated or codominated by *Pennisetum setaceum* and/or *Pennisetum ciliare* or other *Pennisetum* species along with other non-native species in the herbaceous layer. Emergent shrub and tree layers may occur at low cover.

ENVIRONMENT & DYNAMICS

Environmental Description: Habitats are steep coastal cliffs, bluffs, road-cuts, coastal dunes, coastal scrub, and desert scrub in areas with mild, frost-free winters. Elevation ranges from 0-35 m.

Dynamics: *Pennisetum setaceum* and especially *Pennisetum ciliare* are adapted to fire and increase following burns, contributing to their spread. Both grasses establish better than native plants after a fire, and as stands age, they raise fuel loads (Lovich 2000, DiTomaso and Healy 2007).

DISTRIBUTION

Geographic Range: California, frost-free regions, primarily coastal, but extending east into the edges of the Colorado Desert.

Nations: MX, US

States/Provinces: CA, MXBC

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

- > *Pennisetum setaceum* (Fountain grass swards) Semi-natural Stands (Sawyer et al. 2009) [42.085.00]
- > *Pennisetum setaceum* Herbaceous Alliance (Keeler-Wolf and Evens 2006)

LOWER LEVEL UNITS

Associations:

AUTHORSHIP

Primary Concept Source: M.S. Reid, in Faber-Langendoen et al. (2013)

Author of Description: M.S. Reid

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: DiTomaso and Healy 2007, Faber-Langendoen et al. 2017b, Keeler-Wolf and Evens 2006, Lovich 2000, Sawyer et al. 2009, Sproul et al. 2011

3. Desert & Semi-Desert

3.A.2.Na. North American Warm Desert Scrub & Grassland

3.A.2.Na.90.b. M512 North American Warm Desert Ruderal Scrub & Grassland

G819. North American Warm Desert Ruderal Scrub

Type Concept Sentence: This broadly defined ruderal group occurs in Arizona, New Mexico, western Texas and northern Mexico and includes upland desert scrub dominated by exotic shrub species such as *Caesalpinia gilliesii* or invasive native species (*Prosopis glandulosa* and *Prosopis velutina*) with >90% relative cover and >10% absolute shrub cover. Also included are any desert scrub with an herbaceous layer strongly dominated by an exotic herbaceous species (>90% relative cover). Characteristic exotic understory species include *Brassica nigra*, *Brassica tournefortii*, *Bromus madritensis*, *Bromus rubens*, *Cynodon dactylon*, *Centaurea* spp., *Eragrostis lehmanniana*, *Erodium cicutarium*, and *Schismus barbatus*.

OVERVIEW

Scientific Name: *Prosopis glandulosa* - *Prosopis velutina* Warm Desert Ruderal Scrub Group

Common Name (Translated Scientific Name): Honey Mesquite - Velvet Mesquite Warm Desert Ruderal Scrub Group

Colloquial Name: Ruderal Honey Mesquite Desert Sand Scrub

Type Concept: This broadly defined ruderal scrub group occurs in Arizona, New Mexico, western Texas, northern Mexico and elsewhere in the Desert Southwest. It includes upland desert scrub dominated by invasive native species (*Prosopis glandulosa* and *Prosopis velutina*) with >95% relative cover and >10% absolute shrub cover that has become widespread in the last century. However, *Prosopis* spp.-dominated stands that occur naturally (non-ruderal) in desert lowlands, drainages, washes and riparian areas (bosque) are excluded from this ruderal type. Also included in this ruderal group are stands dominated by exotic shrubs such as *Caesalpinia gilliesii*, as well as any disturbed desert scrub with an herbaceous layer strongly dominated by exotic species (>90% relative cover), such that the former natural community cannot be determined. Characteristic understory species of the upland ruderal mesquite (*Prosopis* spp.) stands include native desert graminoids that were part of the former native upland vegetation invaded by mesquite. Many exotic species may dominate ruderal stands such as *Brassica nigra*, *Brassica tournefortii*, *Bromus madritensis*, *Bromus rubens*, *Centaurea* spp., *Cynodon dactylon*, *Eragrostis lehmanniana*, *Erodium cicutarium*, *Schismus arabicus*, *Schismus barbatus*, and *Sisymbrium altissimum*. Stands occur in southeastern Arizona on alluvial fans, ridges, hills and valley floors. The elevation range is 960-1100 m (3150-3600 feet). Climate is warm, semi-arid to arid continental. Mean annual precipitation ranges from 22-28 cm, but can vary greatly from year to year. Drought is not uncommon. Sites occur on gentle to moderate slopes. Substrates are variable but are often well-drained sandy loam.

Classification Comments: Heavy grazing in the late 1800s and early 1900s, altered fire regime, climate change, desertification and other factors are thought to have caused mesquite to invade and dominate the upland grasslands where it did not previously occur. Naturally occurring coppice dunes may have been present locally in areas peripheral to active dunes. However, the coppice dunes in the Tularosa Basin and elsewhere are currently extensive, resulting from sand movement due to degradation of desert grasslands. Some of the characteristic species are shared with other ruderal types; however, this type is restricted to warm deserts and the transition zone with the southern Great Basin. Most shrub plots have a native overstory with an exotic herbaceous understory. Most stands of this type are the invasive upland *Prosopis* spp. scrub with or without an exotic herbaceous understory. *Sorghum halepense* and *Cynodon dactylon* grow best in mesic conditions. Stands dominated by these species that occur in riparian areas are not included in this group.

Similar NVC Types:

- G624 Western North American Interior Ruderal Grassland & Shrubland: has similar ruderal alliances but rather than occurring in cool, semi-arid sites, stands occur in cool, temperate regions and include montane, subalpine and alpine areas. Vegetation lacks obligate wetland species and is not dominated by facultative wetland species.

- G648 Southern Vancouverian Lowland Ruderal Grassland & Shrubland: may include similar alliances, but is restricted to lowlands west of the Cascade Range.
- G524 Western North American Ruderal Marsh, Wet Meadow & Shrubland: has similar ruderal alliances but occurs on mesic to wet sites and vegetation either includes obligate wetland species or is dominated by facultative wetland species.
- G490 Chihuahuan Desert Foothill-Piedmont & Lower Montane Grassland
- G288 Chihuahuan Creosotebush - Mixed Desert Scrub
- G287 Chihuahuan Desert Sand Scrub
- G600 Great Basin-Intermountain Ruderal Dry Shrubland & Grassland: may include similar alliances, but is restricted to cool, semi-arid desert regions.

Diagnostic Characteristics: This broadly defined upland ruderal group occurs in a warm, semi-arid climate in the southwestern U.S. and northern Mexico and includes upland mesquite and all desert scrub with an exotic species-dominated understory (>90% relative cover) in the herbaceous layer of at least 10% cover. Characteristic understory species include *Brassica nigra*, *Brassica tournefortii*, *Bromus madritensis*, *Bromus rubens*, *Cynodon dactylon*, *Eragrostis lehmanniana*, *Erodium cicutarium*, *Schismus arabicus*, *Schismus barbatus*, and *Sorghum halepense* with little native composition remaining. Other woody species may include *Calliandra eriophylla*, *Gutierrezia sarothrae*, or *Isocoma tenuisecta*. The ruderal native annual forb *Amaranthus palmeri* often dominates or codominates disturbed stands.

VEGETATION

Physiognomy and Structure: The physiognomy of this group includes open to dense shrublands and shrub-steppe with a sparse to dense, annual- or perennial-dominated herbaceous layer.

Floristics: This broadly defined ruderal group includes all desert scrub with an exotic species-dominated understory (>90% relative cover) in the herbaceous layer as well as exotic-dominated herbaceous stands. These open to dense grasslands and forblands are composed of either exotic annual or biennial grasses or forbs with low cover of perennial species (<10% absolute cover) or stands with a significant perennial herbaceous layer (>10% absolute cover) strongly dominated by exotics (>90% relative cover) with or without annuals and biennials present to dominant. This group includes upland desert scrub strongly dominated by invasive native species (*Prosopis glandulosa* and *Prosopis velutina*) with >95% relative cover and >10% absolute shrub cover. *Prosopis* spp. that occur naturally (non-ruderal) in desert lowlands, drainages, washes and riparian areas (bosque) are excluded from this ruderal type. Characteristic understory species include *Brassica nigra*, *Brassica tournefortii*, *Bromus madritensis*, *Bromus rubens*, *Cynodon dactylon*, *Eragrostis lehmanniana*, *Erodium cicutarium*, *Panicum antidotale*, *Schismus arabicus*, *Schismus barbatus*, and *Sorghum halepense* with little native composition remaining. Other woody species may include *Calliandra eriophylla*, *Gutierrezia sarothrae*, or *Isocoma tenuisecta*. *Gutierrezia microcephala* is abundant in some stands. Remnant desert grasses include *Aristida ternipes*, *Bouteloua chondrosioides*, *Bouteloua curtipendula*, *Bouteloua eriopoda*, *Bouteloua rothrockii*, *Digitaria californica*, and *Eragrostis intermedia*. Other common herbaceous species include *Allionia incarnata*, *Ambrosia confertiflora*, *Boerhavia erecta*, *Mollugo verticillata*, *Cylindropuntia versicolor* (= *Opuntia versicolor*), *Panicum hirticaule*, *Polygala barbeyana*, *Proboscidea parviflora*, and *Phemeranthus aurantiacus* (= *Talinum aurantiacum*). Other associated species such as *Chenopodium berlandieri*, *Chloris virgata*, *Eragrostis cilianensis*, *Eragrostis pectinacea*, *Eriochloa acuminata*, *Ipomoea* spp., *Kallstroemia grandiflora*, *Leptochloa panicea* ssp. *brachiata* (= *Leptochloa filiformis*), *Salsola kali*, and *Solanum elaeagnifolium* are often present. The ruderal native annual forb *Amaranthus palmeri* often dominates or codominates disturbed stands.

ENVIRONMENT & DYNAMICS

Environmental Description: This ruderal desert scrub group is found in Arizona in areas that were formerly mixed desert grasslands, in northern Mexico, and possibly in New Mexico and Texas. Elevations range from 960-1100 m (3150-3600 feet). Climate is arid to semi-arid with hot summers. Mean annual precipitation ranges from 22-28 cm, but can vary greatly from year to year. Drought is not uncommon. Annual precipitation has bimodal distribution with the proportion of summer precipitation decreasing westward (Barbour and Major 1977). At Tucson, Arizona, about half of the annual rain falls during July to October with the balance during the winter months. The most arid season is late spring and early summer. The summer rain often occurs as high-intensity convective storms. Stands occur on alluvial fans, ridges, hills and valley floors. Sites occur on flats and basins to moderately steep slopes. Substrates are variable and range from well-drained sandy loam to finer-textured silt loam or clays.

Dynamics: During the last century, the area occupied by the ruderal upland mesquite-dominated desert thornscrub group has increased through conversion of desert grasslands as a result of drought, overgrazing and *Prosopis glandulosa* seed dispersion by livestock, and/or decreases in fire frequency (Brown and Archer 1987). It is believed that this group formerly occurred in relatively minor amounts and was largely confined to drainages until cattle distributed seed upland from the bosques into desert grasslands (Brown and Archer 1987, 1989). Shrublands dominated by *Prosopis* spp. have replaced large areas of desert grasslands, especially those formerly dominated by *Bouteloua eriopoda*, in Trans-Pecos Texas, southern New Mexico and southeastern Arizona (York and Dick-Peddie 1969, Hennessy et al. 1983). Studies on the Jornada Experimental Range suggest that combinations of drought,

overgrazing by livestock, wind and water erosion, seed dispersal by livestock, fire suppression, shifting dunes, and changes in the seasonal distribution of precipitation have caused this recent, dramatic shift in vegetation physiognomy (Buffington and Herbel 1965, Herbel et al. 1972, Humphrey 1974, McLaughlin and Bowers 1982, Gibbens et al. 1983, Hennessy et al. 1983, Schlesinger et al. 1990, McPherson 1995).

For sandy site desert scrub it is important to differentiate between (1) coppice dunes / associated interdune and (2) sandsheets. Invasive mesquite dominates on coppice dunes, especially where the interdune contains an argillic horizon layer with increased clay content. Mesquite produces large taproots and long lateral roots which enable it to extract moisture from deeper depths and the associated interdune. On sandsheets, as noted by Steven Yanoff (pers. comm.), sandsage dominates. These soils are typically deeper and coarser-textured (sand and loamy sand). The coarse texture allows rapid infiltration and helps decrease wicking of soil moisture to the surface via capillary rise. Common associations on sandsheets dominated by *Artemisia filifolia*, *Psoralea scoparius*, and *Rhus microphylla* occurred historically and are not included in this group with invasive *Prosopis glandulosa* unless there is an herbaceous understory that is dominated by exotic species.

DISTRIBUTION

Geographic Range: This ruderal desert scrub group occurs in Arizona and possibly New Mexico and Texas in areas that were formerly mixed desert grasslands. It likely occurs in northern Mexico and is presumably widespread in agricultural areas in this warm semi-arid region.

Spatial Scale & Pattern [optional]:

Nations: MX, US

States/Provinces: AZ, CA, CO, MXCH?, MXCO, MXSO?, NM, NV, OK?, TX

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = Shrub - Scrub Disclimax Series - 143.16 (Brown et al. 1979)

LOWER LEVEL UNITS

Alliances:

- A3135 *Prosopis glandulosa* Ruderal Desert Sand Scrub Alliance
- A3162 *Prosopis glandulosa* Ruderal Desert Scrub Alliance
- A3163 *Prosopis velutina* Ruderal Desert Scrub Alliance

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2015)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 11/06/2015

Classif Resp Region: West

Internal Author: KAS 11-15

REFERENCES

References: Barbour and Major 1977, Brown and Archer 1987, Brown and Archer 1989, Brown et al. 1979, Buffington and Herbel 1965, Faber-Langendoen et al. 2017a, Gibbens et al. 1983, Hennessy et al. 1983, Herbel et al. 1972, Humphrey 1974, McLaughlin and Bowers 1982, McPherson 1995, Schlesinger et al. 1990, York and Dick-Peddie 1969

3. Desert & Semi-Desert

3.A.2.Na. North American Warm Desert Scrub & Grassland

G819. North American Warm Desert Ruderal Scrub

A3135. *Prosopis glandulosa* Ruderal Desert Sand Scrub Alliance

Type Concept Sentence: This open-canopied ruderal shrubland alliance occurs in the Tularosa Basin and the southern Jornada del Muerto in south-central New Mexico and western Texas. It is characterized by patchy, large-diameter *Prosopis glandulosa* shrubs forming coppice dunes on a sandsheet. The surface topography is characterized by rolling sandy hummocks or steep dunes, but there is no overall aspect dominance.

OVERVIEW

Scientific Name: *Prosopis glandulosa* Ruderal Desert Sand Scrub Alliance

Common Name (Translated Scientific Name): Honey Mesquite Ruderal Desert Sand Scrub Alliance

Colloquial Name: Ruderal Honey Mesquite Desert Sand Scrub

Type Concept: This is a major ruderal alliance of the Tularosa Basin and occasional within the southern Jornada del Muerto of New Mexico. These open-canopied shrublands are characterized by patches of *Prosopis glandulosa* shrubs that form coppice dunes on a sandsheet. The interdune areas may be sparse to moderately abundant with shrubs, grasses, and forbs such as *Atriplex canescens*, *Baileya multiradiata*, *Dimorphocarpa wislizeni*, *Gutierrezia sarothrae*, *Psoralea scoparius*, *Sporobolus flexuosus*, *Suaeda moquinii* (on alluvial sites), and *Yucca elata*. Stands occur in low-elevation alluvial flats or basins and form extensive coppice dunefields. Surface soils (sand to loamy sand) typically overlie more developed, clayey subsoils (Haplargids). However, alluvial sites include sandy loams, cobbles on the surface, and may have alkaline soils. The surface topography is characterized by rolling sandy hummocks or steep dunes.

Classification Comments: This alliance is considered by some to be a native ruderal invasive alliance that historically did not occur naturally. Whether it occurred naturally or not, it has greatly expanded its range and now dominates huge areas in the Tularosa Basin and other areas. Muldavin et al. (2000b) describe a *Prosopis glandulosa* / *Gutierrezia sarothrae* plant association that may be similar and have *Artemisia filifolia* well-represented. Shrubs with broad ecological amplitudes such as *Atriplex canescens* are included in this alliance when diagnostic psammophilous Chihuahuan Desert species are present in stand. *Prosopis* spp.-dominated stands are considered natural along drainages and in lowland areas.

Internal Comments:

Other Comments:

Similar NVC Types: This alliance is similar to *Prosopis glandulosa* Ruderal Desert Scrub Alliance (A3162) in that both have a shrub layer dominated by *Prosopis glandulosa*; however, this alliance is restricted to sandsheets and typically forms coppice dunes.

- A3952 *Prosopis glandulosa* Shortgrass Prairie Ruderal Scrub Alliance
- A3153 *Prosopis glandulosa* Lowland Basin Chihuahuan Desert Scrub Alliance: is similar but is restricted to lowland basin sites with fine-textured, often alkaline or saline substrates.
- A3163 *Prosopis velutina* Ruderal Desert Scrub Alliance
- A3162 *Prosopis glandulosa* Ruderal Desert Scrub Alliance: is similar in that it is dominated by *Prosopis glandulosa*, but stands occur in uplands and not on sandsheet substrates.

Diagnostic Characteristics: These ruderal desert shrublands occur on upland sand substrates and are characterized by dominance of *Prosopis glandulosa*. Other psammophilous shrubs, such as *Artemisia filifolia*, *Atriplex canescens*, *Ephedra torreyana*, *Ephedra trifurca*, or *Psoralea scoparius*, may be present. The understory is variable, ranging from sparse to moderately abundant psammophilous grasses or forbs such as *Sporobolus flexuosus* and *Dimorphocarpa wislizeni*.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a patchy to open to moderately dense layer of extremely xeromorphic deciduous shrubs less than 2 m tall above the surface but may be buried by several meters by sand forming and occupying coppice dunes. The herbaceous layer is typically sparse and dominated by graminoids, with annual forbs present seasonally.

Floristics: This ruderal alliance is characterized by open-canopied shrublands composed of large-diameter *Prosopis glandulosa* shrubs that form and occupy coppice dunes. The interdune areas may be sparse to moderately abundant with shrubs, grasses, and forbs such as *Atriplex canescens*, *Baileya multiradiata*, *Dimorphocarpa wislizeni*, *Gutierrezia sarothrae*, *Psoralea scoparius*, *Sporobolus flexuosus*, *Suaeda moquinii* (on alluvial sites), and *Yucca elata*.

ENVIRONMENT & DYNAMICS

Environmental Description: This low-elevation ruderal alliance occurs on alluvial flats or basins and forms extensive coppice dunefields. Surface soils (sand to loamy sand) typically overlie more developed, clayey soils (Haplargids) forming a moderately deep to deep layer of sand. However, alluvial sites include sandy loams, cobbles on the surface, and may have alkaline soils. The surface topography is characterized by rolling sandy hummocks or steep dunes, but there is no overall aspect dominance.

Dynamics: Shrublands dominated by *Prosopis glandulosa* have replaced large areas of sandy semi-desert grasslands, especially those formerly dominated by *Bouteloua eriopoda*, in Trans-Pecos Texas, southern New Mexico and southeastern Arizona (York and Dick-Peddie 1969, Hennessy et al. 1983). Studies on the Jornada Experimental Range suggest that combinations of drought, overgrazing by livestock, wind and water erosion, seed dispersal by livestock, fire suppression, shifting dunes, and changes in the seasonal

distribution of precipitation have caused this recent, dramatic shift in vegetation physiognomy (Buffington and Herbel 1965, Herbel et al. 1972, Humphrey 1974, McLaughlin and Bowers 1982, Gibbens et al. 1983, Hennessy et al. 1983, Schlesinger et al. 1990, McPherson 1995).

DISTRIBUTION

Geographic Range: This is a major ruderal alliance on sandy plains and sand deposits of the Tularosa Basin and occasionally within the southern Jornada del Muerto of south-central New Mexico and western Texas. It also occurs in adjacent northern Mexico.

Nations: MX, US

States/Provinces: NM, TX

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- >< Mesquite Series (Dick-Peddie 1993) [in both the Arroyo Riparian and Closed Basin-Playa-Alkali Sink Riparian Vegetation Types.]
- = Mixed Shrub Series (Dick-Peddie 1993) [includes *Prosopis glandulosa*/*Gutierrezia sarothrae*/SMF-F (dunes) association within the Plains-Mesa Sand Scrub Vegetation Type.]

LOWER LEVEL UNITS

Associations:

- CEGL001386 *Prosopis glandulosa* / *Sporobolus flexuosus* Ruderal Shrubland
- CEGL001382 *Prosopis glandulosa* / *Atriplex canescens* Ruderal Shrubland
- CEGL002192 *Prosopis glandulosa* - *Artemisia filifolia* / *Sporobolus giganteus* Ruderal Shrubland

AUTHORSHIP

Primary Concept Source: W.A. Dick-Peddie (1993)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2015/12/21

REFERENCES

References: Barbour and Major 1977, Bourgeron et al. 1993b, Bourgeron et al. 1995a, Bowers 1984, Brown 1982a, Buffington and Herbel 1965, Burgess 1995, Diamond 1993, Dick-Peddie 1993, Faber-Langendoen et al. 2017b, Gardner 1951, Gibbens et al. 1983, Hennessy et al. 1983, Herbel et al. 1972, Humphrey 1974, McAuliffe 1995, McLaughlin and Bowers 1982, McPherson 1995, Muldavin and Mehlhop 1992, Muldavin et al. 2000b, Schlesinger et al. 1990, York and Dick-Peddie 1969

3. Desert & Semi-Desert

3.A.2.Na. North American Warm Desert Scrub & Grassland

G819. North American Warm Desert Ruderal Scrub

A3162. *Prosopis glandulosa* Ruderal Desert Scrub Alliance

Type Concept Sentence: This widespread ruderal alliance occurs as invasive upland shrublands found in former semi-desert grasslands in the foothills and piedmonts of the Chihuahuan Desert, extending west into the Sky Island region of southern Arizona and adjacent Mexico, and north into the lower Mogollon Rim foothills. The open to dense, tall (2-5 m) to short (<2 m) shrub layer is dominated by *Prosopis glandulosa* with typically low cover of desert grasses.

OVERVIEW

Scientific Name: *Prosopis glandulosa* Ruderal Desert Scrub Alliance

Common Name (Translated Scientific Name): Honey Mesquite Ruderal Desert Scrub Alliance

Colloquial Name: Ruderal Honey Mesquite Upland Desert Scrub

Type Concept: This ruderal alliance occurs as the common invasive upland shrublands that are concentrated in extensive areas of former semi-desert grasslands in foothills and piedmonts of the Chihuahuan Desert, extending west into the Sky Island region of southern Arizona and adjacent Mexico, and north into the lower Mogollon Rim foothills. Stands are characterized by an open to dense, tall (2-5 m) to short (<2 m) shrub layer dominated by *Prosopis glandulosa*. Associated species that may codominate or form a short-shrub layer include *Acacia neovernicosa*, *Acacia constricta*, *Acacia greggii*, *Atriplex canescens*, *Ephedra trifurca*, and *Fouquieria*

splendens. Grass cover is generally low and composed of desert grasses such as *Bouteloua eriopoda*, *Dasyochloa pulchella* (= *Erioneuron pulchellum*), *Muhlenbergia porteri*, and *Muhlenbergia setifolia*. Scattered *Juniperus* spp. trees may be present. *Larrea tridentata* is absent or has low cover. Substrates are typically derived from alluvium. During the last century, the area occupied by this vegetation has increased through conversion of desert grasslands as a result of drought, overgrazing by livestock, and/or decreases in fire frequency.

Classification Comments: This alliance is considered by some to be a native ruderal invasive alliance that historically did not occur naturally. Whether or not upland mesquite shrublands occurred naturally or not, they have unnaturally greatly expanded their range and now dominate vast areas of former semi-desert grassland in foothills and piedmonts of the Chihuahuan Desert, extending west into the Sky Island region southern Arizona and adjacent Mexico, and north into the lower Mogollon Rim foothills. Upland *Prosopis velutina*-dominated scrub has similarly expanded its range and occurs further west. In addition, because *Prosopis glandulosa* can have both shrub and tree growth forms, there may be confusion classifying a given stand. In general, desert upland stands are considered shrublands. *Prosopis glandulosa*-dominated stands are considered natural along drainages and in lowland areas.

Internal Comments:

Other Comments:

Similar NVC Types: This alliance is similar to *Prosopis glandulosa* Ruderal Desert Sand Scrub Alliance (A3135) in that both have a shrub layer dominated by *Prosopis glandulosa*; however, this other alliance is restricted to sandsheets and typically forms coppice dunes.

- A3952 *Prosopis glandulosa* Shortgrass Prairie Ruderal Scrub Alliance
- A3163 *Prosopis velutina* Ruderal Desert Scrub Alliance: is ecologically similar, but is dominated by related species *Prosopis velutina*.
- A3153 *Prosopis glandulosa* Lowland Basin Chihuahuan Desert Scrub Alliance: is restricted to lowland basin sites with fine-textured, often alkaline or saline substrates.
- A3135 *Prosopis glandulosa* Ruderal Desert Sand Scrub Alliance: is restricted to sandsheets substrates.

Diagnostic Characteristics: Shrub layer is dominated by *Prosopis glandulosa* and occurs on upland sites with alluvial or colluvial substrates, not eolian sand deposits. Chihuahuan Desert indicator species are often present.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a moderate to dense layer of extremely xeromorphic deciduous shrubs that are less than 5 m tall. The herbaceous layer is typically sparse but ranges from low to moderately dense cover and is dominated by graminoids, with annual forbs present seasonally. Succulents are often present.

Floristics: This alliance occurs as the common invasive upland shrublands that are characterized by open to dense, tall (2-5 m) to short (<2 m) shrub layer dominated by *Prosopis glandulosa*. Associated species that may codominate or form a short-shrub layer include *Acacia neovernicosa*, *Acacia constricta*, *Acacia greggii*, *Atriplex canescens*, *Ephedra trifurca*, and *Fouquieria splendens*. Other characteristic shrubs may include *Ericameria laricifolia*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Larrea tridentata* (low cover), *Lycium* spp., and *Parthenium incanum*. Succulents such as *Opuntia engelmannii*, *Cylindropuntia imbricata* (= *Opuntia imbricata*), *Cylindropuntia leptocaulis* (= *Opuntia leptocaulis*), *Opuntia phaeacantha*, *Nolina microcarpa*, and *Yucca baccata* are often present. Grass cover is generally low and composed of desert grasses such as *Bouteloua eriopoda*, *Dasyochloa pulchella* (= *Erioneuron pulchellum*), *Muhlenbergia porteri*, and *Muhlenbergia setifolia*. Other common perennial grasses may include *Aristida purpurea*, *Bouteloua curtipendula*, *Bouteloua gracilis*, *Muhlenbergia richardsonis*, and *Pleuraphis mutica*. Sparse annual grasses may include *Aristida adscensionis*, *Bouteloua barbata*, and *Dasyochloa pulchella*. Forb cover is also sparse, but it can be relatively diverse. Common forbs may include species of *Chenopodium*, *Croton*, *Eriogonum*, *Euphorbia*, *Solanum*, and *Zinnia*. Scattered *Juniperus* spp. trees may be present. *Larrea tridentata* is absent or has low cover.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance occurs as the common invasive upland shrublands that are concentrated in extensive areas of former semi-desert grasslands in foothills and piedmonts of the Chihuahuan Desert, extending west into the Sky Island region of southern Arizona and adjacent Mexico, and north into the lower Mogollon Rim foothills. Elevation ranges from 1200-1600 m. Climate is arid to semi-arid. Temperature is hot in summer and is frequently below freezing in winter. At the nearby Jornada Experimental Range in southwestern New Mexico, annual precipitation ranged from 7-45 cm with mean annual precipitation of 23 cm (Herbel et al. 1972). Drought is not uncommon. The precipitation has a bimodal distribution with about two-thirds falling during July to October and a third during the winter months. The summer precipitation often occurs as high-intensity convective storms. The driest period is in late spring and early summer. Sites include plains, bajadas, piedmonts, foothills and mesas. They range from flat to moderate slopes occurring on all aspects. Substrate is usually gravelly alluvium. Parent material includes andesite and rhyolite. Soils are generally coarse-textured such as sandy or gravelly loams, but may include finer-textured loamy soils. Muldavin et

al. (1993a) described the ground cover of a stand with 40% bare ground, 25% rock and gravel, and 33% litter. During the last century, the area occupied by this vegetation has increased through conversion of desert grasslands as a result of drought, overgrazing by livestock, and/or decreases in fire frequency.

Dynamics: *Prosopis glandulosa* has invaded large areas of desert grasslands, especially those dominated by *Bouteloua eriopoda* in the Trans-Pecos of Texas, southern New Mexico, and southeastern Arizona (York and Dick-Peddie 1969, Hennessy et al. 1983). Studies on the Jornada Experimental Range suggest that combinations of drought, overgrazing by livestock, wind and water erosion, seed dispersal by livestock, fire suppression, shifting dunes, and changes in the seasonal distribution of precipitation have caused this recent, dramatic shift in vegetation physiognomy (Buffington and Herbel 1965, Herbel et al. 1972, Humphrey 1974, McLaughlin and Bowers 1982, Gibbens et al. 1983, Hennessy et al. 1983, Schlesinger et al. 1990, McPherson 1995).

Prosopis spp. and other shrubs have extensive root systems that allow them to exploit deep soil water that is unavailable to shallower rooted grasses and cacti (Burgess 1995). This strategy works well except on sites that have well-developed argillic or calcic soil horizons that limit infiltration and storage of winter moisture in the deeper soil layers (McAuliffe 1995). McAuliffe (1995) found *Prosopis* spp. invasion on these sites limited to a few, small individuals. This has implications in plant geography and grassland revegetation work in the southwestern U.S.

DISTRIBUTION

Geographic Range: This alliance occurs as invasive upland shrublands that are concentrated in the extensive desert grassland in foothills and piedmonts of the Chihuahuan Desert ranging from the Trans-Pecos of Texas, southern New Mexico, southeastern Arizona and adjacent Mexico.

Nations: MX, US

States/Provinces: AZ, NM, TX

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- >< Mesquite (southern type): 68 (Eyre 1980)
- >< Mesquite (western type): 242 (Eyre 1980)
- = Mesquite - scrub series (Donart et al. 1978a) [from the Chihuahuan Desert Region of the Desert Shrub Formation.]
- = Mixed Shrub Series (Dick-Peddie 1993) [includes *Prosopis glandulosa*/*Gutierrezia sarothrae*/SMF-F (dunes).]
- = Shrub-Mixed Grass Series (Dick-Peddie 1993) [includes *Prosopis glandulosa*-*Microrhamnus ericoides*-*Gutierrezia*.]

LOWER LEVEL UNITS

Associations:

- CEG001510 *Prosopis glandulosa* / *Bouteloua eriopoda* Ruderal Shrub Grassland
- CEG001384 *Prosopis glandulosa* / Mixed Grasses Ruderal Shrubland
- CEG001511 *Prosopis glandulosa* / *Muhlenbergia porteri* Ruderal Shrubland
- CEG001383 *Prosopis glandulosa* / *Bouteloua gracilis* Ruderal Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2015/12/21

REFERENCES

References: Bourgeron et al. 1993b, Bourgeron et al. 1995a, Brown 1982a, Buffington and Herbel 1965, Burgess 1995, Diamond 1993, Dick-Peddie 1993, Donart et al. 1978a, Eyre 1980, Faber-Langendoen et al. 2017b, Gardner 1951, Gibbens et al. 1983, Hennessy et al. 1983, Herbel et al. 1972, Humphrey 1974, McAuliffe 1995, McLaughlin and Bowers 1982, McPherson 1995, Muldavin and Mehlhop 1992, Muldavin et al. 1993a, Muldavin et al. 2000b, Schlesinger et al. 1990, Warren and Treadwell 1980, York and Dick-Peddie 1969

3. Desert & Semi-Desert

3.A.2.Na. North American Warm Desert Scrub & Grassland

G819. North American Warm Desert Ruderal Scrub

A3163. *Prosopis velutina* Ruderal Desert Scrub Alliance

Type Concept Sentence: This widespread ruderal alliance occurs as invasive upland shrublands found in former semi-desert grasslands in the foothills and piedmonts in the Sky Island region of southern Arizona and adjacent Mexico, and north into the lower Mogollon Rim foothills. The open to dense, tall (2-5 m) to short (<2 m) shrub layer is dominated by *Prosopis velutina* with typically low cover of desert grasses.

OVERVIEW

Scientific Name: *Prosopis velutina* Ruderal Desert Scrub Alliance

Common Name (Translated Scientific Name): Velvet Mesquite Ruderal Desert Scrub Alliance

Colloquial Name: Ruderal Velvet Mesquite Desert Scrub

Type Concept: This ruderal alliance occurs as the common invasive upland shrublands found in former semi-desert grasslands in the foothills and piedmonts in the Sky Island region of southern Arizona and adjacent Mexico, and north into the lower Mogollon Rim foothills. The open to dense, tall (2-5 m) to short (<2 m) shrub layer dominated by *Prosopis velutina*. Associated species that may codominate or form a short-shrub layer include *Acacia greggii*, *Atriplex canescens*, *Calliandra eriophylla*, *Fouquieria splendens*, and *Mimosa dysocarpa*. Grass cover is generally low and composed of desert grasses such as *Dasyochloa pulchella* (= *Erioneuron pulchellum*), *Muhlenbergia porteri*, and *Pleuraphis mutica*. Scattered juniper trees may be present. *Larrea tridentata* is absent or has low cover. Substrates are typically derived from alluvium. During the last century, the area occupied by this vegetation has increased through conversion of desert grasslands as a result of drought, overgrazing by livestock, and/or decreases in fire frequency.

Classification Comments: This alliance is considered to be a native ruderal invasive alliance that historically did not occur naturally. Whether or not upland mesquite shrublands ever occurred naturally or not, they have unnaturally greatly expanded their range and now dominate vast areas of former semi-desert grassland in foothills and piedmonts of the Chihuahuan Desert, extending west into the Sky Island region southern Arizona and adjacent Mexico, and north into the lower Mogollon Rim foothills. Upland *Prosopis glandulosa*-dominated scrub has similarly expanded its range and occurs further west. In addition, because *Prosopis velutina* can have both shrub and tree growth forms, there may be confusion classifying a given stand. In general, desert upland stands are considered shrublands. *Prosopis velutina*-dominated stands are considered natural along drainages and in lowland areas.

Internal Comments:

Other Comments:

Similar NVC Types:

- A3135 *Prosopis glandulosa* Ruderal Desert Sand Scrub Alliance: is restricted to sandsheets substrates and is dominated by *Prosopis velutina*.
- A3153 *Prosopis glandulosa* Lowland Basin Chihuahuan Desert Scrub Alliance
- A3162 *Prosopis glandulosa* Ruderal Desert Scrub Alliance: is ecologically similar, but is dominated by related species *Prosopis glandulosa*.

Diagnostic Characteristics: Shrub layer is dominated by *Prosopis velutina* and occurs on upland sites with alluvial or colluvial substrates, not eolian sand deposits or alkaline/saline bottomland sites.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a moderate to dense layer of xeromorphic deciduous shrubs that is less than 5 m tall. The herbaceous layer may be sparse to moderately dense and is dominated by graminoids, with annual forbs present seasonally. Succulents may also be present.

Floristics: This alliance occurs as the common invasive upland shrublands that are characterized by an open to dense, tall (2-5 m) to short (<2 m) shrub layer dominated by *Prosopis velutina*. Associated species that may codominate or form a short-shrub layer include *Acacia constricta*, *Acacia greggii*, *Atriplex canescens*, *Calliandra eriophylla*, *Ericameria laricifolia*, *Fouquieria splendens*, *Gutierrezia sarothrae*, *Isocoma tenuisecta*, *Lycium* spp., *Mimosa aculeaticarpa* var. *biuncifera*, *Mimosa dysocarpa*, and *Cylindropuntia versicolor* (= *Opuntia versicolor*). The herbaceous layer is sparse to moderately dense (<10-50% cover). Common herbaceous species include *Abutilon incanum*, *Aristida ternipes*, *Bouteloua chondrosioides*, *Bouteloua curtipendula*, *Bouteloua repens*, *Bouteloua rothrockii*, *Croton pottsii*, *Digitaria californica*, *Gutierrezia microcephala*, *Kallstroemia grandiflora*, *Muhlenbergia porteri*, *Portulaca oleracea* (= *Portulaca retusa*), and *PheMERanthus aurantiacus* (= *Talinum aurantiacum*). Forbs often have high species richness but with typically relatively low cover. Exotic perennial grass *Eragrostis lehmanniana* may be present to dominant. Scattered juniper trees may be present. *Larrea tridentata* is absent or has low cover.

ENVIRONMENT & DYNAMICS

Environmental Description: This ruderal alliance occurs as the common invasive upland shrublands found in former semi-desert grasslands in the foothills and piedmonts in the Sky Island region of southern Arizona and adjacent Mexico, and north into the lower Mogollon Rim foothills. As described from the foothills of Buenos Aires National Wildlife Refuge in southern Arizona, stands are found on valley floors, swales and ridges at an elevational range of 915-1170 m. Sites are flat to moderately steep slopes on foothills, alluvial fans and outwash plains of all aspects. Substrates are typically well-drained sandy loam but include silt loam and clayey soils. Bare ground or small rocks frequently dominate the ground cover. During the last century, the area occupied by this vegetation has increased through conversion of desert grasslands as a result of drought, overgrazing by livestock, and/or decreases in fire frequency.

Dynamics: Shrublands dominated by *Prosopis* spp. have replaced large areas of desert grasslands, especially those formerly dominated by *Bouteloua eriopoda* in Trans-Pecos Texas, southern New Mexico and southeastern Arizona (York and Dick-Peddie 1969, Hennessy et al. 1983). Studies of related species *Prosopis glandulosa* on the Jornada Experimental Range suggest that combinations of drought, overgrazing by livestock, wind and water erosion, seed dispersal by livestock, fire suppression, shifting dunes and changes in the seasonal distribution of precipitation have caused this recent, dramatic shift in vegetation physiognomy (Buffington and Herbel 1965, Herbel et al. 1972, Humphrey 1974, McLaughlin and Bowers 1982, Gibbens et al. 1983, Hennessy et al. 1983, Schlesinger et al. 1990, McPherson 1995).

Prosopis and other shrubs have extensive root systems that allow them to exploit deep soil water that is unavailable to shallower rooted grasses and cacti (Burgess 1995). This strategy works well except on sites that have well-developed argillic or calcic soil horizons that limit infiltration and storage of winter moisture in the deeper soil layers (McAuliffe 1995). McAuliffe found *Prosopis velutina* invasion on these sites limited to a few, small individuals. This has implications in plant geography and grassland revegetation work in the southwestern U.S.

DISTRIBUTION

Geographic Range: This upland ruderal thornscrub alliance is found on foothills and piedmonts in the Sky Island region of southern Arizona and adjacent Mexico extending north into the lower Mogollon Rim foothills. Stands may occur in extreme southwestern New Mexico.

Nations: MX, US

States/Provinces: AZ, CA, NM?

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- >< Mesquite Series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS

Associations:

- CEG001388 *Prosopis velutina* - *Acacia greggii* Ruderal Shrubland
- CEG001391 *Prosopis velutina* / *Muhlenbergia porteri* Ruderal Shrubland
- CEG005345 *Prosopis velutina* / *Calliandra eriophylla* Ruderal Shrubland
- CEG005346 *Prosopis velutina* / *Mimosa dysocarpa* Ruderal Shrubland
- CEG005343 *Prosopis velutina* / *Eragrostis lehmanniana* Ruderal Shrubland
- CEG005344 *Prosopis velutina* / *Atriplex canescens* / Mixed Grasses Ruderal Shrubland
- CEG005348 *Prosopis velutina* / Mixed Grasses Ruderal Shrubland
- CEG005347 *Prosopis velutina* Ruderal Foothill Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2015/12/21

REFERENCES

References: Anderson et al. 1985, Barbour and Major 1977, Bourgeron et al. 1993b, Bourgeron et al. 1995a, Brown 1982a, Buffington and Herbel 1965, Burgess 1995, Campbell and Green 1968, Dick-Peddie 1993, Donart et al. 1978a, Faber-Langendoen et

al. 2017b, Gibbens et al. 1983, Hennessy et al. 1983, Herbel et al. 1972, Humphrey 1974, McAuliffe 1995, McLaughlin and Asdall 1980, McLaughlin and Bowers 1982, McPherson 1995, Muldavin and Mehlhop 1992, Muldavin et al. 2000b, Rzedowski 1981, Sawyer and Keeler-Wolf 1995, Schlesinger et al. 1990, Smith and Douglas 1989, Stromberg 1995a, Warren et al. 1987, Warren et al. 1992, Whitfield and Anderson 1938, Willis 1939, York and Dick-Peddie 1969

3.B. Cool Semi-Desert Scrub & Grassland

Cool Semi-Desert Scrub & Grassland occurs in dry, cool-temperate climates, at mid-latitudes (35° to 50°N), typically in the interior of continents, and varies from low shrublands to very open grassland and shrub-steppe, including open rocky or sandy semi-desert vegetation.

3.B.1. Cool Semi-Desert Scrub & Grassland

Cool Semi-Desert Scrub & Grassland occurs in dry, cool-temperate climates, at mid-latitudes (35° to 50°N), typically in the interior of continents.

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

This division encompasses all upland shrub and grassland vegetation within the Western North American Cool Semi-desert region, from south-central Alberta through the Great Basin and western margins of the Great Plains to New Mexico, westward to dry-interior southern British Columbia and south through eastern Oregon and interior California, into the mountains of northwestern Baja California, Mexico. It includes extensive shrublands dominated by *Artemisia tridentata*, ranging from mid to upper slopes and deep to shallow soils, and extensive *Atriplex* shrublands.

M171. Great Basin-Intermountain Dry Shrubland & Grassland

This diverse semi-arid macrogroup is found throughout the Intermountain West, including mid-elevation sites in eastern and central Mojave Desert, the Great Basin, Colorado Plateau, Columbia Plateau, and lower elevation sites in the central Rocky Mountains extending east across Wyoming Basins into the western Great Plains. It can occur as open shrubland, dwarf-shrub, shrub herbaceous, or grassland communities. Characteristic species include shrubs *Chrysothamnus viscidiflorus*, *Coleogyne ramosissima*, *Ephedra* spp., *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, and dry grasses such as *Achnatherum hymenoides*, *Achnatherum lettermanii*, *Aristida purpurea*, *Bouteloua gracilis*, *Hesperostipa comata*, *Leymus salinus* ssp. *salinus*, *Muhlenbergia pungens*, *Pleuraphis jamesii*, *Poa fendleriana*, *Poa secunda*, *Pseudoroegneria spicata*, *Sporobolus cryptandrus*, and *Sporobolus airoides*.

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

3.B.1.Ne.1.a. M171 Great Basin-Intermountain Dry Shrubland & Grassland

G296. Mojave Mid-Elevation Mixed Desert Scrub

Type Concept Sentence: This group represents the extensive desert scrub in the transition zone above *Larrea tridentata* - *Ambrosia dumosa* desert scrub and below the lower montane woodlands (at mid-elevations of 700-1800 m) that occurs in the eastern and central Mojave Desert and transition zone into the southern Great Basin. Stands are dominated by a variety characteristic species such as *Coleogyne ramosissima*, *Ericameria cooperi*, *Eriogonum fasciculatum*, *Ephedra* spp., *Eriogonum corymbosum*, *Grayia spinosa*, *Lycium andersonii*, *Menodora spinescens*, *Nolina* spp., *Cylindropuntia acanthocarpa*, *Purshia glandulosa*, *Purshia stansburiana*, *Salazaria mexicana*, *Thamnosma montana*, *Yucca brevifolia*, or *Yucca schidigera*.

OVERVIEW

Scientific Name: *Yucca brevifolia* - *Eriogonum fasciculatum* - *Ephedra aspera* Mixed Desert Scrub Group

Common Name (Translated Scientific Name): Joshua Tree - Eastern Mojave Buckwheat - Rough Joint-fir Mixed Desert Scrub Group

Colloquial Name: Fremont's Chaffbush - Woolly Sage Scrub

Type Concept: This group represents the extensive desert scrub in the transition zone above *Larrea tridentata* - *Ambrosia dumosa* desert scrub and below the lower montane woodlands at mid-elevations in the eastern and central Mojave Desert. It is also common on lower piedmont slopes in the transition zone into the southern Great Basin. The vegetation in this group is quite variable. *Larrea tridentata* may be absent or present to codominant in some examples, but typically does not dominate. Characteristic and dominant species include *Ambrosia eriocentra*, *Arctostaphylos patula*, *Coleogyne ramosissima*, *Ericameria cooperi*, *Eriogonum fasciculatum*, *Ephedra californica*, *Ephedra nevadensis*, *Ephedra torreyana*, *Ephedra viridis*, *Eriogonum corymbosum*, *Grayia spinosa*, *Lycium andersonii*, *Menodora spinescens*, *Nolina bigelovii*, *Nolina microcarpa*, *Nolina parryi*, *Cylindropuntia acanthocarpa* (= *Opuntia*

acanthocarpa), *Purshia glandulosa*, *Purshia stansburiana*, *Salazaria mexicana*, *Thamnosma montana*, *Viguiera parishii*, *Yucca brevifolia*, or *Yucca schidigera*. Less common are stands with scattered *Yucca brevifolia* and a saltbush short-shrub layer dominated by *Atriplex canescens*, *Atriplex confertifolia*, or *Artemisia tridentata*. In some areas in the western Mojave, shrubby *Juniperus californica* is common with the yuccas. *Grayia spinosa* is a common codominant shrub in disturbed stands. Desert grasses, including *Achnatherum hymenoides*, *Achnatherum speciosum*, *Muhlenbergia porteri*, *Pleuraphis jamesii*, *Pleuraphis rigida*, *Poa secunda*, or *Pseudoroegneria spicata*, may form an herbaceous layer. Scattered *Juniperus osteosperma* or warm desert scrub species may also be present. This shrubland group is found in the Mojave Desert of southeastern California and southern Nevada and forms a cool-temperate elevational belt on desert ranges (700-1800 m) elevation. It also occurs at the longitudinal transition zone between the Mojave and southern Great Basin, generally at mid-elevations. Landforms include valleys, bajadas, mountain slopes, ridges, mesas or alluvial fans bordering intermountain basins. The climate is semi-arid and characterized by hot, dry summers and cold winters with precipitation ranging from 5-30 cm annually. Temperatures are continental, with large annual and diurnal ranges. Soils are highly variable across the large range of this vegetation type and are generally shallow, well-drained, coarse-textured loams or sand with rock fragments, but include finer-textured substrates such as silt.

Classification Comments: Diagnostics needs to be rewritten to solidify how this group differs from Colorado Plateau Blackbrush - Mormon-tea Shrubland Group (G312) (T. Keeler-Wolf pers. comm. 2013). TKW recommends the following species be removed from diagnostics: *Coleogyne ramosissima*, *Peucephyllum schottii*. Former Sonoran Mid-elevation Desert Scrub Group (G291) was merged into this group. TKW recommends moving *Chrysothamnus albidus* / *Puccinellia nuttalliana* Shrubland (CEGL001328) to an "alkali" group, perhaps G537 or G672. Colloquial name of the group changed per TKW recommendation, from Mojave Mid-Elevation Mixed Desert Scrub Group to Mojavean-Sonoran Rocky Upland Desert Scrub Group. Also, need to revisit placement of the *Grayia spinosa* associations; *Grayia* alliance is generally considered in this group in California, but may belong in a Great Basin group (cold desert) in Nevada Idaho, Utah, and elsewhere in Great Basin (T. Keeler-Wolf pers. comm. 2013).

Similar NVC Types:

- G312 Colorado Plateau Blackbrush - Mormon-tea Shrubland: shares several dominant species such as *Coleogyne ramosissima* and species of *Ephedra*.

Diagnostic Characteristics: The presence of *Eriogonum fasciculatum*, *Ephedra aspera*, *Yucca brevifolia*, or *Yucca schidigera* is diagnostic of this type, as is *Coleogyne ramosissima*, which is often a dominant species. The widespread desert shrub *Larrea tridentata* may be absent or present to codominant in some stands, but typically does not dominate here as it does at lower elevations. This is a diverse group, and stands may also be dominated or codominated by *Ambrosia eriocentra*, *Ericameria cooperi*, *Ephedra californica*, *Ephedra nevadensis*, *Ephedra torreyana*, *Ephedra viridis*, *Grayia spinosa*, *Lycium andersonii*, *Juniperus californica*, *Menodora spinescens*, *Nolina bigelovii*, *Nolina microcarpa*, *Nolina parryi*, *Cylindropuntia acanthocarpa*, *Purshia glandulosa*, *Purshia stansburiana*, and *Salazaria mexicana*.

VEGETATION

Physiognomy and Structure: This group is an extremely xeromorphic evergreen shrubland sometimes with a sparse tree layer of evergreen sclerophyllous trees. The herbaceous layer is generally sparse, but may have significant perennial grass cover.

Floristics: The vegetation in this group is quite variable. *Larrea tridentata* may be absent or present to codominant in some stands, but typically does not dominate. Characteristic and dominant species include *Ambrosia eriocentra*, *Arctostaphylos patula*, *Coleogyne ramosissima*, *Ericameria cooperi*, *Eriogonum fasciculatum*, *Ephedra californica*, *Ephedra nevadensis*, *Ephedra torreyana*, *Ephedra viridis*, *Eriogonum corymbosum*, *Grayia spinosa*, *Lycium andersonii*, *Menodora spinescens*, *Nolina bigelovii*, *Nolina microcarpa*, *Nolina parryi*, *Cylindropuntia acanthocarpa* (= *Opuntia acanthocarpa*), *Purshia glandulosa*, *Purshia stansburiana*, *Salazaria mexicana*, *Thamnosma montana*, *Viguiera parishii*, *Yucca brevifolia*, or *Yucca schidigera*. Less common are stands with scattered *Yucca brevifolia* and a saltbush short-shrub layer dominated by *Atriplex canescens*, *Atriplex confertifolia*, or *Artemisia tridentata*. In some areas in the western Mojave, shrubby *Juniperus californica* is common with the yuccas. *Grayia spinosa* is a common codominant shrub in disturbed stands. Desert grasses, including *Achnatherum hymenoides*, *Achnatherum speciosum*, *Muhlenbergia porteri*, *Pleuraphis jamesii*, *Pleuraphis rigida*, *Poa secunda*, *Pseudoroegneria spicata*, or *Sporobolus cryptandrus*, may form an herbaceous layer. Scattered *Juniperus osteosperma* or warm desert scrub species may also be present.

ENVIRONMENT & DYNAMICS

Environmental Description: This shrubland group is found in the Mojave Desert of southeastern California and southern Nevada and forms a cool-temperate elevational belt on desert ranges. It also occurs at the longitudinal transition zone between the Mojave and southern Great Basin at mid-elevation (800-1800 m) (Sawyer et al. 2009). Landforms include valleys, bajadas, mountain slopes, ridges, mesas or alluvial fans bordering intermountain basins. Some authors regard this group as delimiting the upper elevational boundary of the Mojave Desert in the transition between the Mojave and Great Basin deserts (Mozingo 1987). Full elevation ranges from 50-2500 m, with stands regularly occurring above 900 m. The climate is semi-arid and characterized by hot, dry summers and

cold winters with precipitation ranging from 5-30 cm annually. Winter precipitation dominates in the western portions, with summer rain becoming more important eastward. Year-to-year precipitation variability can be quite large. Temperatures are continental, with large annual and diurnal ranges. Soils are highly variable across the large range of this vegetation type and are generally shallow, well-drained, coarse-textured loams or sand with rock fragments, but include finer-textured substrates such as silt. Soils are derived from bedrock or alluvial deposits from granitic and sedimentary rocks (Keeler-Wolf and Thomas 2000, Thomas et al. 2004, Sawyer et al. 2009). These communities are more drought-tolerant than *Artemisia tridentata*-dominated communities of the Great Basin but less tolerant of drought than either *Larrea tridentata* or *Atriplex* spp. shrublands. Adjacent vegetation is typically *Artemisia* shrublands at the upper elevational margin and *Larrea tridentata* or *Atriplex* - *Sarcobatus* shrublands where these communities grade into lower-elevation deserts or heavy alkaline soils.

Dynamics:

DISTRIBUTION

Geographic Range: This desert scrub group is found in the eastern and central Mojave Desert and on lower piedmont slopes in the transition zone into the southern Great Basin.

Spatial Scale & Pattern [optional]: Large patch

Nations: MX?, US

States/Provinces: AZ, CA, NV, UT

TNC Ecoregions [optional]: 11:C, 12:P, 17:C, 23:P

USFS Ecoregions (2007): 313A:CC, 322A:CC, 322B:CC, 322C:CC, 341D:CP, 341E:C?, 341F:CC, 342B:PP, M261E:CC, M341A:CC, M341D:C?

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > Mohave Desertscrub, Blackbrush Series - 153.12 (Brown et al. 1979)
- > Mohave Desertscrub, Blackbrush Series, Blackbrush Series, *Coleogyne ramosissima*-*Yucca* spp. Association - 153.122 (Brown et al. 1979)
- > Mohave Desertscrub, Blackbrush Series, Blackbrush Series, *Coleogyne ramosissima* Association - 153.121 (Brown, et al. 1979) (Brown et al. 1979)
- > Mohave Desertscrub, Bladdersage Series - 153.14 (Brown et al. 1979)
- > Mohave Desertscrub, Bladdersage Series, *Salazaria mexicana* Association - 153.141 (Brown et al. 1979)
- > Mohave Desertscrub, Joshuatree Series - 153.15 (Brown et al. 1979)
- > Mohave Desertscrub, Joshuatree Series, *Yucca brevifolia*-*Acamptopappus sphaerocephalus*-*Larrea divaricata*-Mixed Scrub Association - 153.151 (Brown et al. 1979)
- > Mohave Desertscrub, Joshuatree Series, *Yucca brevifolia*-*Coleogyne ramosissima* Association - 153.152 (Brown et al. 1979)
- > Mohave Desertscrub, Joshuatree Series, *Yucca brevifolia*-*Larrea divaricata* Association - 153.153 (Brown et al. 1979)

LOWER LEVEL UNITS

Alliances:

- A3139 *Ephedra aspera* Scrub Alliance
- A4167 *Eriogonum wrightii* - *Eriogonum heermannii* - *Buddleja utahensis* Scrub Alliance
- A4156 *Cylindropuntia acanthocarpa* / *Pleuraphis rigida* Scrub Alliance
- A4157 *Ephedra funerea* Scrub Alliance
- A3150 *Eriogonum fasciculatum* - *Viguiera parishii* Desert Scrub Alliance
- A4159 *Amphipappus fremontii* - *Salvia funerea* Scrub Alliance
- A3148 *Yucca brevifolia* Wooded Scrub Alliance
- A3144 *Coleogyne ramosissima* Mojave Desert Scrub Alliance
- A0502 *Juniperus californica* Mojave Scrub Alliance
- A3147 *Yucca schidigera* Scrub Alliance
- A4245 *Ephedra nevadensis* - *Lycium andersonii* - *Grayia spinosa* Scrub Alliance
- A3145 *Nolina parryi* - *Nolina microcarpa* Scrub Alliance
- A2515 *Menodora spinescens* Scrub Alliance
- A0833 *Purshia stansburiana* Scrub Alliance
- A4158 *Mortonia utahensis* Scrub Alliance

AUTHORSHIP

Primary Concept Source: D.E. Brown, C.H. Lowe, and C.P. Pase (1979)

Author of Description: K.A. Schulz, M.S. Reid and T. Keeler-Wolf

Acknowledgments: T. Keeler-Wolf

Version Date: 11/06/2015

Classif Resp Region: West

Internal Author: KAS 3-10, 4-15, 11-15, mod. MSR/TKW 10-13

REFERENCES

References: Barbour and Major 1988, Beatley 1976, Brown 1982a, Brown et al. 1979, Faber-Langendoen et al. 2017a, Holland and Keil 1995, Keeler-Wolf 2007, Keeler-Wolf and Thomas 2000, MacMahon 1988, Mozingo 1987, Ostler et al. 2000, Peinado et al. 1995c, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994, Thomas et al. 2004

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G296. Mojave Mid-Elevation Mixed Desert Scrub

A4159. Amphipappus fremontii - Salvia funerea Scrub Alliance [Low - Poorly Documented]

Type Concept Sentence: This alliance forms a sparse to open shrub layer of *Amphipappus fremontii* and/or *Salvia funerea*; others that are often present include *Ambrosia dumosa*, *Atriplex confertifolia*, *Echinocactus polycephalus*, and *Lepidium fremontii*. The alliance is currently known from Death Valley National Monument in California where it occurs on alluvial fan toeslopes to summits on all aspects.

OVERVIEW

Scientific Name: *Amphipappus fremontii* - *Salvia funerea* Scrub Alliance

Common Name (Translated Scientific Name): Fremont's Chaffbush - Woolly Sage Scrub Alliance

Colloquial Name: Fremont's Chaffbush - Woolly Sage Scrub

Type Concept: This alliance forms a sparse to open shrub layer. The emergent tree layer is typically sparse, and the herbaceous layer is sparse to open. Characteristic shrubs are *Amphipappus fremontii* and/or *Salvia funerea*; others that are often present include *Ambrosia dumosa*, *Atriplex confertifolia*, *Echinocactus polycephalus*, and *Lepidium fremontii*. *Eriogonum inflatum* is an herb that is often present. Commonly associated nonvascular plants include cryptogamic crust and unknown moss. The alliance is currently known from Death Valley National Monument in California where it occurs on alluvial fan toeslopes to summits on all aspects. Elevations range from approximately 700 to 1550 m. Soils are derived from a variety of substrates, and textures range from sand to silty clay.

Classification Comments: Stands with *Amphipappus fremontii* and/or *Salvia funerea* dominant or codominant are found in both the Great Basin and Mojave Desert. Mojave Mid-Elevation Mixed Desert Scrub Group (G296) has been tentatively assigned to this alliance because of where the surveys clustered in the classification analysis (Evens et al. 2014), though Intermountain Semi-Desert Steppe & Shrubland Group (G310) could also be considered.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: This alliance is characterized by a sparse to open shrub layer with *Amphipappus fremontii* and/or *Salvia funerea* dominant or codominant. The overall shrub cover ranges from 0.7 to 19%.

VEGETATION

Physiognomy and Structure:

Floristics: The alliance forms a sparse to open shrub layer with *Amphipappus fremontii* and/or *Salvia funerea* dominant or codominant, and the overall shrub cover ranges from 0.7 to 19%. The tree layer is typically sparse, and the herb layer is sparse to open. Nonvascular plants are typically sparse. The characteristic shrubs are *Amphipappus fremontii* and/or *Salvia funerea*; others that are often present include *Ambrosia dumosa*, *Atriplex confertifolia*, *Echinocactus polycephalus*, and *Lepidium fremontii*. *Eriogonum inflatum* is an herb that is often present. Commonly associated nonvascular plants include cryptogamic crust and unknown moss.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance occurs at mid to high elevations (approximately 700-1550 m) from toeslopes to summits at all aspects. It primarily occurs on shallow rocky soils with exposed bedrock. Soil textures are variable and are derived from a variety of substrates.

Dynamics: Both *Amphipappus fremontii* and *Salvia funerea* prefer rocky sites, and they are often found on harsher, calcareous parent materials.

DISTRIBUTION

Geographic Range: The alliance was sampled in California in Death Valley National Monument at mid to upper elevations. It occurs in Eureka Valley, Joshua Flat, Cottonwood, Funeral, Grapevine, and Panamint mountains and in the Last Chance Range.

Nations: US

States/Provinces: CA

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007): 322Ad:CCC, 341Fc:CCC, 341Fd:CCC, 341Ff:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

- = *Amphipappus fremontii*-*Salvia funerea* Shrubland Alliance (Evens et al. 2014)

LOWER LEVEL UNITS

Associations:

- CEPP005791 *Amphipappus fremontii* (Limestone) Shrubland
- CEPP006754 *Salvia funerea* Shrubland

AUTHORSHIP

Primary Concept Source: J.M. Evens, K. Sikes, D. Hastings, and J. Ratchford (2014)

Author of Description: J. Evens

Acknowledgments:

Version Date: 2015/01/23

REFERENCES

References: Evens et al. 2014, Faber-Langendoen et al. 2017b, Keeler-Wolf and Thomas 2000

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G296. Mojave Mid-Elevation Mixed Desert Scrub

A3144. Coleogyne ramosissima Mojave Desert Scrub Alliance

Type Concept Sentence: Xeromorphic vegetation characterized by shrublands dominated by *Coleogyne ramosissima* or codominant with other shrubs within the Mojave Desert.

OVERVIEW

Scientific Name: *Coleogyne ramosissima* Mojave Desert Scrub Alliance

Common Name (Translated Scientific Name): Blackbrush Mojave Desert Scrub Alliance

Colloquial Name: Mojave Blackbrush Desert Scrub

Type Concept: These communities are characterized by a sparse to moderately dense shrub layer of *Coleogyne ramosissima*. Associated species include *Ambrosia* spp., *Encelia resinifera*, *Eriogonum fasciculatum*, *Ephedra nevadensis*, *Menodora spinescens*, *Grayia spinosa*, *Larrea tridentata*, *Purshia stansburiana*, and *Thamnosma montana*. Occasionally, scattered individuals of *Yucca brevifolia* may be emergent through the shrub layer. Scattered *Juniperus osteosperma* or *Pinus monophylla* trees are present in some stands. The herbaceous layer is typically sparse with perennial grasses and forbs commonly present. This shrubland alliance occurs in the Mojave Desert of southeastern California and southern Nevada and forms an elevational belt on desert ranges and an latitudinal belt in the transition zone with the southern Great Basin. Stands occur at elevations of 850-1600 m, usually on mountain slopes, mesas or alluvial fans bordering intermountain basins. Soils are highly variable across the large range of this vegetation type and are generally coarse-textured and well-drained, but include finer-textured substrates as well.

Classification Comments: The analogous *Coleogyne ramosissima* Colorado Plateau Shrubland Alliance (A3220) in Colorado Plateau Blackbrush - Mormon-tea Shrubland Group (G312) has a similar concept. Further review may result in the merger of these two alliances.

Internal Comments:

Other Comments:

Similar NVC Types:

- A3220 *Coleogyne ramosissima* Colorado Plateau Shrubland Alliance: is similar but is placed in Colorado Plateau Blackbrush - Mormon-tea Shrubland (G312).

Diagnostic Characteristics: Shrublands dominated or codominated by *Coleogyne ramosissima* with associated flora characteristic of the Mojave Desert.

VEGETATION

Physiognomy and Structure: The vegetation in this alliance is characterized by somewhat low to moderate cover (15-40%) of cold-deciduous or evergreen shrubs. The herbaceous layer is typically sparse (<20% cover) and dominated by caespitose perennial grasses or annual forbs and grasses. Scattered trees may form a sparse (0-10%) emergent layer in some stands, especially at the upper elevational margin and in the southwestern part of the range.

Floristics: These communities are characterized by a sparse to moderately dense shrub layer of *Coleogyne ramosissima*. Although *Coleogyne* is apparently restricted to a particular elevational zone, associated shrub species can be of either Mojavean or Great Basin affinities. Associated species include *Ambrosia dumosa*, *Atriplex confertifolia*, *Atriplex canescens*, *Encelia resinifera*, *Eriogonum fasciculatum*, *Ephedra nevadensis*, *Menodora spinescens*, *Picrothamnus desertorum* (= *Artemisia spinescens*), *Grayia spinosa*, *Larrea tridentata*, *Purshia stansburiana* and *Thamnosma montana*. Occasionally, scattered individuals of *Yucca brevifolia* may be emergent through the shrub layer. Occasional *Juniperus osteosperma* or *Pinus edulis* trees are present in some stands. The herbaceous layer in these southern (and more xeric) stands is typically sparse with *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Achnatherum speciosum* (= *Stipa speciosa*), *Eriogonum* spp., *Dichelostemma capitatum*, *Glandularia gooddingii*, *Pleuraphis jamesii* (= *Hilaria jamesii*), *Navarretia* spp., *Sphaeralcea ambigua*, and *Tridens muticus* being commonly associated species. Exotic annual grasses *Bromus rubens* and *Bromus tectorum* are common in disturbed stands.

ENVIRONMENT & DYNAMICS

Environmental Description: This shrubland alliance is found in the Mojave Desert of southeastern California and southern Nevada and forms an elevational belt on desert ranges. It also occurs at the longitudinal transition zone between the Mojave and southern Great Basin at elevations of 850-1600 m, usually on mountain slopes, mesas or alluvial fans bordering intermountain basins. Some authors regard these shrublands as delimiting the upper elevational boundary of the Mojave Desert in the transition between the Mojave and Great Basin deserts (Mozingo 1987). The climate is arid to semi-arid with precipitation ranging from 15-30 cm annually. Winter precipitation dominates in the western portions, with summer rain becoming more important eastward. Temperatures are continental, with large annual and diurnal ranges. Soils are highly variable across the large range of this vegetation type and are generally coarse-textured and well-drained, but include finer-textured substrates as well. These communities are more drought-tolerant than *Artemisia tridentata*-dominated communities of the Great Basin but less tolerant of drought than either *Larrea tridentata* or *Atriplex* spp. shrublands. Adjacent vegetation is typically *Artemisia* shrublands at the upper elevational margin and *Larrea tridentata* or *Atriplex* - *Sarcobatus* shrublands where these communities grade into lower-elevation deserts or heavy alkaline soils.

Dynamics: These shrubland communities have greater cover than most other shrub communities in the Mojave and Great Basin deserts. They are generally of low value for livestock, but form an important element of winter range for desert bighorn sheep (*Ovis canadensis nelsoni*). Following fire, these communities are often colonized by non-native annual grasses, which serve to encourage recurrent fires and delay shrub regeneration.

DISTRIBUTION

Geographic Range: This shrubland alliance occurs in the Mojave Desert of southeastern California and southern Nevada and forms an elevational belt on desert ranges and an latitudinal belt in the transition zone with the southern Great Basin.

Nations: US

States/Provinces: AZ, CA, NV

TNC Ecoregions [optional]: 11:C, 12:C, 16:C, 17:C

USFS Ecoregions (2007): 322Ad:CCC, 322Af:CCC, 322Ai:CCC, 322Aj:CCC, 322Ak:CCC, 322Al:CCC, 322Am:CCC, 322At:CCC, 322Av:CCC, 341D:CC, 341Fb:CCC, 341Fc:CCC, 341Ff:CCC, M261E:CC, M262A:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Joshua Tree, Lake Mead, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Coleogyne ramosissima* (Black brush scrub) Alliance (Sawyer et al. 2009) [33.020.00]
- = *Coleogyne ramosissima* Shrubland Alliance (Evens et al. 2014)
- = *Coleogyne ramosissima* Shrubland Alliance (Evens et al. 2012)
- = *Coleogyne ramosissima* Shrubland Alliance (CNPS 2017) [33.020.00]
- ? Blackbush Series (Sawyer and Keeler-Wolf 1995) [possibly equivalent]
- = Blackbush Series (Brown et al. 1979)

LOWER LEVEL UNITS

Associations:

- CEGLO01259 *Eriogonum fasciculatum* - *Purshia glandulosa* Shrubland
- CEGLO01260 *Eriogonum fasciculatum* Rock Outcrop Shrubland
- CEGLO02718 *Coleogyne ramosissima* - *Thamnosma montana* Shrubland
- CEGLO02720 *Coleogyne ramosissima* - *Purshia stansburiana* Shrubland
- CEPP005999 *Coleogyne ramosissima* - *Ericameria teretifolia* Mojave Desert Shrubland
- CEGLO05297 *Coleogyne ramosissima* - *Ephedra* spp. Warm Desert Shrubland
- CEGLO05080 *Ambrosia eriocentra* - (*Coleogyne ramosissima*) Dwarf-shrubland
- CEGLO05746 *Coleogyne ramosissima* - *Lycium andersonii* Mojave Desert Shrubland
- CEGLO01333 *Coleogyne ramosissima* - *Eriogonum fasciculatum* Shrubland

AUTHORSHIP

Primary Concept Source: D.E. Brown, C.H. Lowe and C.P. Pase (1979)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Annable 1985, Armstrong 1969, BIA 1979, Barbour and Major 1977, Beatley 1976, Bowns and West 1976, Bradley 1964, Brown et al. 1979, CNPS 2017, Callison et al. 1985, Evens et al. 2012, Evens et al. 2014, Faber-Langendoen et al. 2017b, Harper and Jaynes 1986, Keeler-Wolf and Thomas 2000, Keeler-Wolf et al. 1998a, Loope and West 1979, Mozingo 1987, Paysen et al. 1980, Peterson 1984a, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shields et al. 1959, Shiflet 1994, Spolsky 1979, Stebbins and Major 1965, Thomas et al. 2004, Tuhy and MacMahon 1988, VegCAMP and AIS 2013, Warren et al. 1982, West 1983d, West et al. 1972

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G296. Mojave Mid-Elevation Mixed Desert Scrub

A4156. *Cylindropuntia acanthocarpa* / *Pleuraphis rigida* Scrub Alliance [Low - Poorly Documented]

Type Concept Sentence: This alliance forms an open to intermittent shrub layer in which *Cylindropuntia acanthocarpa* is a characteristic shrub and is dominant or codominant. The alliance is currently known from desert areas of California and Nevada, where it occurs on low to high slopes with east to southwest aspects.

OVERVIEW

Scientific Name: *Cylindropuntia acanthocarpa* / *Pleuraphis rigida* Scrub Alliance

Common Name (Translated Scientific Name): Buckhorn Cholla / Big Galleta Scrub Alliance

Colloquial Name: Buckhorn Cholla Scrub

Type Concept: This alliance forms an open to intermittent shrub layer. The emergent tree layer is typically sparse, and the herbaceous layer is open. *Cylindropuntia acanthocarpa* is a characteristic shrub and is dominant or codominant. Other characteristic shrubs include *Echinocereus engelmannii*, *Ephedra nevadensis*, *Ferocactus cylindraceus*, and *Krameria erecta*. Shrubs that are often present include *Ambrosia dumosa*, *Encelia farinosa*, *Larrea tridentata*, *Viguiera parishii*, and *Yucca schidigera*. Herbs that are often present include *Bromus rubens*, *Eriogonum inflatum*, *Erodium cicutarium*, *Pleuraphis rigida*, *Porophyllum gracile*, and *Sphaeralcea ambigua*. The alliance is currently known from California at Mojave National Preserve and Lake Mead National Recreation Area, Nevada, where it occurs on low to high slopes with east to southwest aspects. Elevations range from approximately 650 to 1450 m. Soils are rocky and derived from a variety of substrates and textures ranging from fine sand to clay loam.

Classification Comments:

Internal Comments: MSR 1-15: this is likely to represent an association within one of the other alliances in G296, such as the *Larrea tridentata* - *Ambrosia dumosa* alliance or the *Yucca schidigera* alliance. More plot data will help to clarify this relationship.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: This alliance is characterized by an open to intermittent shrub layer with *Cylindropuntia acanthocarpa* dominant or codominant. The overall shrub cover ranges from 11 to 35%.

VEGETATION

Physiognomy and Structure:

Floristics: The alliance forms an open to intermittent shrub layer and the overall shrub cover ranges from 11 to 35%. The tree layer is typically sparse, and the herb layer is sparse to open. Nonvascular plants are typically sparse. *Cylindropuntia acanthocarpa* is a characteristic and dominant to codominant shrub. Other characteristic shrubs include *Echinocereus engelmannii*, *Ephedra nevadensis*, *Ferocactus cylindraceus*, and *Krameria erecta*. Shrubs that are often present include *Ambrosia dumosa*, *Encelia farinosa*, *Larrea tridentata*, *Viguiera parishii*, and *Yucca schidigera*. Herbs that are often present include *Bromus rubens*, *Eriogonum inflatum*, *Erodium cicutarium*, *Pleuraphis rigida*, *Porophyllum gracile*, and *Sphaeralcea ambigua*.

ENVIRONMENT & DYNAMICS

Environmental Description: The alliance occurs at mid to high elevations (approximately 650-1450 m) on low to high slopes with east to southwest aspects. Soils are rocky and range from sand to clay loam derived from a variety of substrates.

Dynamics: *Cylindropuntia acanthocarpa* occurs in a fine-scale matrix with other mid-elevation shrubland types in the Mojave Desert where soils are shallow and sites are exposed and rocky.

DISTRIBUTION

Geographic Range: The alliance was sampled in California at Mojave National Preserve in Fenner and Lanfair Valley, in the Ivanpah and Providence mountains, and in the Paiute Range. It also occurs at Temple Bar in Lake Mead National Recreation Area, Nevada.

Nations: US

States/Provinces: AZ, CA, NV

TNC Ecoregions [optional]: 17:C

USFS Ecoregions (2007): 322Aj:CCC, 322Al:CCC, 322Av:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Lake Mead, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

- = *Cylindropuntia acanthocarpa* Shrubland Alliance (Evens et al. 2014)

LOWER LEVEL UNITS

Associations:

- CEPP006733 *Pleuraphis rigida* / (*Acamptopappus sphaerocephalus*, *Ericameria cooperi*) Shrubland
- CEPP006729 *Cylindropuntia acanthocarpa* var. *coloradensis* Shrubland

AUTHORSHIP

Primary Concept Source: J.M. Evens, K. Sikes, D. Hastings, and J. Ratchford (2014)

Author of Description: J. Evens

Acknowledgments:

Version Date: 2015/01/22

REFERENCES

References: Evens et al. 2014, Faber-Langendoen et al. 2017b, Keeler-Wolf et al. 1998a

3. Desert & Semi-Desert
3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland
G296. Mojave Mid-Elevation Mixed Desert Scrub

A3139. *Ephedra aspera* Scrub Alliance

Type Concept Sentence: These sparse semi-desert shrublands are dominated by a short-shrub layer of *Ephedra aspera* often with an herbaceous layer consisting of mixed grasses. They occur in Grand Canyon National Park in Arizona south to the Sonoran Desert.

OVERVIEW

Scientific Name: *Ephedra aspera* Scrub Alliance

Common Name (Translated Scientific Name): Rough Joint-fir Scrub Alliance

Colloquial Name: Arizona Joint-fir Scrub

Type Concept: Vegetation in this shrubland alliance is characterized by a sparse to moderate cover of xeromorphic short shrubs and sparse to moderately dense herbaceous cover. The shrub layer is dominated by *Ephedra aspera* (= *Ephedra fasciculata*) often with *Encelia farinosa* and *Gutierrezia sarothrae* and less commonly with *Acacia greggii*, *Bernardia myricifolia*, and *Ferocactus cylindraceus*. The sparse to moderately dense understory is dominated by graminoids such as *Muhlenbergia porteri*, *Pleuraphis jamesii*, *Achnatherum speciosum*, *Aristida purpurea*, *Dasyochloa pulchella*, and annual *Vulpia octoflora*. *Acourtia wrightii*, *Artemisia ludoviciana*, *Galium stellatum*, *Machaeranthera pinnatifida*, and *Sphaeralcea grossulariifolia* are common forbs. Exotic species such as *Erodium cicutarium* and *Bromus rubens* occur in many stands. This semi-arid shrubland alliance occurs in Arizona in the Grand Canyon National Park and likely in the Sonoran Desert. Stands most typically occur on sideslopes at 600 to 1100 m elevation, but can be found as high as 1650 m, or rarely in drainages and valley bottoms at 675 to 950 m. It is primarily found on moderate to steep (15-40°), north- to east-facing slopes, but also occasionally occurs on gentler slopes (8-15°). Soils are well- to rapidly-drained silty or sandy loams that occasionally contain clay. The soils typically obscure various underlying bedrock types. The diagnostic and dominant species *Ephedra aspera* occurs in the Sonoran, Colorado, and Chihuahuan deserts, but the alliance has not been reported from there. Additional survey and classification work are needed to fully characterize this alliance across its full range.

Classification Comments: This alliance concept was split from the former *Ephedra (fasciculata, nevadensis)* Shrubland Alliance (A.857). *Ephedra fasciculata* is being considered as its own alliance now under the currently accepted name of *Ephedra aspera* Engelm. ex S. Watson, which according to USDA Plants includes *Ephedra clokeyi* Cutler, *Ephedra fasciculata* A. Nelson, *Ephedra nevadensis* S. Watson var. *aspera* (Engelm. ex S. Watson) L.D. Benson, and *Ephedra reedii* Cory (USDA NRCS 2014). *Ephedra aspera* occurs on dry rocky slopes, ravines, and fans at 500-1800 m in Arizona, southern California, southern New Mexico, west Texas; and northern Mexico in the Sonoran, Colorado and Chihuahuan deserts (FNA Editorial Committee 1993). The related shrub *Ephedra nevadensis* is prominent in the Mojave Desert and Great Basin.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Diagnostic of this shrubland alliance is total vegetation cover over 25% that is dominated by *Ephedra aspera*.

VEGETATION

Physiognomy and Structure: Stands in this shrubland alliance are dominated by sparse to moderate cover of xeromorphic evergreen, microphyllous and broad-leaved shrubs.

Floristics: Vegetation in this shrubland alliance is characterized by a sparse to moderate cover of xeromorphic short shrubs and sparse to moderately dense herbaceous cover. The shrub layer is dominated by *Ephedra aspera* (= *Ephedra fasciculata*) often with *Encelia farinosa* and *Gutierrezia sarothrae* and less commonly with *Acacia greggii*, *Bernardia myricifolia*, and *Ferocactus cylindraceus* (Reid and Hall 2010). The sparse to moderately dense understory is dominated by graminoids such as *Muhlenbergia porteri*, *Pleuraphis jamesii*, *Achnatherum speciosum*, *Aristida purpurea*, *Dasyochloa pulchella*, and annual *Vulpia octoflora*. *Acourtia wrightii*, *Artemisia ludoviciana*, *Galium stellatum*, *Machaeranthera pinnatifida*, and *Sphaeralcea grossulariifolia* are common forbs. Exotic species such as *Erodium cicutarium* and *Bromus rubens* occur in many stands.

ENVIRONMENT & DYNAMICS

Environmental Description: This semi-arid shrubland alliance occurs in Arizona in the Grand Canyon National Park and likely in the Sonoran Desert. Stands most typically occurs on sideslopes at 600 to 1100 m elevation, but can be found as high as 1650 m., or rarely in drainages and valley bottoms at 675 to 950 m (Reid and Hall 2010). It is primarily found on moderate to steep (15-40°), north- to east-facing slopes, but also occasionally occurs on gentler slopes (8-15°). Soils are well- to rapidly-drained silty or sandy loams that occasionally contain clay (Reid and Hall 2010). The soils typically obscure various underlying bedrock types. The diagnostic and dominant species *Ephedra aspera* occurs in the Sonoran, Colorado, and Chihuahuan deserts, but the alliance has not been reported from there. Additional survey and classification work are needed to fully characterize this alliance across its full range.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is documented only from Grand Canyon National Park, but it likely occurs in the Sonoran, Colorado, and Chihuahuan deserts.

Nations: US

States/Provinces: AZ

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- > *Ephedra fasciculata* / Mixed Semi-Desert Grasses Shrubland (CEGL005084) (Reid and Hall 2010)
- > *Ephedra fasciculata* Shrubland (CEGL005090) (Reid and Hall 2010)
- = *Ephedra fasciculata* Shrubland Alliance (Reid and Hall 2010) [Alliance is based of the two *Ephedra aspera* shrublands]

LOWER LEVEL UNITS

Associations:

- CEGL005090 *Ephedra aspera* Shrubland
- CEGL005084 *Ephedra aspera* / Mixed Semi-Desert Grasses Shrubland

AUTHORSHIP

Primary Concept Source: M.S. Reid and M.E. Hall (2010)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by M. Hall.

Version Date: 2014/12/18

REFERENCES

References: FNA Editorial Committee 1993, Faber-Langendoen et al. 2017b, Reid and Hall 2010, USDA NRCS n.d.

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G296. Mojave Mid-Elevation Mixed Desert Scrub

A4157. *Ephedra funerea* Scrub Alliance [Low - Poorly Documented]

Type Concept Sentence: This alliance forms an open to intermittent shrub layer in which the dominant and characteristic shrub is *Ephedra funerea*, often with *Ambrosia dumosa* and *Atriplex confertifolia*. The alliance is currently known from the Mojave Desert in California where it is found on upland rocky slopes on various aspects.

OVERVIEW

Scientific Name: *Ephedra funerea* Scrub Alliance

Common Name (Translated Scientific Name): Death Valley Joint-fir Scrub Alliance

Colloquial Name: Death Valley Joint-fir Scrub

Type Concept: This alliance forms an open to intermittent shrub layer. The emergent tree layer is typically not present, and when present is typically sparse. The herbaceous layer is sparse to open. The dominant and characteristic shrub is *Ephedra funerea* and others that are often present include *Ambrosia dumosa* and *Atriplex confertifolia*. Characteristic herbs include *Eriogonum inflatum* as well as *Bromus rubens*, *Sphaeralcea ambigua*, and *Xylorhiza tortifolia*. The alliance is currently known from the Mojave Desert in California where it is found on upland rocky slopes on various aspects. Elevations range from approximately 900 to 1800 m. Soils are derived from a variety of substrates, though often nutrient-poor, including calcareous, granodiorite, and rhyolite/basalt. Textures are typically loamy sand or loam.

Classification Comments:

Internal Comments: MSR 1-15: this could easily be treated as an association within the *Larrea tridentata* - *Ambrosia dumosa* alliance, as both of those shrubs occur in stands of this type. Root, R. 1978. Unpublished dataset from Death Valley National Park, California.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: This alliance is characterized by an open to intermittent shrub layer with *Ephedra funerea* dominant or codominant. The overall shrub cover ranges from 4 to 38%.

VEGETATION

Physiognomy and Structure:

Floristics: The alliance forms an open to intermittent shrub layer with *Ephedra funerea* dominant or codominant, and the overall shrub cover ranges from 4 to 38%. The tree layer is typically not present, and the herb layer is sparse to open. Nonvascular plants are typically sparse, when present. The dominant and characteristic shrub is *Ephedra funerea* and others that are often present include *Ambrosia dumosa* and *Atriplex confertifolia*. Characteristic herbs include *Eriogonum inflatum* as well as *Bromus rubens*, *Sphaeralcea ambigua*, and *Xylorhiza tortifolia*.

ENVIRONMENT & DYNAMICS

Environmental Description: The alliance is found on upland rocky slopes at various aspects. The alliance occurs at mid to high elevation (approximately 900-1800 m). Soils are derived from a variety of substrates, though often nutrient-poor calcareous, granodiorite, and rhyolite/basalt substrates, and textures are often loamy sand or loam.

Dynamics: *Ephedra funerea* typically occurs as a dominant along nutrient-poor slopes, including on calcareous and basalt slopes that are rugged and rocky. It can tolerate natural disturbance from rockfall.

DISTRIBUTION

Geographic Range: The alliance appears to be common in parts of the Kingston, Mesquite, and Nopah ranges (Root 1978, Thomas et al. 2004) in the Mojave Desert, and it occurs in the Panamint Mountains (Thomas et al. 2004) in the southeastern Great Basin. It is well-defined in sampling at Death Valley National Monument, California, and is represented by two plots in the Cinder Cones area of Mojave National Preserve.

Nations: US

States/Provinces: CA

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007): 322Ad:CCC, 322Af:CCC, 322Aj:CCC, 341Fc:CCC, 341Ff:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

- = *Ephedra funerea* (Death Valley joint fir scrub) Provisional Alliance (Sawyer et al. 2009) [33.275.00]
- = *Ephedra funerea* Shrubland Alliance (Evens et al. 2014)
- = *Ephedra funerea* Provisional Shrubland Alliance (CNPS 2017) [33.275.00]

LOWER LEVEL UNITS

Associations:

- CEGL005750 *Ephedra funerea* Shrubland

AUTHORSHIP

Primary Concept Source: J.M. Evens, K. Sikes, D. Hastings, and J. Ratchford (2014)

Author of Description: J. Evens

Acknowledgments:

Version Date: 2015/01/22

REFERENCES

References: Beatley 1976, CNPS 2017, Evens et al. 2014, Faber-Langendoen et al. 2017b, Keeler-Wolf and Thomas 2000, Sawyer et al. 2009, Thomas et al. 2004, VegCAMP and AIS 2013

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G296. Mojave Mid-Elevation Mixed Desert Scrub

A4245. *Ephedra nevadensis* - *Lycium andersonii* - *Grayia spinosa* Scrub Alliance

Type Concept Sentence: Shrublands of the Mojave Desert, Great Basin, Colorado Plateau, and Sonoran Desert where the short-shrub layer is dominated by *Ephedra nevadensis*, *Lycium andersonii*, and/or *Lycium cooperi* with *Ericameria cooperi*, *Eriogonum fasciculatum*, *Grayia spinosa*, and/or *Yucca baccata* present to codominant.

OVERVIEW

Scientific Name: *Ephedra nevadensis* - *Lycium andersonii* - *Grayia spinosa* Scrub Alliance

Common Name (Translated Scientific Name): Nevada Joint-fir - Water Jacket - Spiny Hopsage Scrub Alliance

Colloquial Name: Nevada Joint-fir - Desert-thorn - Spiny Hopsage Scrub

Type Concept: This semi-arid shrubland alliance occurs in valleys, bajadas, and mountains of the Mojave Desert, Great Basin, Colorado Plateau, Sonoran Desert and possibly Chihuahuan Desert. Vegetation in this shrubland alliance is characterized by a sparse to moderate cover of mixed xeromorphic short shrubs and sparse herbaceous cover. The shrub layer is dominated by *Ephedra nevadensis*, *Lycium andersonii*, and/or *Lycium cooperi* with *Ericameria cooperi*, *Eriogonum fasciculatum*, *Grayia spinosa*, and/or *Yucca baccata* present to codominant. Other characteristic shrubs which may be present to codominant are *Acamptopappus sphaerocephalus*, *Chrysothamnus viscidiflorus*, *Ephedra torreyana*, and *Ephedra viridis*. These shrublands may include 35 species of shrubs. If present, the understory may include a sparse to moderately dense herbaceous layer composed mostly of dry perennial grasses and scattered forbs. Stands are found in valleys, bajadas, and mountains. Elevation ranges from 500-1800 m. Sites are commonly found on all aspects in broad valleys, alluvial fans, moderate to steep rocky slopes, and in rocky intermittently flooded drainages. Soil textures range from loamy sands to loams with rock fragments and are derived from alluvial deposits from granitic and sedimentary rocks. In the Mojave Desert this alliance occurs above *Larrea* / *Ambrosia* shrublands and is often surrounded by *Artemisia tridentata*-dominated shrublands.

Classification Comments: This alliance concept was split from former *Ephedra (fasciculata, nevadensis)* Shrubland Alliance (A.857), to create *Ephedra nevadensis* Scrub Alliance (A3140), which was subsequently combined with *Lycium andersonii* - *Lycium cooperi* Scrub Alliance (A3142) to better represent the broad mixed shrub desert scrub that is common, but widely scattered, throughout the mid-elevations of the Mojave Desert and southeastern Great Basin, and occurring throughout much of the interior western U.S.

Ephedra nevadensis is one of the most ubiquitous shrubs in the upper Mojave and mixes with a huge diversity of other shrubs, especially *Lycium* spp. and widespread *Grayia spinosa*, only rarely forming dominant stands. The characteristic shrub species in this alliance tend to occupy areas of similar elevation and precipitation, and tend to recover quickly from disturbance such as fire or clearing. The species occupies a similar climatic zone as *Grayia spinosa*, but the *Ephedra nevadensis* alliance tends to prefer shallower alluvial soils than does *Grayia spinosa* Scrub Alliance (A3171). Stands appear related, in part, to disturbance from fire, grazing, or clearing (Webb et al. 1988b). These stands often have a high floristic diversity and may include up to 35 shrub species (Reid et al. 1999). In addition, many of these mid-elevation vegetation types have been burned repeatedly (largely due to relatively high cover of non-native grasses, which persists as flashy fuels in these areas of relatively high precipitation) or they occur in high-reflectance areas (such as along playas) where overstory shrub type is difficult for the photointerpreters to discern, causing errors in vegetation mapping (T. Keeler-Wolf pers. comm. 2016).

Internal Comments: KAS 11-16: this new alliance was created by merging A3140 *Ephedra nevadensis* Scrub Alliance and A3142 *Lycium andersonii* - *Lycium cooperi* Scrub Alliance based on suggestions from Todd Keeler-Wolf and Julie Evens and ecological review. *Ephedra nevadensis* is the most ubiquitous shrub in the upper Mojave and mixes with a huge diversity of other shrubs especially *Lycium* spp. and widespread *Grayia spinosa* only rarely forming dominant stands. *Ephedra nevadensis* is present in many of the *Lycium* spp.-dominated stands.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Diagnostic of this semi-arid shrubland alliance is total vegetation cover over 10% that is dominated by *Ephedra nevadensis*, *Lycium andersonii*, and/or *Lycium cooperi* with >2% absolute cover and more than two times the cover of other shrub species (Sawyer et al. 2009). Herb layer, if present, is characterized by an open to moderately dense layer of graminoids.

VEGETATION

Physiognomy and Structure: Stands in this shrubland alliance are dominated by sparse to moderate cover of xeromorphic evergreen, microphyllous and broad-leaved shrubs.

Floristics: Vegetation in this shrubland alliance has sparse to moderate cover of mixed xeromorphic short shrubs and sparse herbaceous cover. The shrub layer is usually dominated or codominated by *Ephedra nevadensis*, *Lycium andersonii*, and/or *Lycium cooperi* with *Ericameria cooperi*, *Eriogonum fasciculatum*, *Grayia spinosa*, and/or *Yucca baccata* present to codominant. Other characteristic shrubs which may be present to codominant are *Acamptopappus sphaerocephalus*, *Chrysothamnus viscidiflorus*, *Ephedra torreyana*, and *Ephedra viridis*. These shrublands may include 35 species of shrubs. Other associated shrubs and cacti include *Adenophyllum porophylloides*, *Ambrosia dumosa*, *Atriplex canescens*, *Atriplex confertifolia*, *Echinocereus triglochidiatus*, *Encelia californica*, *Ephedra californica*, *Gutierrezia sarothrae*, *Hymenoclea salsola*, *Opuntia polyacantha*, *Psoralea arborescens*, *Salazaria mexicana*, *Viguiera parishii*, and *Yucca harrimaniae*. *Coleogyne ramosissima* is absent or has low cover. Blackburn (1967) described stands where mean canopy cover of *Ephedra nevadensis*, *Grayia spinosa*, and *Sarcobatus baileyi* was 6.7%, 1.8%, and 1.5%, respectively. If present, the understory may include a sparse to moderately dense herbaceous layer composed mostly of dry perennial grasses and scattered forbs. Perennial grasses include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Aristida purpurea*, *Bouteloua gracilis*, *Elymus elymoides*, *Hesperostipa comata*, *Pleuraphis jamesii*, *Pleuraphis rigida*, *Poa secunda* (= *Poa scabrella*), *Sporobolus airoides*, and *Sporobolus flexuosus*. Common forbs may include perennials such as *Mentzelia multiflora*, *Camissonia multijuga*, *Astragalus layneae*, and *Lomatium mohavense*, and annuals such as *Eriogonum polycladon*, *Camissonia contorta*, *Navarretia* spp., *Eriastrum eremicum*, *Oxytheca perfoliata*, and *Phacelia* spp. Exotic annual grasses such as *Bromus rubens*, and *Bromus tectorum* may be common on disturbed sites.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance includes semi-desert shrublands from the Great Basin, Mojave Desert, Colorado Plateau, Sonoran Desert and possibly Chihuahuan Desert. Stands occur in valleys, bajadas, and mountains. Elevation ranges from 500-1800 m in the Mojave Desert (Sawyer et al. 2009) and 750-1250 m in the Colorado Plateau. Climate is characterized by hot, dry summers and cold winters. The rain occurs mostly in winter. Stands in the Colorado Plateau and Sonoran Desert may have bimodal precipitation. Annual precipitation varies widely from year to year with mean annual precipitation ranging from 16-20 cm depending on elevation and location. Sites are commonly found on all aspects in broad valleys, alluvial fans, moderate to steep rocky slopes, and in rocky intermittently flooded drainages/washes (Sawyer et al. 2009). Topography is typically flat or undulating to moderately sloping, but can be more diverse at higher elevations. Soil textures range from loamy sands to loams with rock fragments. Soils are derived from alluvial deposits from granitic and sedimentary rocks. In the Mojave Desert this alliance occurs above *Larrea / Ambrosia* shrublands and is often surrounded by *Artemisia tridentata*-dominated shrublands (Sawyer et al. 2009). Stands occur at higher elevations than shrublands dominated by *Menodora spinescens* (Sawyer et al. 2009).

Dynamics: Peterson (1984a), citing research by Yoder (1983), suggested that introduced livestock may control the community structure of shrublands included in *Ephedra nevadensis* - *Ericameria cooperi* Shrubland (CEGL001253). Yoder (1983) suggests that these shrublands represent a species shift from *Coleogyne ramosissima*- or *Grayia spinosa*-dominated shrubland to one dominated by *Ephedra nevadensis* and *Ericameria cooperi*.

DISTRIBUTION

Geographic Range: This alliance includes semi-arid shrublands from the Mojave Desert, Great Basin, Colorado Plateau, Sonoran Desert and possibly Chihuahuan Desert in Arizona, California, Nevada, New Mexico, and Utah.

Nations: US

States/Provinces: AZ, CA, NM, NV, UT

TNC Ecoregions [optional]: 11:C, 17:C, 19:C, 23:C, 24:?

USFS Ecoregions (2007): 313A:CC, 321A:??, 322Ab:CCC, 322Ac:CCC, 322Ad:CCC, 322Af:CCC, 322Ai:CCC, 322Aj:CCC, 322Al:CCC, 322B:CC, 341A:CC, 341B:CC, 341Fc:CCC, 341Ff:CCC, 341Fg:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Joshua Tree, Lake Mead, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- > *Ephedra nevadensis* (Nevada joint fir scrub) Alliance (Sawyer et al. 2009) [33.280.00]
- > *Ephedra nevadensis* Shrubland Alliance (CNPS 2017) [33.280.00]
- > *Ephedra nevadensis* Shrubland Alliance (Evens et al. 2012)
- > *Ephedra nevadensis* Shrubland Alliance (Evens et al. 2014)
- ? *Ericameria cooperi*-*Ephedra nevadensis* association (Peterson 1984a) [included within the Mixed Shrub Zone.]
- > *Lycium (andersonii, cooperi)* Shrubland Alliance (Evens et al. 2014)
- > *Lycium andersonii* (Anderson's boxthorn scrub) Alliance (Sawyer et al. 2009) [33.360.00]
- > *Lycium andersonii* Shrubland Alliance (CNPS 2017) [33.360.00]
- > *Lycium andersonii* Shrubland Alliance (Evens et al. 2012)

- >< Blackbush Scrub (#34300) (Holland 1986b)
- >< Mojave Mixed Woody Scrub (#34210) (Holland 1986b)
- >< Sagebrush Scrub (#35200) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEGLO01347 *Grayia spinosa* - *Lycium andersonii* Shrubland
- CEGLO01348 *Grayia spinosa* - *Lycium pallidum* Shrubland
- CEGLO01271 *Grayia spinosa* - *Larrea tridentata* Shrubland
- CEGLO01254 *Ephedra nevadensis* - *Eriogonum fasciculatum* Shrubland
- CEGLO01255 *Ephedra nevadensis* / *Achnatherum hymenoides* Shrubland
- CEGLO05752 *Ephedra nevadensis* - *Lycium andersonii* Shrubland
- CEGLO05150 *Lycium andersonii* - *Ephedra (torreyana, viridis)* Shrubland
- CEGLO05486 *Ephedra nevadensis* - *Yucca baccata* Basalt Shrubland
- CEGLO06857 *Lycium andersonii* Shrubland
- CEPP006726 *Lycium cooperi* Shrubland
- CEGLO05751 *Ephedra nevadensis* - (*Salazaria mexicana*, *Hymenoclea salsola*) Shrubland
- CEGLO01253 *Ephedra nevadensis* - *Ericameria cooperi* Shrubland

AUTHORSHIP

Primary Concept Source: J.O. Sawyer et al. (2009)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2016/11/11

REFERENCES

References: Anderson 2004c, Blackburn 1967, Blackburn et al. 1969c, Blackburn et al. 1969d, CNPS 2017, Evens et al. 2012, Evens et al. 2014, Faber-Langendoen et al. 2017b, Holland 1982, Holland 1986b, Keeler-Wolf and Thomas 2000, Keeler-Wolf pers. comm., Peterson 1984a, Reid and Hall 2010, Reid et al. 1999, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Thomas et al. 2004, VegCAMP and AIS 2013, Webb et al. 1988b, Yoder 1983

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G296. Mojave Mid-Elevation Mixed Desert Scrub

A3150. *Eriogonum fasciculatum* - *Viguiera parishii* Desert Scrub Alliance [Low - Poorly Documented]

Type Concept Sentence: Low shrublands dominated by *Viguiera parishii* occupying wash and arroyo margins, rocky to bouldery alluvium, on moderate to steep colluvial slopes of the southwest deserts.

OVERVIEW

Scientific Name: *Eriogonum fasciculatum* - *Viguiera parishii* Desert Scrub Alliance

Common Name (Translated Scientific Name): Eastern Mojave Buckwheat - Parish's Goldeneye Desert Scrub Alliance

Colloquial Name: Eastern Mojave Buckwheat - Parish's Goldeneye Desert Scrub

Type Concept: This alliance occurs in a variety of upland habitats in the southwestern deserts from southern California to the Sonoran Desert in western Arizona, and extends into southern Nevada. The vegetation is characterized by an open shrub layer dominated or codominated by the facultatively deciduous *Viguiera parishii* and *Eriogonum fasciculatum*. Other short shrubs and dwarf-shrubs present may include *Agave deserti*, *Bebbia juncea*, *Ephedra nevadensis*, *Encelia farinosa*, *Ericameria teretifolia*, *Ferocactus cylindraceus*, *Galium stellatum*, *Gutierrezia microcephala*, *Krameria grayi*, *Cylindropuntia acanthocarpa* (= *Opuntia acanthocarpa*), *Salazaria mexicana*, *Salvia dorrii*, *Simmondsia chinensis*, or *Yucca schidigera*. Occasional emergent tall shrubs or small trees may be present such as *Acacia greggii*, *Fouquieria splendens*, or *Juniperus californica*. The herbaceous layer is generally sparse. *Achnatherum speciosum*, *Adenophyllum porophyllum*, *Mirabilis laevis* var. *villosa* (= *Mirabilis bigelovii*), short cacti such as *Echinocereus engelmannii* or *Opuntia basilaris*, and introduced annual grasses such as *Bromus madritensis* and *Bromus rubens* are commonly present. Sites are commonly on moderate to steep colluvial slopes. Stands may also be found in valleys on rocky or bouldery alluvium and along washes and arroyos. Elevation ranges from 900 to 1400 m. Disturbance may be important to stands of this alliances. Soils are coarse-textured and often derived from granitic or volcanic rock.

Classification Comments: More information, plot data and classification analysis are needed to clarify the concept of this alliance within its full extent, especially in the Sonoran Desert. The central distribution may be more oriented in the Sonoran Desert. Therefore, this alliance may be better placed in Mojave-Sonoran Bajada & Valley Desert Scrub Group (G295).

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: *Viguiera parishii* greater than or equal to any other species in absolute cover in the shrub canopy. Emergent shrubs such as *Juniperus californica* and *Rhus ovata* have <5% absolute cover (Sawyer et al. 2009). These low shrublands occupy wash and arroyo margins, rocky to bouldery alluvium, on moderate to steep colluvial slopes of the southwestern deserts.

VEGETATION

Physiognomy and Structure: Stands in this low shrubland alliance are dominated by sparse to open cover of xeromorphic short shrubs.

Floristics: This alliance is characterized by an open shrub layer dominated or codominated by the facultatively deciduous *Viguiera parishii* and *Eriogonum fasciculatum*. Other short shrubs and dwarf-shrubs present may include *Agave deserti*, *Bebbia juncea*, *Ephedra nevadensis*, *Encelia farinosa*, *Ericameria teretifolia*, *Ferocactus cylindraceus*, *Galium stellatum*, *Gutierrezia microcephala*, *Krameria grayi*, *Cylindropuntia acanthocarpa* (= *Opuntia acanthocarpa*), *Salazaria mexicana*, *Salvia dorrii*, *Simmondsia chinensis*, or *Yucca schidigera*. Occasional emergent tall shrubs or small trees may be present such as *Acacia greggii*, *Fouquieria splendens*, or *Juniperus californica*. The herbaceous layer is generally sparse. *Achnatherum speciosum*, *Adenophyllum porophyllum*, *Mirabilis laevis* var. *villosa* (= *Mirabilis bigelovii*), short cacti such as *Echinocereus engelmannii* or *Opuntia basilaris*, and introduced annual grasses such as *Bromus madritensis* and *Bromus rubens* are commonly present (Keeler-Wolf and Thomas 2000, Thomas et al. 2004, Sawyer et al. 2009).

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance occurs in a variety of upland habitats in the southwestern deserts from southern California to the Sonoran Desert in western Arizona, and extends into southern Nevada. Elevation ranges from 900 to 1400 m. Sites are commonly moderate to steep colluvial slopes. Stands may also be found in valleys on rocky or bouldery alluvium and along washes and arroyos. Disturbance may be important to stands of this alliances. Soils are coarse-textured and often derived from granitic or volcanic rock (Keeler-Wolf and Thomas 2000, Thomas et al. 2004, Sawyer et al. 2009).

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is known from the Sonoran and Mojave deserts of Arizona, California and southern Nevada.

Nations: US

States/Provinces: AZ, CA, NV

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007): 322Ac:CCC, 322Ad:CCC, 322Ae:CCC, 322Af:CCC, 322Aj:CCC, 322Ak:CCC, 322Al:CCC, 322Am:CCC, 322At:CCC, 322Av:CCC, 322Ay:CCC, 322Az:CCC, 341Fa:CCC, 341Fb:CCC, 341Fc:CCC, 341Fd:CCC, 341Ff:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Joshua Tree, Lake Mead, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

- = *Eriogonum fasciculatum* - *Viguiera parishii* Shrubland Alliance (Evens et al. 2012)
- = *Eriogonum fasciculatum*-*Viguiera parishii* Shrubland Alliance (Evens et al. 2014)
- = *Viguiera parishii* (Parish's goldeneye scrub) Alliance (Sawyer et al. 2009) [33.032.00]

LOWER LEVEL UNITS

Associations:

- CEG002721 *Viguiera parishii* Shrubland
- CEPP006706 *Eriogonum fasciculatum* Desert Wash Shrubland
- CEPP006705 *Eriogonum fasciculatum* - *Ericameria (laricifolia, linearifolia)* Desert Shrubland
- CEG005775 *Viguiera parishii* - *Eriogonum fasciculatum* Desert Shrubland

AUTHORSHIP

Primary Concept Source: J.O. Sawyer, T. Keeler-Wolf, and J. Evens (2009)

Author of Description: K.A Schulz

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Evens and San 2006, Evens et al. 2012, Evens et al. 2014, Faber-Langendoen et al. 2017b, Keeler-Wolf and Thomas 2000, Keeler-Wolf et al. 1998a, Sawyer et al. 2009, Thomas et al. 2004, VegCAMP and AIS 2013

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G296. Mojave Mid-Elevation Mixed Desert Scrub

A4167. *Eriogonum wrightii* - *Eriogonum heermannii* - *Buddleja utahensis* Scrub Alliance

Type Concept Sentence: Stands have diagnostic presence of *Eriogonum wrightii*, *Eriogonum heermannii*, and/or *Buddleja utahensis* in the shrub layer; other characteristic shrubs at lower cover may include *Eriogonum fasciculatum* and *Prunus fasciculata*. The alliance is found in California and Arizona. In desert areas it is found primarily on bedrock outcrops at various aspects and high slopes at east to southeast aspects. It may also occur on flats, ridgetops, and stony slopes on granitic, sedimentary, or serpentine substrates.

OVERVIEW

Scientific Name: *Eriogonum wrightii* - *Eriogonum heermannii* - *Buddleja utahensis* Scrub Alliance

Common Name (Translated Scientific Name): Bastard-sage - Heermann's Buckwheat - Utah Butterfly-bush Scrub Alliance

Colloquial Name: Bastard-sage - Heermann's Buckwheat - Utah Butterfly-bush Scrub

Type Concept: This alliance forms an open shrub layer. The emergent tree layer, when present, is typically sparse, and the herbaceous layer is sparse to open. The stands have diagnostic presence of *Eriogonum wrightii*, *Eriogonum heermannii*, and/or *Buddleja utahensis* in the shrub layer; other characteristic shrubs at lower cover may include *Eriogonum fasciculatum* and *Prunus fasciculata*. Shrubs that are often present include *Brickellia microphylla*, *Echinocactus polycephalus*, *Echinocereus mojavensis*, *Ericameria linearifolia*, *Eriogonum fasciculatum*, *Escobaria vivipara*, *Gutierrezia microcephala*, *Gutierrezia sarothrae*, *Opuntia polyacantha* var. *erinacea*, *Quercus turbinella*, *Scopulophila rixfordii*, and *Yucca schidigera*. *Juniperus osteosperma* is a commonly emergent tree at sparse cover. Dominant and characteristic herbs may include *Achnatherum speciosum*, *Arabis* spp., *Aristida purpurea*, *Bouteloua gracilis*, *Bromus rubens*, *Bromus tectorum*, *Descurainia pinnata*, *Elymus elymoides*, *Erigeron* spp., *Erodium cicutarium*, *Gilia* spp., *Hymenoxys cooperi*, *Lesquerella kingii*, *Lomatium nevadense*, *Poa secunda*, *Sphaeralcea ambigua*, and *Streptanthus cordatus*. Cryptogamic crust and moss are often present. The alliance is found in California and Arizona. In desert areas it is found primarily on bedrock outcrops at various aspects and high slopes at east to southeast aspects. It may also occur on flats, ridgetops, and stony slopes on granitic, sedimentary, or serpentine substrates. Elevations range from approximately 950 to 1900 m. Soils are derived from calcareous substrates, including limestone, sandstone with dolostone (dolomite), alluvium, and granodiorite. Textures include clay loam, sandy loam, and silty clay, as well as sandy and gravelly alluvium.

Classification Comments: *Eriogonum wrightii* is an intricate branched low shrub with gray leaves. The species is morphologically variable and widespread in much of California and the Southwest. The species includes six varieties that vary from small, matted perennials to small shrubs; all occupy open habitats: *Eriogonum wrightii* var. *membranaceum* grows in southern California from 300 to 2200 m; *Eriogonum wrightii* var. *nodosum* grows in hot deserts and Peninsular Ranges from 150 to 1600 m; *Eriogonum wrightii* var. *olanchense* grows in Olancha Peak in the southern Sierra Nevada at 3500 m; *Eriogonum wrightii* var. *subscaposum* grows in the mountains of much of California from 200 to 3400 m; *Eriogonum wrightii* var. *trachygonum* grows in the mountains of northern California from 50 to 800 m; and *Eriogonum wrightii* var. *wrightii* grows in the Mojave Desert from 30 to 2300 m.

The sampled stands of *Eriogonum wrightii* var. *subscaposum* in the inner Coast Ranges are relatively small (usually <1 ha) and have a similar range as the *Juniperus californica* alliance (Sawyer et al. 2009). The studies in southern California did not distinguish plants to the variety level. Future sampling should identify plants completely. Varieties overlap in elevation and range, but they may vary in habitat conditions. All varieties are included in this alliance at this time.

Six of the 10 varieties of *Eriogonum heermannii* grow in California; *Eriogonum heermannii* var. *occidentale* has scattered populations in Fresno and San Benito counties in the Central Coast Ranges and the foothills of the Sierra Nevada. *Eriogonum heermannii* var. *heermannii* also occurs in the Central Coast but is more widespread. Other varieties occur on limestone substrates, but, overall, the species occupies many open substrates. *Eriogonum heermannii* var. *heermannii* and *Eriogonum heermannii* var. *occidentale* are included in this provisional alliance.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: This alliance is characterized by an open shrub layer with diagnostic presence of *Eriogonum wrightii*, *Eriogonum heermannii*, and/or *Buddleja utahensis*. The overall shrub cover ranges from 3 to 15%.

VEGETATION

Physiognomy and Structure:

Floristics: The alliance forms an open shrub layer and the overall shrub cover ranges from 3 to 15% cover. The tree layer, when present, is typically sparse, and the herb layer is sparse to open. Nonvascular plants are typically sparse to open. Stands have diagnostic presence of *Eriogonum wrightii*, *Eriogonum heermannii*, and/or *Buddleja utahensis*, and characteristic presence of *Eriogonum fasciculatum* and *Prunus fasciculata* at lower cover. Other shrubs that are often present at lower cover include *Brickellia microphylla*, *Echinocactus polycephalus*, *Echinocereus mojavensis*, *Ericameria linearifolia*, *Eriogonum fasciculatum*, *Escobaria vivipara*, *Gutierrezia microcephala*, *Gutierrezia sarothrae*, *Opuntia polyacantha* var. *erinacea*, *Quercus turbinella*, *Scopolophila rixfordii*, and *Yucca schidigera*. *Juniperus osteosperma* is a commonly emergent tree at sparse cover. Dominant and/or characteristic herbs include *Achnatherum speciosum*, *Arabis* spp., *Aristida purpurea*, *Bouteloua gracilis*, *Bromus rubens*, *Bromus tectorum*, *Descurainia pinnata*, *Elymus elymoides*, *Erigeron* spp., *Erodium cicutarium*, *Gilia* spp., *Hymenoxys cooperi*, *Lesquerella kingii*, *Lomatium nevadense*, *Poa secunda*, *Sphaeralcea ambigua*, and *Streptanthus cordatus*. Cryptogamic crust and moss are often present.

ENVIRONMENT & DYNAMICS

Environmental Description: The alliance is found at mid to high elevations (950 to 1900 m) primarily on bedrock outcrops at various aspects and at high elevations on high slopes with east to southeast aspects. Soils are derived from calcareous substrates, including granodiorite, limestone and sandstone with dolostone (dolomite), alluvium, granodiorite. Textures include clay loam, sandy loam, and silty clay.

Dynamics: Stands with *Eriogonum wrightii*, *Eriogonum heermannii*, and/or *Buddleja utahensis* occur on nutrient-poor and rocky soils, including calcareous rock outcrops that receive colluvial disturbance.

The fire history is unclear. Since stands tend to occur on slightly shallower and more rocky soil than the adjacent grasslands, fire intensity and frequency are expected to be lower in these more sites. It is unlikely that short fire-return intervals are adaptive for this alliance.

DISTRIBUTION

Geographic Range: The alliance is well-defined in sampling in the Mojave Desert in the northern half of Death Valley National Monument, California. The alliance is also found in the at Lake Mead National Recreation Area in the Black Mountains of Arizona and has been observed in Mojave National Preserve at Clark Mountain. It also occurs in the central Coast Ranges, northern interior Coast Ranges, Great Central Valley, Sierra Nevada and foothills, and southern California mountains and valleys.

Nations: US

States/Provinces: AZ, CA

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007): 322Av:CCC, 341Fc:CCC, 341Fd:CCC, 341Ff:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Lake Mead, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- > *Eriogonum heermannii* - *Buddleja utahensis* Shrubland Alliance (Evens et al. 2014)
- > *Eriogonum heermannii* (Heermann's buckwheat patches) Provisional Alliance (Sawyer et al. 2009) [32.035.00]
- > *Eriogonum wrightii* (Wright's buckwheat patches) Alliance (Sawyer et al. 2009) [32.041.00]
- > *Eriogonum wrightii* Shrubland Alliance (Evens et al. 2014)
- < California juniper series (Sawyer and Keeler-Wolf 1995)
- >< Mojave Mixed Woody Scrub (#34210) (Holland 1986b)
- >< Upper Sonoran Subshrub Scrub (#39000) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEGLO05467 *Hecastocleis shockleyi* Shrubland
- CEPP005784 (*Buddleja utahensis*, *Eriogonum heermannii*) - *Gutierrezia* spp. Limestone Scrub
- CEPP006708 *Eriogonum wrightii* var. *wrightii* Shrubland
- CEPP006707 *Eriogonum heermannii* Shrubland

AUTHORSHIP**Primary Concept Source:** J. Evens and M.S. Reid, after Sawyer et al. (2009)**Author of Description:** J. Evens and M.J. Russo after Sawyer et al. (2009)**Acknowledgments:****Version Date:** 2015/02/20**REFERENCES**

References: Alexander et al. 2007, Buck-Diaz et al. 2012, CNPS 2017, Evens and San 2006, Evens et al. 2006, Evens et al. 2014, Faber-Langendoen et al. 2017b, Holland 1986b, Keeler-Wolf et al. 1998a, Kittel et al. 2012a, Moran 2004a, Moran 2004b, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, VegCAMP and AIS 2013

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G296. Mojave Mid-Elevation Mixed Desert Scrub

A0502. Juniperus californica Mojave Scrub Alliance

Type Concept Sentence: This semi-arid and desert woodland is dominated by *Juniperus californica*. Other trees present may include *Quercus turbinella*, *Yucca brevifolia*, *Pinus quadrifolia*, and *Pinus monophylla*. Stands of this desert woodland alliance occur in southern California in the inner central Coast Ranges, the montane Transverse and Peninsular ranges, south and east through Baja California, Mexico, and the Mojave Desert.

OVERVIEW**Scientific Name:** *Juniperus californica* Mojave Scrub Alliance**Common Name (Translated Scientific Name):** California Juniper Mojave Scrub Alliance**Colloquial Name:** Mojave California Juniper Scrub

Type Concept: This semi-arid open woodland alliance is found in the Mojave Desert, southern California, and the Baja Peninsula. The vegetation is characterized by an open woodland is dominated by *Juniperus californica*. Other trees present with low cover may include *Quercus turbinella*, *Yucca brevifolia*, *Pinus quadrifolia*, and *Pinus monophylla*. An open or intermittent shrub layer may include *Artemisia tridentata*, *Coleogyne ramosissima*, *Hesperoyucca whipplei* (= *Yucca whipplei*), *Yucca schidigera*, *Ephedra* spp., *Purshia stansburiana* (= *Purshia mexicana* var. *stansburiana*), and *Lepidospartum squamatum*. The herbaceous layer is sparse or dominated by graminoids. Stands are found from 600-2450 m elevation and grow on ridges, slopes and valleys on soils derived from bedrock or alluvium.

Classification Comments: It's difficult to determine if this alliance is centrally distributed in the Mojave Desert and warrants placement in this group. California ecologists recommend this alliance be moved from this group because *Juniperus californica* Woodland Alliance (Sawyer et al 2009) is primarily a Mediterranean alliance that crosses into the western Mojave Desert and occurs in transitional areas between Mediterranean woodland and Mojavean scrubland (T. Keeler-Wolf pers. comm. 2014). However, occurrences in the Mojave Desert have characteristic Mojave Desert indicator species present, such as *Coleogyne ramosissima*, *Nolina bigelovii*, and *Yucca schidigera*, it will remain in this group for the time being. However, another way to address Mojave Desert *Juniperus californica* associations included in this alliance would be to assign them to other alliances in this group. For example, proposed USNVC association *Juniperus californica* / *Coleogyne ramosissima* could be moved to *Coleogyne ramosissima* Mojave Desert Scrub Alliance (A3144), proposed USNVC association *Juniperus californica* / *Yucca schidigera* / *Pleuraphis rigida* could be moved to *Yucca schidigera* Scrub Alliance (A3147), and proposed USNVC association *Juniperus californica* / *Nolina bigelovii* (provisional) could be moved to *Nolina parryi* - *Nolina microcarpa* Scrub Alliance (A3145). Most stands of these proposed USNVC associations have an open to sparse *Juniperus californica* tree canopy so the *Juniperus californica* trees form an emergent woody layer, but often do not dominate the site. More classification review is needed.

Internal Comments: mjr 1-15: NV added for Lake Mead (MOJN).**Other Comments:****Similar NVC Types:**

Diagnostic Characteristics: *Juniperus californica* occurs as a small tree or large shrub with >1% absolute cover and no other tree (or tall shrub) with equal or greater cover (>50% relative cover) (Sawyer et al. 2009).

VEGETATION

Physiognomy and Structure: This rounded-crown, temperate or subpolar, needle-leaved evergreen woodland forms an open tree canopy less than 5 m in height. The shrub layer is intermittent to open. The herbaceous layer is sparse or grassy.

Floristics: This semi-arid and desert woodland is dominated by *Juniperus californica*. Other trees present with low cover may include *Quercus turbinella*, *Yucca brevifolia*, *Pinus quadrifolia*, and *Pinus monophylla*. An open or intermittent shrub layer may include *Artemisia tridentata*, *Coleogyne ramosissima*, *Hesperoyucca whipplei* (= *Yucca whipplei*), *Yucca schidigera*, *Ephedra* spp., *Purshia stansburiana* (= *Purshia mexicana* var. *stansburiana*), and *Lepidospartum squamatum*. The herbaceous layer is sparse or dominated by graminoids.

ENVIRONMENT & DYNAMICS

Environmental Description: This woodland alliance of the Mojave Desert, southern California, and the Baja Peninsula, grows on ridges, slopes and valleys. Stands are found from 600 to 2450 m elevation. Annual precipitation totals are quite low, varying from 20 to 40 cm. The precipitation is strongly seasonal, with the bulk falling between November and April. Soils are shallow, porous, rocky, coarse, sandy or silty derived from bedrock or alluvium (Sawyer et al. 2009).

Dynamics: This alliance of semi-arid southern California and the Mojave Desert does not tolerate fire. If a stand of this alliance burns, it is succeeded by chaparral.

DISTRIBUTION

Geographic Range: Stands of this desert woodland alliance occur in southern California in the inner central Coast Ranges, the montane Transverse and Peninsular ranges, south and east through Baja California, Mexico, and the Mojave Desert.

Nations: MX, US

States/Provinces: CA, MXBC, NV

TNC Ecoregions [optional]: 11:C, 12:C, 13:C, 14:C, 15:C, 16:C, 17:C

USFS Ecoregions (2007): 322Al:CCC, 322Am:CCC, M261A:CC, M261E:CC, M261F:CC, M262A:CC, M262B:CC

Omernik Ecoregions:

Federal Lands [optional]: BLM (Carrizo Plain); NPS (Joshua Tree, Lake Mead, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Juniperus californica* (California juniper woodland) Alliance (Sawyer et al. 2009) [89.100.00]
- = *Juniperus californica* Alliance (California juniper woodland) (Buck-Diaz et al. 2012)
- >< *Juniperus californica* Wooded Shrubland Alliance (Evens et al. 2014)
- = *Juniperus californica* Woodland Alliance (Evens et al. 2012)
- = *Juniperus californica* Woodland Alliance (CNPS 2017) [89.100.00]
- = California juniper series (Sawyer and Keeler-Wolf 1995)
- >< Cismontane Juniper Woodland and Scrub (#72400) (Holland 1986b)
- >< Mojavean Juniper Woodland and Scrub (#72220) (Holland 1986b)
- >< Peninsular Juniper Woodland and Scrub (#72320) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEGLO03058 *Juniperus californica* Mojave Scrub
- CEPP006713 *Juniperus californica* / *Coleogyne ramosissima* Mojave Scrub
- CEPP006714 *Juniperus californica* / *Nolina bigelovii* Mojave Scrub
- CEPP006715 *Juniperus californica* / *Yucca schidigera* / *Pleuraphis rigida* Mojave Scrub

AUTHORSHIP

Primary Concept Source: J.O. Sawyer, T. Keeler-Wolf, and J. Evens (2009)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by M. Schindel.

Version Date: 2014/12/18

REFERENCES

References: Boyd 1983, Buck-Diaz et al. 2012, CNPS 2017, Cope 1992b, Evens et al. 2006, Evens et al. 2012, Evens et al. 2014, Faber-Langendoen et al. 2017b, Holland 1986b, Keeler-Wolf 1990c, Keeler-Wolf and Thomas 2000, Keeler-Wolf et al. 1998a, Keeler-Wolf et al. 2005, Keeler-Wolf pers. comm., Kittel et al. 2012a, Klein and Evens 2006, Klein et al. 2007, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Stout et al. 2013, Thomas 1996, Thomas et al. 2004, Thorne 1982, Thorne et al. 2007, VegCAMP and AIS 2013

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland
G296. Mojave Mid-Elevation Mixed Desert Scrub

A2515. Menodora spinescens Scrub Alliance [Low - Poorly Documented]

Type Concept Sentence: This xeromorphic upland shrubland alliance occurs locally in the Mojave Desert and southern Great Basin and is characterized by an open, xeromorphic, short-shrub layer (0.5-2 m tall) that is dominated or codominated by *Menodora spinescens*. Other shrubs and dwarf-shrubs are present.

OVERVIEW

Scientific Name: *Menodora spinescens* Scrub Alliance

Common Name (Translated Scientific Name): Spiny Menodora Scrub Alliance

Colloquial Name: Spiny Menodora Scrub

Type Concept: This upland shrubland alliance occurs locally in the Mojave Desert and southern Great Basin. The vegetation is characterized by an open, xeromorphic, short-shrub layer (0.5-2 m tall) that is dominated or codominated by *Menodora spinescens*. Other shrubs and dwarf-shrubs present may include *Picrothamnus desertorum* (= *Artemisia spinescens*), *Atriplex confertifolia*, *Coleogyne ramosissima*, *Ephedra nevadensis*, *Hymenoclea salsola*, *Krascheninnikovia lanata*, *Lepidium fremontii*, *Lycium andersonii*, *Sphaeralcea ambigua*, and *Tetradymia axillaris*. Emergent *Yucca brevifolia* may be scattered through the stand with very low cover (<1% cover). Herbaceous cover is sparse or absent. Stands are found on ridges, hills, slopes and upper bajadas. Elevation ranges from 900 to 1500 m. Substrates are shallow, rocky soils derived from bedrock or alluvium.

Classification Comments: This description is based on classification work done by Keeler-Wolf and Thomas (2000) on the Mojave Ecosystem Mapping Project.

Internal Comments: KAS 11-16: CEGL001349 *Grayia spinosa* - *Menodora spinescens* Shrubland Association was moved from A3171 *Grayia spinosa* Scrub Alliance to A2515 *Menodora spinescens* Scrub Alliance because *Menodora spinescens* is considered to be more diagnostic than the ubiquitous *Grayia spinosa* and reference citation for CEGL001349 is from the Grapevine Mountains in Death Valley NP (Kurzius 1981).

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: *Menodora spinescens* $\geq 2\%$ cover, no other single shrub species with greater cover although many others may be present (Thomas et al. 2004).

VEGETATION

Physiognomy and Structure:

Floristics: The vegetation in this alliance is characterized by an open, xeromorphic, short-shrub layer (0.5-2 m tall) that is dominated or codominated by *Menodora spinescens*, usually with other shrubs such as *Atriplex confertifolia*, *Ephedra nevadensis*, and *Grayia spinosa* present to codominant (Keeler-Wolf and Thomas 2000, Thomas et al. 2004, Sawyer et al. 2009). Other shrubs and dwarf-shrubs present may include *Coleogyne ramosissima*, *Hymenoclea salsola* (= *Ambrosia salsola*), *Krascheninnikovia lanata*, *Lepidium fremontii*, *Lycium andersonii*, *Picrothamnus desertorum* (= *Artemisia spinescens*), *Sphaeralcea ambigua*, and *Tetradymia axillaris*. Emergent *Yucca brevifolia* may be scattered through the stand with very low cover (<1% cover). Herbaceous cover is sparse or absent (Keeler-Wolf and Thomas 2000, Thomas et al. 2004, Sawyer et al. 2009).

ENVIRONMENT & DYNAMICS

Environmental Description: This xeromorphic upland shrubland alliance occurs locally in the Mojave Desert and southern Great Basin. Elevation ranges from 900 to 1500 m. Stands are found on ridges, hills, slopes and upper bajadas. Substrates are shallow, rocky soils derived from bedrock or alluvium (Keeler-Wolf and Thomas 2000, Thomas et al. 2004, Sawyer et al. 2009).

Dynamics: Keeler-Wolf and Thomas (2000) suggest that this alliance is intolerant of disturbance and occurs on relatively stable sites. Effects of fire patterns are unknown but likely detrimental. *Menodora spinescens* is apparently frost sensitive, despite its occupation of mid-elevation sites.

DISTRIBUTION

Geographic Range: This alliance is found in the Mojave Desert and extends into the southwestern Great Basin.

Nations: US

States/Provinces: CA, NV

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007): 322Ac:CCC, 322Ad:CCC, 341Dj:CCC, 341Fa:CCC, 341Fb:CCC, 341Fc:CCC, 341Fd:CCC, 341Fe:CCC, 341Fg:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley)

CONFIDENCE LEVEL**USNVC Confidence Level with Comments:** Low - Poorly Documented.**SYNONYMY**

- = *Menodora spinescens* (Spiny menodora scrub) Alliance (Sawyer et al. 2009) [33.290.00]
- = *Menodora spinescens* (Provisional) Shrubland Alliance (Keeler-Wolf and Thomas 2000)
- = *Menodora spinescens* Shrubland Alliance (Evens et al. 2014)
- = *Menodora spinescens* Shrubland Alliance (CNPS 2017) [33.290.00]
- >< Blackbush Scrub (#34300) (Holland 1986b)
- >< Joshua Tree Woodland (#73000) (Holland 1986b)
- >< Mojave Mixed Woody Scrub (#34210) (Holland 1986b)
- >< Mojave Mixed Woody and Succulent Scrub (#34240) (Holland 1986b)
- >< Mojavean Juniper Woodland and Scrub (#72220) (Holland 1986b)

LOWER LEVEL UNITS**Associations:**

- CEGLO02767 *Menodora spinescens* - (*Ephedra nevadensis*) Dwarf-shrubland
- CEGLO05769 *Menodora spinescens* - *Atriplex confertifolia* Scrub
- CEGLO01349 *Grayia spinosa* - *Menodora spinescens* Shrubland

AUTHORSHIP**Primary Concept Source:** J.O. Sawyer, T. Keeler-Wolf, and J. Evens (2009)**Author of Description:** K.A. Schulz**Acknowledgments:****Version Date:** 2016/11/11**REFERENCES**

References: CNPS 2017, Evens et al. 2014, Faber-Langendoen et al. 2017b, Holland 1986b, Keeler-Wolf and Thomas 2000, Keeler-Wolf et al. 2007, Kurzius 1981, Sawyer et al. 2009, Thomas et al. 2004, VegCAMP and AIS 2013

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G296. Mojave Mid-Elevation Mixed Desert Scrub

A4158. *Mortonia utahensis* Scrub Alliance

Type Concept Sentence: This alliance forms an open shrub layer in which *Mortonia utahensis* is dominant or codominant; other shrubs often present include *Echinocactus polycephalus*, *Echinocereus engelmannii*, *Eriogonum heermannii*, and *Gutierrezia sarothrae*. The alliance is currently known from desert areas of Nevada, California, and Arizona, where it is found primarily on skeletal rocky slopes of various aspects.

OVERVIEW**Scientific Name:** *Mortonia utahensis* Scrub Alliance**Common Name (Translated Scientific Name):** Utah *Mortonia* Scrub Alliance**Colloquial Name:** Utah *Mortonia* Scrub

Type Concept: This alliance forms an open shrub layer. The emergent tree layer is typically sparse, and the herbaceous layer is open. *Mortonia utahensis* is dominant or codominant in the shrub layer, and other shrubs often present include *Echinocactus polycephalus*, *Echinocereus engelmannii*, *Eriogonum heermannii*, and *Gutierrezia sarothrae*. Dominant and characteristic herbs include *Bromus rubens* and *Sphaeralcea ambigua*, and *Aristida purpurea* is often present. Cryptogamic crust is often present. The alliance is currently known from Lake Mead National Recreation Area, Nevada, Mojave National Preserve and Death Valley National Monument, California, and Grand Canyon National Park, Arizona, where it is found primarily on skeletal rocky slopes of various aspects. Elevations range from approximately 900 to 1700 m. Soils are typically calcareous, and textures include clay loam, silty clay loam, and sandy loam.

Classification Comments: *Mortonia utahensis* associations are currently placed in Mojave Mid-Elevation Mixed Desert Scrub Group (G296) and Western Madrean Chaparral Group (G281) of the USNVC hierarchy. However, stands within Evens et al.'s (2014) study area are also ecologically related to those within Colorado Plateau Blackbrush - Mormon-tea Shrubland Group (G312). Other related associations include those with *Eriogonum heermannii*, *Buddleja utahensis*, *Coleogyne ramosissima*, and *Purshia stansburiana*.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: This alliance is characterized by an open shrub layer of *Mortonia utahensis* as a dominant or codominant shrub. The overall shrub cover ranges from 4 to 29%.

VEGETATION

Physiognomy and Structure:

Floristics: The alliance forms an open shrub layer with the overall shrub cover ranging from 4 to 29%. The tree layer is typically sparse, and the herb layer is sparse to open. Nonvascular plants are typically sparse. *Mortonia utahensis* is dominant or codominant in the shrub layer, and other shrubs often present include *Echinocactus polycephalus*, *Echinocereus engelmannii*, *Eriogonum heermannii*, and *Gutierrezia sarothrae*. Dominant and characteristic herbs include *Bromus rubens* and *Sphaeralcea ambigua*, and *Aristida purpurea* is often present. Cryptogamic crust is often present in this alliance.

ENVIRONMENT & DYNAMICS

Environmental Description: The alliance is found primarily on skeletal rocky slopes of various aspects. The alliance occurs at mid to high elevations (approximately 900-1700 m). Soils are typically calcareous, and textures include clay loam, silty clay loam, and sandy loam.

Dynamics: *Mortonia utahensis* stands occur on steep, rocky slopes with nutrient-poor sedimentary substrates, including limestone and sandstone.

DISTRIBUTION

Geographic Range: The alliance is found northeast of Iceberg Canyon in Lake Mead National Recreation Area, Nevada, and in California in Mojave National Preserve in the Clark Mountains, and in Death Valley National Monument in the Funeral Mountains. It also occurs in Grand Canyon National Park, Arizona.

Nations: US

States/Provinces: AZ, CA, NV

TNC Ecoregions [optional]: 11:C, 17:C, 19:C

USFS Ecoregions (2007): 322Ad:CCC, 322Aj:CCC, 322At:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Grand Canyon, Lake Mead, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Mortonia utahensis* Shrubland Alliance (Evens et al. 2014)

LOWER LEVEL UNITS

Associations:

- CEG005153 *Mortonia utahensis* Shrubland

AUTHORSHIP

Primary Concept Source: J.M. Evens, K. Sikes, D. Hastings, and J. Ratchford (2014)

Author of Description: J. Evens

Acknowledgments:

Version Date: 2015/01/22

REFERENCES

References: Evens et al. 2014, Faber-Langendoen et al. 2017b, Keeler-Wolf and Thomas 2000

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G296. Mojave Mid-Elevation Mixed Desert Scrub

A3145. *Nolina parryi* - *Nolina microcarpa* Scrub Alliance

Type Concept Sentence: This extremely xeromorphic evergreen shrubland is characterized by the subshrubs *Nolina parryi* or *Nolina microcarpa* forming an open canopy over a low-shrub layer. It is found in the Mojave Desert of California, and in Arizona and southern Nevada.

OVERVIEW

Scientific Name: *Nolina parryi* - *Nolina microcarpa* Scrub Alliance

Common Name (Translated Scientific Name): Parry's Bear-grass - Sacahuista Scrub Alliance

Colloquial Name: Parry's Bear-grass - Sacahuista Scrub

Type Concept: This extremely xeromorphic evergreen shrubland of the southwestern mountains and deserts is characterized by the rosette shrubs *Nolina parryi* (= *Nolina bigelovii* var. *parryi*) or *Nolina microcarpa* forming an open canopy over a low-shrub layer. Shrubs may include *Ferocactus cylindraceus*, *Coleogyne ramosissima*, *Encelia farinosa*, *Eriogonum fasciculatum*, *Acacia greggii*, *Salazaria mexicana*, *Agave deserti*, *Hyptis emoryi*, *Ericameria linearifolia*, and *Ambrosia dumosa*. Emergent individuals of *Juniperus californica*, *Yucca schidigera*, and/or *Fouquieria splendens* may occur. The herbaceous layer is sparse and often composed of perennial graminoids such as *Achnatherum speciosum* and *Poa secunda*. This alliance is found in the Mojave Desert of California, and in Arizona and southern Nevada. Stands typically occur on steep slopes, ridges or in valleys.

Classification Comments: It was suggested during the classification of the Grand Canyon that these two taxa (*Nolina microcarpa* and *Nolina parryi*) be combined into one alliance (Reid and Hall 2010).

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Succulent low shrublands dominated by *Nolina parryi* or *Nolina microcarpa* with >3% absolute cover and evenly distributed over scattered low shrubs and herbs (Thomas et al. 2004, Sawyer et al. 2009).

VEGETATION

Physiognomy and Structure: Tall rosette shrubs are emergent over a short-shrub canopy. The canopy is open. The herbaceous layer is sparse. Emergent individual trees and shrubs, up to 5 m in height, may be present.

Floristics: This extremely xeromorphic evergreen shrubland of the southwestern mountains and deserts is characterized by the rosette shrubs *Nolina parryi* (= *Nolina bigelovii* var. *parryi*) or *Nolina microcarpa* forming an open canopy over a low-shrub layer. Shrubs may include *Acacia greggii*, *Agave deserti*, *Ambrosia dumosa*, *Coleogyne ramosissima*, *Encelia farinosa*, *Ericameria linearifolia*, *Ericameria teretifolia*, *Eriogonum fasciculatum*, *Eriogonum heermannii*, *Ferocactus cylindraceus*, *Hyptis emoryi*, *Cylindropuntia acanthocarpa*, *Salazaria mexicana*, *Salvia mohavensis*, and *Thamnosma montana* (Sawyer et al. 2009). Emergent individuals of *Juniperus californica*, *Yucca schidigera*, and/or *Fouquieria splendens* may occur. The herbaceous layer is sparse and often composed of perennial graminoids such as *Achnatherum speciosum* and *Poa secunda*.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance is found in the Mojave Desert of California, and in Arizona and southern Nevada. This widespread xeromorphic evergreen shrublands of the desert Southwest is highly localized and requires very xeric conditions, although its range extends beyond the pure deserts of the Mojave and Colorado (Sawyer et al. 2009). Stands may occur at elevations ranging from 250 to 2250 m. Stands typically occur on steep slopes, ridges or in valleys (Sawyer et al. 2009). Optimal soils are thin and rocky, and are derived from granite crystalline metamorphic rocks or are of calcareous origin.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is found in the Mojave Desert of California, and in Arizona and southern Nevada.

Nations: US

States/Provinces: AZ, CA, NV

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > *Nolina (bigelovii, parryi)* (*Nolina* scrub) Alliance (Sawyer et al. 2009) [33.080.00]
- = *Nolina (bigelovii-parryi-microcarpa)* Mojave Desert Shrubland Alliance (Reid and Hall 2010)

LOWER LEVEL UNITS

Associations:

- C EGL002956 *Nolina parryi* Shrubland [Placeholder]
- C EGL003064 *Nolina bigelovii* Shrubland

AUTHORSHIP

Primary Concept Source: M.S. Reid and M.E. Hall (2010)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by M.S. Reid.

Version Date: 2014/12/18

REFERENCES

References: Cheatham and Haller 1975, Faber-Langendoen et al. 2017b, Hickman 1993, Holland 1986b, Keeler-Wolf and Thomas 2000, Reid and Hall 2010, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Thomas et al. 2004

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G296. Mojave Mid-Elevation Mixed Desert Scrub

A0833. *Purshia stansburiana* Scrub Alliance

Type Concept Sentence: This alliance consists of shrublands dominated by *Purshia stansburiana*. It occurs throughout the Intermountain West at middle elevations (800-2000 m) on edges of intermittent watercourses, canyons, hills, steep slopes, and cliffs. Soils are well-drained, shallow, rocky, rapidly permeable, and usually calcareous.

OVERVIEW

Scientific Name: *Purshia stansburiana* Scrub Alliance

Common Name (Translated Scientific Name): Stansbury's Cliffrose Scrub Alliance

Colloquial Name: Stansbury's Cliffrose Scrub

Type Concept: This alliance consists of shrublands dominated by *Purshia stansburiana*. Associated shrubs include *Agave utahensis*, *Artemisia nova*, *Artemisia tridentata*, *Coleogyne ramosissima*, *Ephedra viridis*, *Ericameria nauseosa* (= *Chrysothamnus nauseosus*), *Mortonia utahensis*, and *Yucca baccata*. The herbaceous ground layer is typically sparse and includes *Achnatherum speciosum*, *Poa secunda*, *Pseudoroegneria spicata*, and *Sporobolus cryptandrus*. Emergent *Juniperus osteosperma* and *Pinus monophylla* trees may be present. Stands occur throughout the Intermountain West at middle elevations (800-2000 m) on edges of intermittent watercourses, canyons, hills, steep slopes, and cliffs. Soils are well-drained, shallow, rocky, rapidly permeable, and usually calcareous, but it is known to occur on limestone. Precipitation averages 20-45 cm annually. The alliance in California is restricted to mountains of the eastern Mojave Desert and adjacent Great Basin. It occurs in small, scattered stands on relatively steep slopes, which are often adjacent to *Pinus monophylla* stands or *Artemisia tridentata* or *Purshia tridentata* shrublands. Virtually all stands observed occur on limestone or marble. Disturbance from flooding is likely in the canyon bottom stands.

Classification Comments: All the associations in the alliance for the western U.S. are based upon the old taxon of *Purshia mexicana* var. *stansburiana*, which is now treated as *Purshia stansburiana*. *Purshia mexicana* is considered by most taxonomists to occur in far southern Arizona and into Mexico, with *Purshia stansburiana* occurring in the Colorado Plateau, Great Basin and Mojave regions.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Shrublands dominated by or with a significant component of *Purshia stansburiana*.

VEGETATION

Physiognomy and Structure: These are microphyllous evergreen shrublands that grows up to 8 m tall.

Floristics: This alliance consists of shrublands dominated by *Purshia stansburiana*. Associated shrubs include *Agave utahensis*, *Artemisia nova*, *Artemisia tridentata*, *Coleogyne ramosissima*, *Ephedra viridis*, *Ericameria nauseosa* (= *Chrysothamnus nauseosus*), *Mortonia utahensis*, and *Yucca baccata*. The herbaceous ground layer is typically sparse and includes *Achnatherum speciosum*, *Poa secunda*, *Pseudoroegneria spicata*, and *Sporobolus cryptandrus*. Emergent *Juniperus osteosperma* and *Pinus monophylla* trees may be present.

ENVIRONMENT & DYNAMICS

Environmental Description: The vegetation in this alliance occurs at middle elevations (800-2000 m) of the Intermountain West, usually in washes, on cliffs, or on steep, rocky terrain. Precipitation averages 20-45 cm annually. These communities occur on skeletal soils derived from granitic or sedimentary parent materials. In central Utah the alliance is associated with limestone (Price and Brotherson 1987).

Dynamics: Fire is probably infrequent in this alliance since stands are relatively open and have low fuel loads. The ability of *Purshia stansburiana* to sprout after fire varies geographically. In general, it appears to be a weak sprouter, and plants are usually killed after severe and even light fires (Howard 1995). *Purshia stansburiana* does not appear to sprout after fire in California, and fire in the rocky, sparsely vegetated stands is probably very rare. Price and Brotherson (1987) report that there has been a noticeable decline in recruitment of *Purshia stansburiana* since 1957 at sites in Utah. They attributed the decline to competitive exclusion and increased fire frequency associated with invasion by non-native annual grasses.

DISTRIBUTION

Geographic Range: This alliance has been described from Arizona, California and Utah but may occur elsewhere across the southwest from southeastern California east to Colorado and south into Mexico.

Nations: MX?, US

States/Provinces: AZ, CA, CO?, NV?, UT

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007): 322Aj:CCC, 341Fc:CCC, 341Fd:CCC, 341Ff:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Cowania mexicana* var. *stansburiana* (Price and Brotherson 1987)
- = *Purshia stansburiana* (Stansbury cliff rose scrub) Alliance (Sawyer et al. 2009) [33.240.00]
- = *Purshia stansburiana* Shrubland Alliance (Evens et al. 2014)
- = *Purshia stansburiana* Shrubland Alliance (CNPS 2017) [33.240.00]
- >< Big Sagebrush Scrub (#35210) (Holland 1986b)
- >< Great Basin Mixed Scrub (#35100) (Holland 1986b)
- >< Sagebrush Steppe (#35300) (Holland 1986b)
- < Singleleaf pinyon-Utah juniper series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS**Associations:**

- C EGL002957 *Purshia stansburiana* Shrubland
- C EGL001053 *Purshia stansburiana* / *Pseudoroegneria spicata* Shrubland
- C EPP006749 *Purshia stansburiana* - *Artemisia tridentata* Shrubland
- C EGL004011 *Purshia stansburiana* - *Eriogonum corymbosum* Shrubland
- C EPP006748 *Purshia stansburiana* - *Agave utahensis* Shrubland
- C EGL002948 *Purshia stansburiana* - *Arctostaphylos patula* Shrubland

AUTHORSHIP

Primary Concept Source: D. Sarr, in Faber-Langendoen et al. (2013)

Author of Description: M.S. Reid

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: CNPS 2017, Evens et al. 2014, Faber-Langendoen et al. 2017b, Holland 1986b, Howard 1995, Keeler-Wolf and Thomas 2000, Mozingo 1987, Price and Brotherson 1987, Reid et al. 1999, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Warren et al. 1982

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G296. Mojave Mid-Elevation Mixed Desert Scrub

A3148. *Yucca brevifolia* Wooded Scrub Alliance

Type Concept Sentence: The vegetation is characterized by an emergent (up to 13 m tall) and typically abundant *Yucca brevifolia* layer over a shrub-dominated understory layer and/or a perennial graminoid-dominated layer. It is generally limited to the Mojave Desert, but may extend into the transition zone with the southern Great Basin.

OVERVIEW

Scientific Name: *Yucca brevifolia* Wooded Scrub Alliance

Common Name (Translated Scientific Name): Joshua Tree Wooded Scrub Alliance

Colloquial Name: Joshua Tree Wooded Scrub

Type Concept: This alliance is generally limited to the Mojave Desert, but may extend into the transition zone with the southern Great Basin. The vegetation is characterized by an emergent (up to 13 m tall) and open canopy of *Yucca brevifolia* over an open to moderately dense short-shrub layer and/or a perennial graminoid-dominated layer. *Yucca brevifolia* must be evenly distributed with over 1% total cover. Emergent *Quercus turbinella*, *Pinus monophylla*, or *Juniperus* spp. may be present, but have less than 1% cover. Shrub and ground layers are variable. Shrub species may include *Artemisia tridentata*, *Chrysothamnus viscidiflorus*, *Coleogyne ramosissima*, *Ephedra nevadensis*, *Eriogonum fasciculatum*, *Larrea tridentata*, *Lycium andersonii*, *Cylindropuntia acanthocarpa* (= *Opuntia acanthocarpa*), *Salazaria mexicana*, *Tetradymia axillaris*, and *Yucca schidigera*. If present, the herbaceous layer is usually open to intermittent and is dominated by perennial grasses, such as *Achnatherum speciosum*, *Pleuraphis jamesii* (above 1400 m), *Pleuraphis rigida*, or *Poa secunda*, and seasonal annuals. Other graminoid species may include *Achnatherum hymenoides* or *Muhlenbergia porteri*. Forb cover is mostly from seasonal annuals. Stands are found on gentle to moderate alluvial fans, slopes and ridgetops. Stands occur at mid-elevations ranging from 750-1800 m. Soil types and elevation limit the distribution of the vegetation. Soils are derived from colluvial or alluvial deposits and have variable textures, ranging from gravel, coarse sand or loamy, to fine silt.

Classification Comments: The concept and description of this alliance are based on classification work done by Thomas et al. (2004) on the Mojave Ecosystem Mapping Project and Sawyer et al. (2009), and this concept has not yet been expanded to include current vegetation classification projects in the Mojave Desert and Grand Canyon. The original concept was made to include *Yucca brevifolia* - *Juniperus osteosperma* / *Artemisia tridentata* Wooded Shrubland (CEGL002744), but this is noted to be a Great Basin element. Stands of vegetation with relatively sparse cover of *Yucca brevifolia* are included in this wooded herbaceous alliance because of the results of quantitative analysis of a large number of stands conducted by Keeler-Wolf and Thomas (2000). Although cover of *Yucca brevifolia* was variable, the analysis showed that even 1% cover is a good indicator for this mid- to upper-elevation Mojave Desert vegetation type as long as the cover is evenly distributed and trees species such as *Pinus monophylla*, *Juniperus californica*, or *Juniperus osteosperma* have less than 1% cover. The indicator species, *Yucca brevifolia*, is recognized at a lower cover level (<1%) than is standard for a wooded herbaceous alliance in the USNVC because of Thomas et al.'s (2004) research.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: *Yucca brevifolia* evenly distributed at $\geq 1\%$ cover with *Juniperus* and/or *Pinus* spp. <1% absolute cover in the tree canopy (Thomas et al. 2004).

VEGETATION

Physiognomy and Structure: Vegetation in this alliance has an sparse to open emergent xeromorphic tree canopy (up to 12 m in height) above an open to sparse(or absent) shrub layer that is less than 3 m tall. The ground layer may be sparse to moderately dense is often dominated by perennial graminoids with sparse to abundant cacti. Annuals may be seasonally present.

Floristics: This desert vegetation is characterized by an emergent (up to 13 m tall) and open canopy of *Yucca brevifolia* over an open to moderately dense short shrub layer and/or a perennial graminoid-dominated layer. *Yucca brevifolia* must be evenly distributed with over 1% total cover (Keeler-Wolf and Thomas 2000). Emergent *Quercus turbinella*, *Pinus monophylla* or *Juniperus* spp. may be present, but have less than 1% cover (Sawyer et al. 2009). Shrub and ground layers are variable. Shrub species may include *Artemisia tridentata*, *Chrysothamnus viscidiflorus*, *Coleogyne ramosissima*, *Ephedra nevadensis*, *Eriogonum fasciculatum*, *Larrea tridentata*, *Lycium andersonii*, *Cylindropuntia acanthocarpa* (= *Opuntia acanthocarpa*), *Salazaria mexicana*, *Tetradymia axillaris*, and *Yucca schidigera*. Other shrub present such as *Ambrosia dumosa*, *Ericameria cooperi*, *Ericameria nauseosa*, *Ericameria linearifolia*, *Gutierrezia microcephala*, *Hymenoclea salsola*, *Krascheninnikovia lanata*, *Sphaeralcea ambigua*, or *Yucca baccata*. If present, the herbaceous layer is usually is open to intermittent and is dominated by perennial grasses, such as *Achnatherum speciosum*, *Pleuraphis jamesii* (above 1400 m), *Pleuraphis rigida*, or *Poa secunda*, and seasonal annuals. Other graminoid species may include *Achnatherum hymenoides* or *Muhlenbergia porteri*. Forb cover is mostly from seasonal annuals (Thomas et al. 2004).

ENVIRONMENT & DYNAMICS

Environmental Description: This Mojave Desert alliance is found on alluvial fans, gentle to moderate alluvial fans, slopes and ridgetops. Stands occurs at mid-elevations ranging from 750-1800 m (Sawyer et al. 2009). Climate is semi-arid. Annual precipitation varies from 4 to 20 cm, and summer droughts are typical. Soil types and elevation limit the distribution of the vegetation. Soils are derived from colluvial or alluvial deposits and have variable textures, ranging from gravel, coarse sand or loamy, to fine silt. Some stands have bimodal soils with both coarse- and fine-textured layers (Keeler-Wolf and Thomas 2000).

Dynamics: Natural fire regimes may have been altered because of grazing by livestock and fire suppression over the last 100 years, causing a reduction in fire frequency. This may allow the presence of relatively fire-intolerant species such as *Artemisia tridentata*, *Coleogyne ramosissima*, or *Larrea tridentata* in stands of this alliance (Keeler-Wolf and Thomas 2000).

DISTRIBUTION

Geographic Range: This alliance is generally limited to the Mojave Desert, but may extend into the transition zone with the southern Great Basin.

Nations: US

States/Provinces: AZ, CA, NV, UT?

TNC Ecoregions [optional]: 11:C, 12:C, 16:C, 17:C

USFS Ecoregions (2007): 322Aj:CCC, 322Ak:CCC, 322Al:CCC, 322Av:CCC, 341Fb:CCC, 341Fc:CCC, 341Fe:CCC, M261E:CC, M262B:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Joshua Tree, Lake Mead, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Yucca brevifolia* (Joshua tree woodland) Alliance (Sawyer et al. 2009) [33.170.00]
- = *Yucca brevifolia* Wooded Shrubland Alliance (Evens et al. 2014)
- = *Yucca brevifolia* Woodland Alliance (Evens et al. 2012)
- = *Yucca brevifolia* Woodland Alliance (Thomas et al. 2004)
- = *Yucca brevifolia* Woodland Alliance (CNPS 2017) [33.170.00]
- >< Joshua Tree Series: PSW-45 Type (Paysen et al. 1980)
- >< Joshua Tree Woodland (Cheatham and Haller 1975)
- >< Joshua Tree Woodland (#73000) (Holland 1986b)
- = Joshua tree series (Sawyer and Keeler-Wolf 1995)
- >< Mojave Mixed Steppe (#34220) (Holland 1986b)
- >< Mojave Mixed Woody Scrub (#34210) (Holland 1986b)

LOWER LEVEL UNITS**Associations:**

- CEGLO02725 *Yucca brevifolia* / *Pleuraphis rigida* Wooded Grassland
- CEGLO03116 *Yucca brevifolia* Wooded Shrubland
- CEGLO02744 *Yucca brevifolia* - *Juniperus osteosperma* / *Artemisia tridentata* Wooded Shrubland
- CEGLO05294 *Yucca brevifolia* / *Coleogyne ramosissima* Wooded Shrubland
- CEGLO05777 *Yucca brevifolia* / *Larrea tridentata* - *Yucca schidigera* / *Pleuraphis rigida* Wooded Shrubland
- CEGLO05776 *Yucca brevifolia* / (*Prunus fasciculata*, *Salazaria mexicana*) Wooded Shrubland
- CEPP006862 *Yucca brevifolia* / (*Yucca baccata*) / *Pleuraphis (rigida, jamesii)* Wooded Shrubland
- CEGLO05779 *Yucca brevifolia* / *Cylindropuntia acanthocarpa* Wooded Shrubland
- CEPP006854 *Yucca brevifolia* / (*Artemisia tridentata*, *Atriplex confertifolia*) Wooded Shrubland
- CEGLO05778 *Yucca brevifolia* / *Lycium andersonii* - *Ephedra nevadensis* Wooded Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Thomas et al. (2004)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by M. Schindel.

Version Date: 2014/12/18

REFERENCES

References: Barbour and Major 1977, CNPS 2017, Cheatham and Haller 1975, Evens et al. 2012, Evens et al. 2014, Faber-Langendoen et al. 2017b, Gucker 2006a, Holland 1986b, Johnson 1976, Keeler-Wolf 2007, Keeler-Wolf and Thomas 2000, Keeler-

Wolf et al. 2005, MacMahon 1988, Paysen et al. 1980, Reid et al. 1999, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Thomas et al. 2004, Thorne 1982, Turner 1982a, Turner 1982b, Vasek and Barbour 1988, VegCAMP and AIS 2013

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G296. Mojave Mid-Elevation Mixed Desert Scrub

A3147. *Yucca schidigera* Scrub Alliance

Type Concept Sentence: Stands of this shrubland alliance have a sparse, emergent tree layer of *Yucca schidigera* with 3-5% total cover over a shrub canopy. It occurs throughout the Mojave and Colorado deserts, and southern Great Basin on alluvial fans, rocky slopes and upper bajadas.

OVERVIEW

Scientific Name: *Yucca schidigera* Scrub Alliance

Common Name (Translated Scientific Name): Mojave Yucca Scrub Alliance

Colloquial Name: Mojave Yucca Scrub

Type Concept: Stands of this desert alliance are found throughout the Mojave and Colorado deserts and southern Great Basin. The vegetation is characterized by a sparse, emergent woody layer of *Yucca schidigera* (2-5 m tall) with 3-5% total cover over an open to moderately dense short-shrub layer. Short shrubs present may include *Ambrosia dumosa*, *Agave deserti*, *Coleogyne ramosissima*, *Echinocactus polycephalus*, *Echinocereus engelmannii*, *Encelia farinosa*, *Ephedra nevadensis*, *Eriogonum fasciculatum*, *Ferocactus cylindraceus*, *Larrea tridentata*, *Cylindropuntia acanthocarpa*, *Opuntia* spp., *Peucephyllum schottii*, *Salazaria mexicana*, *Simmondsia chinensis*, and *Viguiera parishii*. The herbaceous layer is open or patchy to sparse and often dominated by *Pleuraphis rigida* with annuals seasonally present. Stands occur on alluvial fans, rocky slopes and upper bajadas. Sites are rocky, well-drained slopes between 50 and 2500 m elevation, but stands regularly occur above 900 m in the Mojave Desert. Substrates are well-drained sandy loams.

Classification Comments: *Yucca schidigera* is one of the characteristic shrubs at mid elevations in the eastern and central Mojave Desert and of the desert slopes of the Peninsular and Transverse ranges. In these areas, *Yucca schidigera* rarely dominates but acts as an indicator species at low cover in stands at slightly lower elevations and on shallower soils than those of *Yucca brevifolia* Wooded Scrub Alliance (A3148). Some stands attain the highest shrub diversities, up to 30 species, found in hot deserts of California. Stands grade into those of *Larrea tridentata* - *Ambrosia dumosa* Bajada & Valley Desert Scrub Alliance (A3277) at lower elevations and at mid elevations into *Coleogyne ramosissima* Mojave Desert Scrub Alliance (A3144), *Eriogonum fasciculatum* - *Viguiera parishii* Desert Scrub Alliance (A3150), *Grayia spinosa* Scrub Alliance (A3171), *Ephedra nevadensis* - *Lycium andersonii* - *Grayia spinosa* Scrub Alliance (A4245), and *Prunus fasciculata* - *Salazaria mexicana* Northern Mojave Desert Wash Scrub Alliance (A4185).

There are several new proposed associations from California which do not have descriptions, but are identified in Sawyer et al. (2009). Therefore, this alliance description will require revision when they are authored and included in the USNVC.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Stands of this alliance have *Yucca schidigera* with >2% cover in the emergent small tree layer or shrub layer over a short-shrub canopy; other species, including *Ambrosia dumosa* and *Larrea tridentata*, may be equal or higher cover (Thomas et al. 2004). *Yucca schidigera* may not be dominant, but is regarded as an indicator species with other desert scrub species often dominating the vegetation (Sawyer et al. 2009).

VEGETATION

Physiognomy and Structure: This succulent, extremely xeromorphic, evergreen shrubland has emergent trees (<2-5 m tall) over an open desert scrub canopy. *Yucca schidigera* is very low in total cover but dominates the tree layer. The herbaceous layer is often dominated by graminoids.

Floristics: Stands of this shrubland of the Mojave and Colorado deserts are characterized by a sparse, emergent woody layer of *Yucca schidigera* with 3-5% total cover over a short-shrub canopy. *Yucca schidigera* range from 2-9 m tall, but are usually <5 m tall. Short shrubs present may include *Ambrosia dumosa*, *Agave deserti*, *Coleogyne ramosissima*, *Echinocactus polycephalus*, *Echinocereus engelmannii*, *Encelia farinosa*, *Ephedra nevadensis*, *Eriogonum fasciculatum*, *Ferocactus cylindraceus*, *Larrea tridentata*, *Cylindropuntia acanthocarpa*, *Opuntia* spp., *Peucephyllum schottii*, *Salazaria mexicana*, *Simmondsia chinensis*, and *Viguiera parishii*. The herbaceous layer is open or patchy to sparse and often dominated by *Pleuraphis rigida* with annuals seasonally present.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands of this desert alliance are found throughout the Mojave and Colorado deserts and southern Great Basin on alluvial fans, rocky slopes and upper bajadas. The climate is semi-arid with yearly precipitation totals are quite low, averaging between 10 and 25 cm. Year-to-year precipitation variability can be quite large. Sites are rocky, well-drained slopes between 50 and 2500 m elevation, but stands regularly occurs above 900 m in the Mojave Desert. Substrates are well-drained sandy loams.(Sawyer et al. 2009).

Dynamics: This alliance occurs in extremely xeric sites and is well-adapted to prolonged drought and heat stress. Growth slows or stops in winter due to cold and is inhibited at other times by heat. Winter rains are sometimes sufficient to allow ephemeral herbs to flower in the spring. Late summer thunderstorms also contribute moisture.

Yucca schidigera sprouts from roots after fire or mechanical disturbance (Tirmenstein 1990). Sprouting is less vigorous when the plants are severely injured (Vasek et al. 1975). A high percentage of individuals can survive recurrent fire (Tratz 1978), most likely the result of patchy fires and strong sprouting abilities. However, plant response varies in different regions. For example, plants in the Mojave Desert took up to 6 years to attain pre-burn cover with many more years to recover stature and biomass, whereas plants in southern California chaparral responded more readily in 2 years with an increase in stem number (Tirmenstein 1990). The fire characteristics are little known for this alliance.

DISTRIBUTION

Geographic Range: Stands of this desert alliance occur throughout the Mojave and Colorado deserts, and southern Great Basin.

Nations: US

States/Provinces: AZ, CA, NV

TNC Ecoregions [optional]: 11:C, 16:C, 17:C, 23:C

USFS Ecoregions (2007): 322Ai:CCC, 322Aj:CCC, 322Ak:CCC, 322Al:CCC, 322Am:CCC, 322Av:CCC, 322B:CC, 322C:CC, 341F:CC, M262B:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Joshua Tree, Lake Mead, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = *Yucca schidigera* (Mojave yucca scrub) Alliance (Sawyer et al. 2009) [33.070.00]
- = *Yucca schidigera* Shrubland Alliance (Evens et al. 2012)
- = *Yucca schidigera* Shrubland Alliance (Evens et al. 2014)
- = *Yucca schidigera* Shrubland Alliance (CNPS 2017) [33.070.00]
- >< Mojave Mixed Steppe (#34220) (Holland 1986b)
- >< Mojave Yucca Scrub and Steppe (#34230) (Holland 1986b)
- = Mojave yucca series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS**Associations:**

- CEG003117 *Yucca schidigera* / *Pleuraphis rigida* Shrubland
- CEG005295 *Yucca schidigera* - *Larrea tridentata* - *Ambrosia dumosa* Shrubland
- CEG005782 *Yucca schidigera* - *Larrea tridentata* - *Ephedra nevadensis* Shrubland
- CEG005781 *Yucca schidigera* - *Eriogonum fasciculatum* Shrubland
- CEG005783 *Yucca schidigera* - *Cylindropuntia acanthocarpa* Shrubland
- CEG005780 *Yucca schidigera* - *Coleogyne ramosissima* Shrubland

AUTHORSHIP

Primary Concept Source: J.O. Sawyer, T. Keeler-Wolf, and J. Evens (2009)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by M. Schindel.

Version Date: 2014/12/18

REFERENCES

References: Burk 1977, CNPS 2017, Evens et al. 2012, Evens et al. 2014, Faber-Langendoen et al. 2017b, Holland 1986b, Keeler-Wolf and Thomas 2000, Keeler-Wolf et al. 1998a, Keeler-Wolf et al. 2005, MacMahon 1988, Reid et al. 1999, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Thorne 1982, Tirmenstein 1990, Tratz 1978, Vasek et al. 1975, VegCAMP and AIS 2013

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

3.B.1.Ne.1.b. M171 Great Basin-Intermountain Dry Shrubland & Grassland

G312. Colorado Plateau Blackbrush - Mormon-tea Shrubland

Type Concept Sentence: This semi-arid shrubland group occurs in the Colorado Plateau on sandy substrates and is characterized by extensive, typically open shrublands dominated by *Artemisia filifolia*, *Coleogyne ramosissima*, *Ephedra cutleri*, *Ephedra torreyana*, *Ephedra viridis*, *Poliomintha incana*, *Quercus havardii* var. *tuckeri*, or *Vancleavea stylosa*.

OVERVIEW

Scientific Name: *Coleogyne ramosissima* - *Ephedra cutleri* - *Ephedra torreyana* Colorado Plateau Shrubland Group

Common Name (Translated Scientific Name): Blackbrush - Cutler's Joint-fir - Torrey's Joint-fir Colorado Plateau Shrubland Group

Colloquial Name: Colorado Plateau Sand Sagebrush Shrubland

Type Concept: This semi-arid Colorado Plateau shrubland group is characterized by extensive, typically open shrublands dominated by *Coleogyne ramosissima* or one of three species of *Ephedra*: *Ephedra cutleri*, *Ephedra torreyana*, or *Ephedra viridis*. *Ephedra cutleri* and *Ephedra viridis* often assume a distinctive matty growth form. Other dominant /diagnostic shrubs that occur either singly or in mixed stands include *Artemisia filifolia* (often on deep-sand sites), *Poliomintha incana*, *Quercus havardii* var. *tuckeri*, and *Vancleavea stylosa*. Other more widespread shrubs, such as *Ericameria nauseosa* and *Grayia spinosa*, may be present to dominant locally. The herbaceous layer is sparse and composed of graminoids such as *Achnatherum hymenoides*, *Hesperostipa comata*, *Pleuraphis jamesii*, or *Sporobolus cryptandrus*. The general aspect of occurrences is an open low shrubland but may include small blowouts and dunes. Occasionally grasses may be moderately abundant locally and form a distinct layer. Stands occur on windswept mesas, benchlands, colluvial slopes, pediments, alluvial fans, broad basins and plains. Elevation ranges from 560-1800 m. Substrates are shallow, typically calcareous, non-saline and gravelly or sandy soils over sandstone bedrock or limestone bedrock (less common), caliche or limestone alluvium. It also occurs in deeper soils on sandy plains and stabilized sandsheets and may form small hummocks or small coppice dunes. Disturbance may be important in maintaining the woody component. Eolian processes are evident, such as pediceled plants, occasional blowouts or small dunes, but the generally higher vegetative cover and less prominent geomorphic features distinguish this group from active and stabilized dune complexes.

Classification Comments:**Similar NVC Types:**

- G296 Mojave Mid-Elevation Mixed Desert Scrub

Diagnostic Characteristics: *Coleogyne ramosissima* is an indicator species for this shrubland group in the northern portion of its range and often dominates or codominates with species of *Ephedra*. *Ephedra* species are typically present to dominant throughout the range of this group with *Ephedra cutleri* largely restricted to the southern portions. *Artemisia filifolia* may also be present to dominant, but is a widespread western shrub on sandy substrates and is not a good indicator of this Colorado Plateau group.

VEGETATION

Physiognomy and Structure: This group is composed of a typically open evergreen, microphyllous semi-desert scrub with succulents, half-shrubs, and scattered deciduous shrubs. Occasionally shrub cover can be moderately dense. Herbaceous species are typically sparse and composed of perennial graminoids.

Floristics: This semi-arid shrubland group is characterized by extensive, typically open shrublands dominated by *Coleogyne ramosissima* or one of several different species of *Ephedra*: *Ephedra cutleri*, *Ephedra torreyana*, or *Ephedra viridis*. *Ephedra cutleri* and *Ephedra viridis* often assume a distinctive matty growth form. *Artemisia filifolia* is often present and may be codominant to dominant on deep-sand sites. *Poliomintha incana*, *Quercus havardii* var. *tuckeri*, and *Vancleavea stylosa* may also dominant stands in either singly or in mixed stands. Other more widespread shrubs may be present, including *Atriplex canescens*, *Atriplex confertifolia*, *Ericameria nauseosa*, and *Grayia spinosa*, but not dominant. The herbaceous layer is sparse and composed of perennial graminoids such as *Achnatherum hymenoides*, *Bouteloua gracilis*, *Hesperostipa comata*, *Pleuraphis jamesii*, or *Sporobolus cryptandrus*. The general aspect of occurrences is an open low shrubland but may include small blowouts and dunes. Occasionally grasses may be moderately abundant locally and form a distinct layer.

ENVIRONMENT & DYNAMICS

Environmental Description: This semi-arid shrubland group occurs in the Colorado Plateau on windswept mesas, benchlands, colluvial slopes, pediments, alluvial fans, broad basins and plains. Elevation ranges from 560-1800 m. Substrates are shallow, typically calcareous, non-saline and gravelly or sandy soils over sandstone bedrock and, less commonly, limestone bedrock (regolith),

caliche (petrocalcic layer) or limestone alluvium. Stands also occur in deeper soils on extensive sandy plains and stabilized sandsheets and may form small hummocks or small coppice dunes. Disturbance may be important in maintaining the woody component. Eolian processes are evident, such as pediceled plants, occasional blowouts or small dunes, but the generally higher vegetative cover and less prominent geomorphic features distinguish this group from active and stabilized dune complexes.

Climate: This shrubland group occurs in an arid to semi-arid climate with annual precipitation in the form of summer monsoons and winter storms averaging approximately 20 cm. **Soil/substrate/hydrology:** This group typically occurs on gentle to steep, bouldery or rocky slopes of mountains, canyons, and mesas with varying aspects, but includes extensive sandy plains and basin in the southern portion of the Colorado Plateau. Soils are highly variable, and parent materials may include shale, sandstone, limestone, quartzites, and igneous rocks. Soils are generally coarse-textured, often rocky, shallow and well-drained. Effective soil moisture appears to be primarily controlled by depth of regolith (layer of loose, heterogeneous material covering solid rock) and position in relation to the water table. In most sites the regolith is uniformly shallow. In association with blackbrush (*Coleogyne ramosissima*) sites, the soil moisture is concentrated on top of impermeable bedrock at a shallow depth. This perching effect allows for gradual uptake of moisture by the plants roots (Loope and West 1979). This permits growth of plants with more mesic habitat requirements (Warren et al. 1982). On sites with deep soil, blackbrush may occur in almost pure stands with only a few associated species (Warren et al. 1982). Dark-colored cryptogamic soil crusts, composed of lichens, mosses, fungi, and algae, are often present in this group in fairly undisturbed areas. Sandy soils may have more cryptogamic crusts than clayish or silty soil surfaces. This group also occurs in deeper soils on sandy plains and stabilized sandsheets and may form small hummocks or small coppice dunes. Eolian processes are evident, such as pediceled plants, occasional blowouts or small dunes, but the generally higher vegetative cover and less prominent geomorphic features distinguish this group from active and stabilized dune complexes.

Dynamics: Fire does not appear to play a role in maintenance of shrublands within this group. Topographic breaks dissect the landscape, and isolated pockets of vegetation are separated by rockwalls or steep canyons. Blackbrush is fire-intolerant (Loope and West 1979). Following fires, these communities are often colonized by non-native grasses, which serve to encourage recurrent fires and delay shrub regeneration (Reid et al. 1999). In shallow regolith situations, secondary succession, in the sense of site preparation by seral plants, may not occur at all (Loope and West 1979). When this vegetation group (especially *Artemisia filifolia*-dominated stands) occurs on deeper loessal soils, some consider this shrub invasion of semi-desert shrub-steppe (Loope 1977).

Disturbance may be important in maintaining the woody component. Eolian processes are typically evident, such as pediceled plants, occasional blowouts or small dunes, but the generally higher vegetative cover and less prominent geomorphic features distinguish this group from active and stabilized dune complexes.

DISTRIBUTION

Geographic Range: This group occurs in the Colorado Plateau on benchlands, colluvial slopes, pediments or alluvial fans common in Canyonlands portion in central Utah and extends south into southern Utah and northeastern Arizona where it occurs on vast sandy plains and mesatops.

Spatial Scale & Pattern [optional]: Large patch

Nations: US

States/Provinces: AZ, CO, NM, NV, UT

TNC Ecoregions [optional]: 18:C, 19:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313D:CC, 322A:CC, 341B:CC, 341C:C?, 341F:CP, M313A:CC, M331E:PP, M331H:PP, M341B:CC, M341C:PP

Omernik Ecoregions:

Federal Lands [optional]: NPS (Arches, Canyonlands)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = Colorado Plateau - Mohavian Blackbush Semi-Desert (West 1983d)

LOWER LEVEL UNITS

Alliances:

- A3220 *Coleogyne ramosissima* Colorado Plateau Shrubland Alliance
- A0862 *Poliomintha incana* Shrubland Alliance
- A3201 *Ephedra viridis* Colorado Plateau Shrubland Alliance
- A3181 *Artemisia filifolia* Colorado Plateau Shrubland Alliance
- A2572 *Ephedra torreyana* Shrubland Alliance
- A2654 *Quercus havardii* var. *tuckeri* Shrubland Alliance
- A2644 *Ephedra cutleri* Shrubland Alliance

AUTHORSHIP

Primary Concept Source: N.E. West (1983d)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 11/06/2015

Classif Resp Region: West

Internal Author: KAS 2-10, 11-15

REFERENCES

References: AZGAP unpubl. data 2004, Faber-Langendoen et al. 2017a, Loope 1977, Loope and West 1979, Reid et al. 1999, Shiflet 1994, Thatcher 1975, Tuhy and MacMahon 1988, Tuhy et al. 2002, Warren et al. 1982, West 1983d

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G312. Colorado Plateau Blackbrush - Mormon-tea Shrubland

A3181. *Artemisia filifolia* Colorado Plateau Shrubland Alliance

Type Concept Sentence: Shrublands of the Colorado Plateau dominated by *Artemisia filifolia* on flat, hummocky, or rolling terrain, as well as on partially stabilized dunes and sandsheets.

OVERVIEW

Scientific Name: *Artemisia filifolia* Colorado Plateau Shrubland Alliance

Common Name (Translated Scientific Name): Sand Sagebrush Colorado Plateau Shrubland Alliance

Colloquial Name: Colorado Plateau Sand Sagebrush Shrubland

Type Concept: The vegetation is characterized by an open shrub canopy dominated by *Artemisia filifolia* that is usually mixed with other shrubs. Total vegetation cover ranges broadly from sparsely vegetated disturbed sites with less than 5% total cover to stable, well-developed communities with more than 50% cover. Other shrub associates may include *Atriplex canescens*, *Coleogyne ramosissima*, *Ephedra torreyana*, *Ephedra viridis*, *Ericameria nauseosa*, *Eriogonum leptocladon*, *Opuntia* spp., *Sarcobatus vermiculatus*, and *Vanclvea stylosa*. The herbaceous layer is moderate in terms of species composition and provides sparse to moderate cover. Graminoids that may be present include *Achnatherum hymenoides*, *Hesperostipa comata*, *Pleuraphis jamesii*, *Sporobolus cryptandrus*, and *Vulpia octoflora*. The non-native *Bromus tectorum* may be prominent on disturbed sites. Forbs vary among sites but are typical of sandy habitats, including *Abronia fragrans*, *Lepidium montanum*, *Oenothera pallida*, *Salsola tragus*, and *Sphaeralcea parvifolia*. Cryptogams may be absent or may provide up to 40% cover. These shrublands are known from the Colorado Plateau and occur on sandy, often somewhat disturbed sites on valley floors, stream terraces, stabilized dunes and sandsheets, benches, floodplains and alluvial fans. Most sites are level to gently sloping, with a few on moderate slopes (up to 21%), and may be oriented to any aspect, although there is a slight tendency toward warmer southerly aspects. Elevations range from 1122 to 1769 m.

Classification Comments: There will be a need to clarify why this alliance does not belong in the other sagebrush groups. Little is known about *Artemisia filifolia* - *Ephedra (torreyana, viridis)* Shrubland (CEGL002786) and this alliance description is largely based on *Artemisia filifolia* Colorado Plateau Shrubland (CEGL002697).

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: This alliance is characterized by *Artemisia filifolia*-dominated shrublands of the Colorado Plateau. Total vegetation cover is low, typically not exceeding 30%. It occurs on sandy, often somewhat disturbed sites on valley floors, stream terraces, stabilized dunes and sandsheets, benches, floodplains and alluvial fans.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a sparse to moderately dense cover of microphyllous evergreen shrubs less than 1.5 m tall. The sparse to moderately dense graminoid layer is dominated by tall, medium-tall or short bunch grasses. Forb cover is generally sparse. Scattered broad-leaved deciduous tall shrubs may be present.

Floristics: The vegetation of this alliance is characterized by a sparse to moderately dense woody layer approximately 1 m tall that is dominated by the microphyllous evergreen shrub *Artemisia filifolia*. These shrubs usually do not grow as clumps but as individuals with the interstices most often dominated by a sparse to moderately dense layer of tall, mid or short grasses (Ramaley 1939a,

1939b, Steinauer 1989, Dick-Peddie 1993). Other shrub associates may include *Atriplex canescens*, *Coleogyne ramosissima*, *Ephedra torreyana*, *Ephedra viridis*, *Ericameria nauseosa*, *Eriogonum leptocladon*, *Opuntia* spp., *Sarcobatus vermiculatus*, and *Vancoveria stylosa*. The sparse to moderately dense herbaceous layer is typically dominated by graminoids. Graminoids that may be present include *Achnatherum hymenoides*, *Hesperostipa comata*, *Pleuraphis jamesii*, *Sporobolus cryptandrus*, and *Vulpia octoflora*. The non-native *Bromus tectorum* may be prominent on disturbed sites. Forbs vary among sites but are typical of sandy habitats, including *Abronia fragrans*, *Lepidium montanum*, *Oenothera pallida*, *Salsola tragus*, and *Sphaeralcea parvifolia*. Cryptogams may be absent or may provide up to 40% cover.

ENVIRONMENT & DYNAMICS

Environmental Description: This common alliance occurs on sandy sites on valley floors, valley sides, stream terraces, stabilized dunes and sandsheets, benches, floodplains, terraces and alluvial fans. Most sites are level to gently sloping, with a few on moderate slopes (up to 20%), and may be oriented to any aspect, although there is a slight tendency to occur on warmer southerly aspects. Elevations range from 1122 to 1769 m (3680-5803 feet). Sand or bare soil covers most of the unvegetated ground surface, although cryptobiological soil crusts may have up to 40% cover. Soils are sandy to sometimes gravelly and derived from local sandstones, alluvium, or eolian deposits.

Dynamics: These shrublands occur as any one of several stages in a successional sequence. Drought or overgrazing will reduce vegetation cover and can allow the wind to cause blowouts or active dunes (Ramaley 1939b). Ramaley (1939b) describes the succession in Colorado from loose sand to a sandhills - mixed community dominated by *Muhlenbergia pungens*. It then may proceed to an *Artemisia filifolia* community or skip this stage and succeed to the sand prairie, late-seral community dominated by *Andropogon hallii*, *Calamovilfa longifolia*, and *Hesperostipa comata*.

DISTRIBUTION

Geographic Range: This sand sagebrush shrubland alliance is widespread on sandy sites in the Colorado Plateau of Utah, Colorado, Arizona and New Mexico.

Nations: US

States/Provinces: AZ, CO, NM, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Artemisia filifolia* Series #303 (Johnston 1987)
- ? Sand Sagebrush (Dick-Peddie 1993) [New Mexico]

LOWER LEVEL UNITS

Associations:

- CEGLO02786 *Artemisia filifolia* - *Ephedra* (*torreyana*, *viridis*) Shrubland
- CEPP005686 *Artemisia filifolia* - *Ephedra cutleri* Sandsheet Shrubland
- CEGLO02697 *Artemisia filifolia* Colorado Plateau Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Dick-Peddie 1993, Faber-Langendoen et al. 2017b, Johnston 1987, Ramaley 1939a, Ramaley 1939b, Steinauer 1989

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G312. Colorado Plateau Blackbrush - Mormon-tea Shrubland

A3220. *Coleogyne ramosissima* Colorado Plateau Shrubland Alliance

Type Concept Sentence: These shrublands are characterized by a sparse to moderately dense shrub layer of *Coleogyne ramosissima* and are known from the Colorado Plateau, southern Great Basin, Mojave Desert, and Sierra Nevada foothills.

OVERVIEW

Scientific Name: *Coleogyne ramosissima* Colorado Plateau Shrubland Alliance

Common Name (Translated Scientific Name): Blackbrush Colorado Plateau Shrubland Alliance

Colloquial Name: Colorado Plateau Blackbrush Shrubland

Type Concept: The shrub layer is characterized by an open to relatively closed canopy of *Coleogyne ramosissima*. Total vegetation cover ranges from 5 to 70%. Other codominant and associate shrubs may include *Ambrosia dumosa*, *Artemisia filifolia*, *Atriplex canescens*, *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ephedra funerea*, *Ephedra torreyana*, *Ephedra nevadensis*, *Ephedra torreyana*, *Ericameria linearifolia*, *Ericameria nauseosa*, *Ericameria teretifolia*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Lycium* spp., *Menodora spinescens*, *Opuntia* spp., *Purshia stansburiana*, and *Quercus havardii* var. *tuckeri*. Occasional *Juniperus* spp., *Pinus edulis*, or *Pinus monophylla* trees are present in some stands. The herbaceous layer varies from sparse to moderate (1-30% cover) and composition varies by region, but is always dominated by graminoids. Dominant species include *Achnatherum hymenoides*, *Aristida purpurea*, *Dasyochloa pulchella* (= *Erioneuron pulchellum*), *Muhlenbergia pungens*, and *Pleuraphis jamesii*. Forbs may have high diversity, but do not have high cover. Associate forbs may include *Amsonia tomentosa*, *Astragalus* spp., *Calochortus nuttallii*, *Chaenactis* spp., *Cryptantha* spp., *Eriogonum inflatum*, *Eriogonum nutans*, *Heterotheca villosa*, *Ipomopsis polycladon*, *Phacelia* spp., *Plantago* spp., *Sphaeralcea leptophylla*, *Stenotus acaulis* (= *Haplopappus acaulis*), and *Streptanthella* spp. These shrublands are known from the Colorado Plateau, southern Great Basin, Mojave Desert, and Sierra Nevada foothills. Stands occur on plains, ridges, bajadas, mesatops, canyon rims, escarpments, valley sides, sand dunes, washes, alluvial terraces and benches with flat to steep slopes (up to 45%) with elevations ranging between 1000 and 2200 m.

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

- A3144 *Coleogyne ramosissima* Mojave Desert Scrub Alliance

Diagnostic Characteristics: Sparse to moderately dense shrublands dominated by *Coleogyne ramosissima* in association with other Colorado Plateau floristic elements. Topographic positions and landforms are highly variable.

VEGETATION

Physiognomy and Structure: The vegetation in this alliance is characterized by somewhat low to moderate cover (5-70%) of cold-deciduous or evergreen shrubs. The herbaceous layer is typically sparse (<20% cover) and dominated by caespitose perennial grasses or annual forbs and grasses. Scattered trees may form a sparse (0-10%) emergent layer in some stands, especially at the upper elevation margin and in the southwestern part of the range.

Floristics: The shrub layer is characterized by an open to relatively closed canopy of *Coleogyne ramosissima*. Total vegetation cover ranges from 5 to 70%. Although *Coleogyne ramosissima* is apparently restricted to a particular elevational zone, associated shrub species can be of Colorado Plateau, Mojavean or Great Basin affinities. Other codominant and associate shrubs may include *Ambrosia dumosa*, *Artemisia filifolia*, *Atriplex canescens*, *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ephedra funerea*, *Ephedra torreyana*, *Ephedra nevadensis*, *Ephedra torreyana*, *Ericameria linearifolia*, *Ericameria nauseosa*, *Ericameria teretifolia*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Lycium* spp., *Menodora spinescens*, *Opuntia* spp., *Purshia stansburiana*, and *Quercus havardii* var. *tuckeri*. Occasional *Juniperus* spp., *Pinus edulis*, or *Pinus monophylla* trees are present in some stands. The herbaceous layer varies from sparse to moderate (1-30% cover) and composition varies by region, but is always dominated by graminoids. *Achnatherum hymenoides*, *Aristida purpurea*, *Dasyochloa pulchella* (= *Erioneuron pulchellum*), *Muhlenbergia pungens*, and *Pleuraphis jamesii*. Forbs may have high diversity, but do not have high cover. Associate forbs may include *Amsonia tomentosa*, *Astragalus* spp., *Calochortus nuttallii*, *Chaenactis* spp., *Cryptantha* spp., *Eriogonum inflatum*, *Eriogonum nutans*, *Heterotheca villosa*, *Ipomopsis polycladon*, *Phacelia* spp., *Plantago* spp., *Sphaeralcea leptophylla*, *Stenotus acaulis* (= *Haplopappus acaulis*), and *Streptanthella* spp. Cover of introduced annual *Bromus* spp. may be high in disturbed stands.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands occur on plains, ridges, bajadas, mesatops, canyon rims, escarpments, valley sides, sand dunes, washes, alluvial terraces and benches with flat to steep slopes (up to 45%) with elevations ranging between 1000 and 2200 m. The unvegetated surface is covered by bare soil, sand or gravel. There is sparse cover by litter and typically early-stage biological soil crusts, although there may be significant cover locally. Substrates range from barren shales to alluvium and eolian sands to broken limestone. Soil textures range from eolian or alluvial sand; to deep, rapidly drained, alkaline loamy sands or sandy loams derived from sandstone; to silt loam, silty clay loam or rocky clay soils derived from shale and sandstone. There is often with a caliche subhorizon. Gravel, boulders and rock outcrops are common.

Dynamics: These shrubland communities have greater cover than most other shrub communities in their range. They are generally of low value for livestock, but form an important element of winter range for desert bighorn sheep (*Ovis canadensis nelsoni*). Following fire, these communities are often colonized by non-native annual grasses, which serve to encourage recurrent fires and delay shrub regeneration.

DISTRIBUTION

Geographic Range: These shrublands are known from the Colorado Plateau, southern Great Basin, Mojave Desert, and Sierra Nevada foothills.

Nations: US

States/Provinces: AZ, CA, CO, NV, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Coleogyne ramosissima* (Black brush scrub) Alliance (Sawyer et al. 2009) [33.020.00]
- ? Blackbush Series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS

Associations:

- CEG001332 *Coleogyne ramosissima* Shrubland
- CEG001334 *Coleogyne ramosissima* / *Pleuraphis jamesii* Shrubland
- CEPP005688 *Coleogyne ramosissima* - *Acamptopappus sphaerocephalus* - *Ephedra torreyana* Shrubland
- CEPP005687 *Coleogyne ramosissima* - *Ephedra cutleri* Sandsheet Shrubland
- CEG002348 *Coleogyne ramosissima* - *Purshia stansburiana* - *Quercus havardii* var. *tuckeri* Shrubland

AUTHORSHIP

Primary Concept Source: D. Sarr and K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Faber-Langendoen et al. 2017b, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G312. Colorado Plateau Blackbrush - Mormon-tea Shrubland

A2644. *Ephedra cutleri* Shrubland Alliance [Low - Poorly Documented]

Type Concept Sentence: There is no description or data for this alliance. A review of the literature will be necessary when alliance descriptions are completed.

OVERVIEW

Scientific Name: *Ephedra cutleri* Shrubland Alliance

Common Name (Translated Scientific Name): Cutler's Joint-fir Shrubland Alliance

Colloquial Name: Cutler's Joint-fir Shrubland

Type Concept: There is no description or data for this alliance. A review of the literature will be necessary when alliance descriptions are completed.

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure:

Floristics:

ENVIRONMENT & DYNAMICS

Environmental Description:

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is currently known from Arizona and Utah.

Nations: US

States/Provinces: AZ, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEGLO05804 *Ephedra cutleri* Shrubland
- CEPP005691 *Ephedra cutleri* - *Opuntia* spp. / Mixed Grass Shrub-Steppe
- CEPP005689 *Ephedra cutleri* / *Achnatherum hymenoides* - *Muhlenbergia pungens* - *Oenothera pallida* Sandsheet Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Faber-Langendoen et al. 2017b

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G312. Colorado Plateau Blackbrush - Mormon-tea Shrubland

A2572. *Ephedra torreyana* Shrubland Alliance

Type Concept Sentence: This alliance includes semi-desert shrublands from the Colorado Plateau region of eastern Utah and northern Arizona characterized by an open canopy of *Ephedra torreyana*.

OVERVIEW

Scientific Name: *Ephedra torreyana* Shrubland Alliance

Common Name (Translated Scientific Name): Torrey's Joint-fir Shrubland Alliance

Colloquial Name: Colorado Plateau Torrey's Joint-fir Shrubland

Type Concept: The vegetation is characterized by an open canopy of *Ephedra torreyana* shrubs. Stands range from less than <10 to 75% total vegetation cover and range in structure from shrub-herbaceous (steppe) to shrublands. Vegetation composition is dominated or codominated by *Ephedra torreyana* that ranges between 2 and 25% cover. Associated shrubs and cacti include *Atriplex canescens*, *Atriplex confertifolia*, *Echinocereus triglochidiatus*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Yucca harrimaniae*. *Coleogyne ramosissima* is absent or has low cover. If present, the understory may include a sparse to moderately dense herbaceous layer composed mostly of dry grasses, such as *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua gracilis*, *Hesperostipa*

comata, *Pleuraphis jamesii*, *Sporobolus airoides*, and *Sporobolus flexuosus*, with low cover of forbs. This alliance includes semi-desert shrublands from the Colorado Plateau region of eastern Utah and northern Arizona between 1220 and 2000 m elevation. Stands occur in large patches on broad sandy plains, as well as in smaller patches on knolls, toeslope pediments, and a mesa capped with basalt boulders. Sites are flat to gentle (up to 10% slope) and occur on all aspects, although it often is found on warmer south- or west-facing slopes. The unvegetated surface has up to 90% exposure of sand, bare soil, cinder, large and small rocks or gravel. Litter cover is generally low. Soils are rapidly drained to well-drained loamy sands to sandy clays derived from basalt, cinder, sandstone or shales.

Classification Comments: The placement of *Ephedra torreyana* - (*Atriplex canescens*, *Atriplex confertifolia*) Sparse Vegetation (CEGL005801) within this alliance is tentative. There is not a suitable ecological group developed for Colorado Plateau sparse vegetation.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Sparse to dense low shrubland and shrub-herbaceous vegetation dominated by *Ephedra torreyana* in association with other low shrubs and grasses of the Colorado Plateau.

VEGETATION

Physiognomy and Structure: The vegetation in this alliance is characterized by sparse to moderate cover (<10-70%) of cold-deciduous or evergreen shrubs. The herbaceous layer is typically sparse (<20% cover) and dominated by cespitose perennial grasses or annual forbs and grasses.

Floristics: The vegetation included in this alliance is characterized by an open to moderate canopy of *Ephedra torreyana* shrubs. Stands range from 75% to less than 10% total vegetation cover and vary in structure from shrub-herbaceous (steppe) to shrublands. Vegetation composition is dominated or codominated by *Ephedra torreyana* that ranges between 2 and 25% cover. Associated shrubs and cacti include *Atriplex canescens*, *Atriplex confertifolia*, *Echinocereus triglochidiatus*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Yucca harrimaniae*. *Coleogyne ramosissima* is absent or has low cover. If present, the understory may include a sparse to moderately dense herbaceous layer composed mostly of dry grasses, such as *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua gracilis*, *Hesperostipa comata*, *Pleuraphis jamesii*, *Sporobolus airoides*, and *Sporobolus flexuosus*. Low cover of forbs is usually present and includes *Astragalus amphioxys*, *Chaetopappa ericoides*, *Malacothrix sonchoides*, *Sphaeralcea coccinea*, and *Sphaeralcea parvifolia*.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance includes semi-desert shrublands from the Colorado Plateau region of eastern Utah and northern Arizona between 1220 and 2000 m elevation. Stands occur in large patches on broad sandy plains, as well as in smaller patches on knolls, toeslope pediments, and a mesa capped with basalt boulders. Sites are flat to gentle (up to 10% slope) and occur on all aspects, although it often is found on warmer south- or west-facing slopes. The unvegetated surface has up to 90% exposure of sand, bare soil, large and small rocks and gravel. Soils are rapidly drained to well-drained loamy sands where derived from secondary materials or sandy clays where derived from underlying shales. Parent materials may include sandy clays derived from basalt, cinder deposits and Entrada, Navajo, Summerville and Carmel formation materials that have eroded to alluvial or eolian sands and clays.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance includes semi-desert shrublands from the Colorado Plateau region of eastern Utah and northern Arizona.

Nations: US

States/Provinces: AZ, NM?, NV?, UT

TNC Ecoregions [optional]: 17:C

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEGLO05802 *Ephedra torreyana* - *Achnatherum hymenoides* Hummock Shrubland
- CEGLO05801 *Ephedra torreyana* - (*Atriplex canescens*, *Atriplex confertifolia*) Sparse Vegetation
- CEGLO02352 *Ephedra torreyana* / *Achnatherum hymenoides* - *Pleuraphis jamesii* Shrubland
- CEGLO02351 *Ephedra torreyana* / *Bouteloua gracilis* - *Pleuraphis jamesii* Shrubland
- CEPP005690 *Ephedra (torreyana, viridis)* - *Psoralea fremontii* Shrubland
- CEGLO05107 *Ephedra torreyana* - *Opuntia basilaris* Shrubland
- CEGLO05113 *Ephedra (torreyana, viridis)* / Mixed Semi-Desert Grasses Shrubland
- CEPP005698 *Polygala acanthoclada* - Mixed Scrub
- CEGLO03772 *Ephedra torreyana* / *Pleuraphis jamesii* Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Faber-Langendoen et al. 2017b

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G312. Colorado Plateau Blackbrush - Mormon-tea Shrubland

A3201. *Ephedra viridis* Colorado Plateau Shrubland Alliance

Type Concept Sentence: Low shrublands and shrub-herbaceous vegetation of the Colorado Plateau dominated by *Ephedra viridis*.

OVERVIEW

Scientific Name: *Ephedra viridis* Colorado Plateau Shrubland Alliance

Common Name (Translated Scientific Name): Mormon-tea Colorado Plateau Shrubland Alliance

Colloquial Name: Colorado Plateau Mormon-tea Shrubland

Type Concept: The vegetation is characterized by a sparse to moderately dense shrub layer dominated by xeromorphic evergreen microphyllous shrub *Ephedra viridis*. *Artemisia tridentata* or *Tetradymia canescens* may be present to codominant in some stands of this alliance. A variety of other shrubs may be present with low cover, such as *Acacia greggii*, *Agave* spp., *Atriplex canescens*, *Coleogyne ramosissima*, *Encelia farinosa*, the dwarf-shrub *Gutierrezia sarothrae*, and cacti *Echinocereus engelmannii*, *Ferocactus cylindraceus*, *Opuntia polyacantha* var. *erinacea* (= *Opuntia erinacea*), *Opuntia polyacantha* var. *polyacantha*, and *Sclerocactus whipplei*. The herbaceous layer is sparse to moderately dense, in some stands being more prominent than the shrubs, and is usually dominated by perennial bunchgrasses such as *Achnatherum hymenoides*, *Bouteloua gracilis*, *Hesperostipa comata*, *Pleuraphis jamesii*, or the exotic annual grass *Bromus tectorum*. Other grasses such as *Aristida purpurea*, *Muhlenbergia pungens*, *Sporobolus airoides*, and *Sporobolus cryptandrus* may be present depending on the site. Forb cover is generally sparse but may be surprisingly diverse. Biological crusts are often present and provide up to 25% cover. Stands of this alliance occur in the Colorado Plateau and Great Basin and are found on dry, rocky, gravelly or sandy sites in valleys and washes, and on slopes, alluvial fans, mesas, and foothills from 1380 to 2020 m elevation. Slopes are gentle to moderately steep (1-45%).

Classification Comments: Some stands of the vegetation in this alliance may be too sparse to classify as a shrubland.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Sparse to moderately dense (10-60% cover) shrublands and shrub-herbaceous vegetation of the Colorado Plateau and Great Basin dominated by *Ephedra viridis* in association with other Colorado Plateau shrub and grass species.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has sparse to moderately dense woody cover dominated by xeromorphic broad-leaved and microphyllous evergreen shrubs (0.3-1 m tall). Sparse to dense cover of medium-tall bunch grasses and scattered cacti is also present. Annual grasses and forbs are seasonally present.

Floristics: Stands of this alliance may be shrub or shrub-herbaceous in structure. The shrub layer is characterized by a sparse to moderately dense shrub layer dominated by xeromorphic evergreen microphyllous shrub *Ephedra viridis*. *Artemisia tridentata* or *Tetradymia canescens* may be present to codominant in some stands of this alliance. A variety of other shrubs may be present with low cover, such as *Acacia greggii*, *Agave* spp., *Atriplex canescens*, *Coleogyne ramosissima*, *Encelia farinosa*, the dwarf-shrub *Gutierrezia sarothrae*, and cacti *Echinocereus engelmannii*, *Ferocactus cylindraceus*, *Opuntia polyacantha* var. *erinacea* (= *Opuntia erinacea*), *Opuntia polyacantha* var. *polyacantha*, and *Sclerocactus whipplei*. The herbaceous layer is sparse to moderately dense and may be more prominent than the shrubs. It is usually dominated by perennial bunchgrasses such as *Achnatherum hymenoides*, *Bouteloua gracilis*, *Hesperostipa comata*, *Pleuraphis jamesii*, *Pleuraphis rigida*, or the exotic annual grass *Bromus tectorum*. Other grasses such as *Aristida purpurea*, *Muhlenbergia pungens*, *Sporobolus airoides*, and *Sporobolus cryptandrus* may be present depending on the site. Forb cover is generally sparse but may be surprisingly diverse. Biological crusts are often present and provide up to 25% cover.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands of this alliance occur in semi-arid environments. Total mean annual precipitation is approximately 25 cm. Stands are found on dry, rocky or sandy sites in valleys and washes, and on slopes, alluvial fans, mesas, and foothills. In the Colorado Plateau, stands are reported from 1380 to 2020 m elevation and occur on sand dunes and sandsheets deposited on plateaus, benches and valley floors. Sites occupy gentle to moderately steep slopes (1-45%). The unvegetated surface has high exposure of bare soil and low to moderate cover of litter; biological soil crusts provide up to 30% cover. Soils are rapidly drained, fine sandy loam, loamy sand, and sandy clay soils derived from sandstones and shales, eolian deposits and alluvium. In the Grand Canyon, sites occur on moderate to steep northern slopes, the most mesic slopes of the Inner Gorge. Elevation ranges from 580-980 m. The soils are shallow, coarse-textured and rocky, and derived from limestone, sandstone and igneous rocks.

Dynamics: *Ephedra viridis* is known to sprout vigorously from the roots or woody rootcrowns or establish by seed following fire (Anderson 2001b). These fire adaptations may favor it over more fire-sensitive species such as *Coleogyne ramosissima*.

DISTRIBUTION

Geographic Range: This alliance is restricted to the Colorado Plateau of Utah and Colorado.

Nations: US

States/Provinces: CO, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- ? *Ephedra viridis* - *Hilaria rigida* - *Acacia greggii* Shrubland Association (Warren et al. 1982) [Stands were described from the Grand Canyon.]

LOWER LEVEL UNITS

Associations:

- CEG001257 *Ephedra viridis* / *Pleuraphis rigida* Shrubland
- CEG002973 *Tetradymia canescens* - *Ephedra viridis* Shrubland
- CEG001648 *Ephedra viridis* / *Achnatherum hymenoides* - *Bouteloua gracilis* Shrub Grassland
- CEG001649 *Ephedra viridis* / *Achnatherum hymenoides* - *Sporobolus cryptandrus* Shrub Grassland
- CEPP006703 *Ephedra viridis* Shrubland
- CEG002354 *Ephedra viridis* / (*Achnatherum hymenoides*, *Hesperostipa comata*) Shrubland
- CEG003934 *Ephedra viridis* / *Bouteloua gracilis* Shrubland
- CEPP005684 *Acamptopappus sphaerocephalus* - *Ephedra* spp. Shrubland
- CEPP006702 *Ephedra viridis* - *Purshia glandulosa* Shrubland
- CEG002356 *Ephedra viridis* / *Pleuraphis jamesii* Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Anderson 2001b, Faber-Langendoen et al. 2017b, Warren et al. 1982

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G312. Colorado Plateau Blackbrush - Mormon-tea Shrubland

A0862. *Poliomintha incana* Shrubland Alliance

Type Concept Sentence: This shrubland alliance is characterized by a sparse woody layer dominated by the xeromorphic evergreen shrub *Poliomintha incana*. It occurs on sandy sites in the Colorado Plateau in southeastern Utah and northern Arizona, to northern New Mexico in the southern Rocky Mountains.

OVERVIEW

Scientific Name: *Poliomintha incana* Shrubland Alliance

Common Name (Translated Scientific Name): Frosted Mint Shrubland Alliance

Colloquial Name: Colorado Plateau Frosted Mint Shrubland

Type Concept: Vegetation included in this alliance is characterized by a sparse woody layer dominated by the xeromorphic evergreen shrub *Poliomintha incana* with *Artemisia filifolia* present to codominant on some sites. The two different habitats in which this alliance occurs, stabilized and shifting sands, produce stands with different associated species. Stabilized deep-sand sites in northern New Mexico have higher shrub diversity with scattered *Juniperus monosperma* and *Pinus edulis* trees. Common shrubs and dwarf-shrubs include *Brickellia californica*, *Ericameria nauseosa* var. *bigelovii* (= *Chrysothamnus nauseosus* ssp. *bigelovii*), *Gutierrezia sarothrae*, and the cacti *Opuntia phaeacantha* and *Opuntia polyacantha*. The perennial grasses *Bouteloua gracilis*, *Pleuraphis jamesii*, *Schizachyrium scoparium*, and *Sporobolus cryptandrus* are the most common dominants in the herbaceous layer. The stands described from the dune area have a sparse herbaceous layer that is dominated by perennial graminoids such as *Sporobolus flexuosus* or by annual forbs such as *Chamaesyce parryi* that are seasonally present to abundant in wet years. Weedy annual forbs such as *Amaranthus* spp., *Dimorphocarpa wislizeni* (= *Dithyrea wislizeni*), and the exotic *Conyza canadensis* are common. This shrubland alliance occurs on sandy sites in the Colorado Plateau in southeastern Utah and northern Arizona, to northern New Mexico. Stands occur in both stabilized deep sand and areas near active dunes.

Classification Comments: Muldavin et al. (1998a) described two community types, *Poliomintha incana* / Sparse and *Poliomintha incana* / *Sporobolus flexuosus* that were included in this alliance description, but are without association-level descriptions. Further work is necessary to complete the classification and description of stands in this alliance.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Diagnostic of this alliance is the relatively sparse shrub layer dominated by *Poliomintha incana* or a mixture of *Poliomintha incana*, *Artemisia filifolia*, and *Vanclvea stylosa* on sandy sites of the Colorado Plateau and southern Rocky Mountains.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a sparse shrub layer (0.1-1.5 m tall) dominated by xeromorphic, broad-leaved and microphyllous evergreen shrubs. A sparse herbaceous layer is dominated by perennial grasses.

Floristics: Stands have a sparse woody layer dominated by the xeromorphic evergreen shrub *Poliomintha incana* with *Artemisia filifolia* present to codominating on some sites. The herbaceous layer is typically sparse and may be dominated by graminoids or forbs. Two major habitats, stabilized and shifting sands, produce stands with different associated species. Stabilized deep-sand sites described by Dick-Peddie et al. (1984) were found on hillsides in northern New Mexico and had scattered *Juniperus monosperma* and *Pinus edulis* trees. Common shrubs and dwarf-shrubs present may include *Brickellia californica*, *Ericameria nauseosa* var. *bigelovii* (= *Chrysothamnus nauseosus* ssp. *bigelovii*), *Gutierrezia sarothrae*, *Vanclvea stylosa*, and the cacti *Opuntia phaeacantha* and *Opuntia polyacantha*. The sparse herbaceous layer may be dominated by the perennial grasses *Bouteloua gracilis*, *Pleuraphis*

jamesii, *Sporobolus cryptandrus*, or *Schizachyrium scoparium*. Forb species tend to be sand specialists such as *Abronia fragrans*, *Ambrosia acanthicarpa*, *Cryptantha crassisejala*, *Chamaesyce parryi* (= *Euphorbia parryi*), *Hymenopappus filifolius*, *Oxytenia acerosa* (= *Iva acerosa*), *Oenothera pallida*, *Stephanomeria exigua*, and *Streptanthella longirostris*.

ENVIRONMENT & DYNAMICS

Environmental Description: Climate is semi-arid. Mean annual precipitation is about 20 cm. Summers are hot and winters are cold. Elevations range from 1200-1850 m. Stands are found in deep-sand and dune areas. Sites are flat to undulating, occurring on all aspects. The soils are well-drained, moderately deep sands. Biological soil crusts may be absent or provide sparse to moderate cover, up to 25%.

Dynamics: *Poliomintha incana* is a sand-adapted species that avoids burial by shifting sands by rapidly growing its meristems (Bowers 1982).

DISTRIBUTION

Geographic Range: Stands included in this minor shrubland alliance occur on sandy sites sporadically in north-central New Mexico, and the Colorado Plateau in Arizona and Utah.

Nations: US

States/Provinces: AZ, NM, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Poliomintha incana* Series (Muldavin et al. 1998b)
- < *Poliomintha incana* Shrubland Alliance (Muldavin et al. 2000b)
- ? Bushmint-Sandsage Scrub (Dick-Peddie et al. 1984)

LOWER LEVEL UNITS

Associations:

- CEG002930 *Poliomintha incana* / (*Pleuraphis jamesii*) Shrubland
- CEG002418 *Poliomintha incana* - *Artemisia filifolia* - *Vancleavea stylosa* Shrubland
- CEG001339 *Poliomintha incana* / *Bouteloua gracilis* Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Bowers 1982, Dick-Peddie et al. 1984, Faber-Langendoen et al. 2017b, Muldavin et al. 1998a, Muldavin et al. 1998b, Muldavin et al. 2000b

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G312. Colorado Plateau Blackbrush - Mormon-tea Shrubland

A2654. *Quercus havardii* var. *tuckeri* Shrubland Alliance

Type Concept Sentence: This Colorado Plateau shrubland alliance is dominated by patches of *Quercus havardii* and is currently known from Utah but may extend into western Colorado.

OVERVIEW

Scientific Name: *Quercus havardii* var. *tuckeri* Shrubland Alliance

Common Name (Translated Scientific Name): Tucker Sand Shinnery Oak Shrubland Alliance

Colloquial Name: Colorado Plateau Tucker Sand Shinnery Oak Shrubland

Type Concept: The vegetation is dominated by patches of *Quercus havardii* var. *tuckeri* shrubs that range in cover from 5 to 85%. Because shrub roots anchor the sandy soil in this erosive habitat, *Quercus havardii* var. *tuckeri* shrubs often occupy hummocks of

sand as much as a meter high. Associated shrubs include *Coleogyne ramosissima*, *Ephedra viridis*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Shepherdia rotundifolia*. The herbaceous layer provides sparse cover. Graminoids present often include *Achnatherum hymenoides*, *Muhlenbergia pungens*, *Pleuraphis jamesii*, and *Vulpia octoflora*. Scattered forbs may include *Cryptantha* sp., *Hymenopappus filifolius*, *Lepidium montanum*, and *Streptanthella longirostris*. Scattered *Juniperus osteosperma* trees are present in some stands. This Colorado Plateau shrubland alliance is currently known from Utah but may extend into western Colorado. Stands are restricted to dunes, sandsheets and pockets of sand on mesas, plateaus and valley bottoms. Sites are generally on flat, gentle slopes, with a few sites on moderately steep (50%) slopes. Elevations range between 1335 and 1772 m, and aspect is not a major factor in determining the distribution of this association. Bare ground or loose sand cover most of the unvegetated surface, although in less-disturbed sites biological soil crusts can have as much as 30% cover. Soils are rapidly drained, deep loamy sands and sandy loams derived from alluvium or eolian deposits.

Classification Comments: A similar alliance is characterized by *Quercus havardii* var. *havardii* and is found in the sandy plains in the southern Great Plains, whereas this alliance is characterized by *Quercus havardii* var. *tuckeri* and is restricted to the Colorado Plateau.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Sparse to dense shrublands occupying dunes, sandsheets and pockets of sand on mesas, plateaus and valley bottoms of the Colorado Plateau dominated by *Quercus havardii* var. *tuckeri*.

VEGETATION

Physiognomy and Structure:

Floristics: Stands included in this alliance are characterized by a sparse to moderately dense shrub layer (10-85% cover) dominated by patches of *Quercus havardii* var. *tuckeri* (5-85% cover). Because shrub roots anchor the sandy soil in this erosive setting, *Quercus havardii* var. *tuckeri* shrubs often occupy hummocks of sand as much as a meter high forming coppice dunes. Associated shrubs include *Coleogyne ramosissima*, *Ephedra viridis*, *Gutierrezia sarothrae*, *Opuntia polyacantha*, and *Shepherdia rotundifolia*. The herbaceous layer provides sparse cover. Graminoids present often include *Achnatherum hymenoides*, *Muhlenbergia pungens*, *Pleuraphis jamesii*, and *Vulpia octoflora*. Scattered forbs may include *Cryptantha* sp., *Hymenopappus filifolius*, *Lepidium montanum*, and *Streptanthella longirostris*. Scattered *Juniperus osteosperma* trees are present in some stands.

ENVIRONMENT & DYNAMICS

Environmental Description: This Colorado Plateau shrubland alliance is restricted to dunes, sandsheets and pockets of sand on mesas, plateaus and valley bottoms. Sites are generally on flat, gentle slopes, with a few sites on moderately steep (50%) slopes. Elevations range between 1335 and 1772 m, and aspect is not a major factor in determining the distribution of this association. Bare ground or sand cover most of the unvegetated surface, although in less-disturbed sites biological soil crusts can have as much as 30% cover. Soils are rapidly drained, deep loamy sands and sandy loams derived from alluvium or eolian deposits.

Dynamics: Sites are constantly exposed to erosion by wind and between dune areas may be scoured to alluvial surfaces. The vegetation in this alliance is well-adapted to its dynamic environment.

DISTRIBUTION

Geographic Range: This Colorado Plateau shrubland alliance is currently known from Utah but may extend into western Colorado.

Nations: US

States/Provinces: CO?, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEPP005692 *Quercus havardii* var. *tuckeri* - *Eriogonum leptocladon* - *Artemisia filifolia* Sandsheet Shrubland
- CEG002486 *Quercus havardii* var. *tuckeri* Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Faber-Langendoen et al. 2017b

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

3.B.1.Ne.1.c. M171 Great Basin-Intermountain Dry Shrubland & Grassland

G311. Intermountain Semi-Desert Grassland

Type Concept Sentence: This widespread semi-arid to arid grassland group occurs throughout the intermountain western U.S. that are composed of dominant drought-resistant perennial bunchgrasses such as *Achnatherum* spp., *Bouteloua gracilis*, *Hesperostipa comata*, *Pleuraphis jamesii*, *Poa cusickii*, *Poa secunda*, and *Pseudoroegneria spicata* often with scattered shrubs, especially *Artemisia tridentata*, *Atriplex* spp., *Coleogyne ramosissima*, *Ephedra* spp., *Gutierrezia sarothrae*, and *Krascheninnikovia lanata*.

OVERVIEW

Scientific Name: *Pleuraphis jamesii* - *Achnatherum hymenoides* - *Hesperostipa comata* Semi-Desert Grassland Group

Common Name (Translated Scientific Name): James' Galleta - Indian Ricegrass - Needle-and-Thread Semi-Desert Grassland Group

Colloquial Name: Indian Ricegrass - Bluebunch Wheatgrass - Sandhill Muhly Grassland

Type Concept: This widespread group includes semi-arid to arid grasslands found throughout the intermountain western U.S. The dominant perennial bunchgrasses and shrubs within this group are all drought-resistant plants. Dominant or codominant species are *Achnatherum hymenoides*, *Achnatherum lettermanii*, *Achnatherum nelsonii*, *Achnatherum speciosum*, *Bouteloua gracilis*, *Hesperostipa comata*, *Pleuraphis jamesii*, *Poa cusickii*, *Poa secunda*, *Pseudoroegneria spicata*, and *Sporobolus cryptandrus*. Scattered shrubs and dwarf-shrubs often are present, especially *Artemisia tridentata* ssp. *tridentata*, *Artemisia tridentata* ssp. *wyomingensis*, *Atriplex* spp., *Coleogyne ramosissima*, *Ephedra* spp., *Gutierrezia sarothrae*, and *Krascheninnikovia lanata*, which are the typical dominant species of adjacent shrublands. Stands occur on sites on a variety of landforms, including swales, playas, mesas, alluvial flats, and plains over an elevational range of approximately 1100 to 3290 m in most of its range and 350 to 425 m in the Columbia Basin. This group may constitute the matrix over large areas of intermountain basins, and also may occur as large patches in mosaics with semi-desert shrublands. Grasslands in areas of higher precipitation, at higher elevation, typically belong to other groups. Substrates are often well-drained sandy or loam soils derived from sedimentary parent materials but are quite variable and may include fine-textured soils derived from igneous and metamorphic rocks.

Classification Comments: This group was merged with former Columbia Basin Foothill & Canyon Dry Grassland Group (G274), which was very similar compositionally and a northern variant of this intermountain group. Communities dominated by *Achnatherum lettermanii*, *Achnatherum nelsonii*, and *Agrostis variabilis* are poorly understood and require further documentation. The only occurrence of a community dominated by *Agrostis variabilis* is known from Utah and may be the result of disturbance. *Achnatherum speciosum* is a southern Great Basin species, which extends in distribution into the Mojave and Colorado deserts, for now its communities are included here. Occurrences of this semi-desert grassland group in the relatively high-elevation basins of Wyoming and south-central Montana resemble in species composition the foothill grasslands that grow at slightly higher elevations and in the Columbia Plateau.

Similar NVC Types:

- G273 Central Rocky Mountain Lower Montane, Foothill & Valley Grassland

Diagnostic Characteristics: This group consists of semi-arid to arid grasslands often creating the matrix over large areas. Characteristic graminoids include *Achnatherum hymenoides*, *Bouteloua eriopoda*, *Bouteloua gracilis*, *Hesperostipa comata*, *Pleuraphis jamesii*, *Poa cusickii*, *Poa secunda*, and *Pseudoroegneria spicata*.

VEGETATION

Physiognomy and Structure: Medium to tall bunchgrass-dominated group occurring with scattered shrubs as a matrix community or interspersed among shrub-dominated communities. Cover within this group is variable from dense to less than 25% cover.

Floristics: The dominant perennial bunchgrasses and shrubs within this group are all drought-resistant plants. Dominant or codominant species are *Achnatherum hymenoides*, *Achnatherum lettermanii*, *Achnatherum nelsonii*, *Achnatherum speciosum*, *Bouteloua eriopoda*, *Bouteloua gracilis*, *Hesperostipa comata*, *Pleuraphis jamesii*, *Poa cusickii*, *Poa secunda*, and *Pseudoroegneria spicata*. Other graminoids may include *Aristida purpurea*, *Carex filifolia*, *Elymus elymoides*, *Koeleria macrantha*, *Leymus salinus*, or *Sporobolus cryptandrus*. Scattered shrubs and dwarf-shrubs often are present, especially *Artemisia tridentata ssp. tridentata*, *Artemisia tridentata ssp. wyomingensis*, *Atriplex* spp., *Coleogyne ramosissima*, *Ephedra* spp., *Gutierrezia sarothrae*, and *Krascheninnikovia lanata*. Forb cover is also sparse but can be relatively diverse. Common forbs are *Gaura coccinea*, *Balsamorhiza sagittata*, *Hymenopappus filifolius*, *Machaeranthera canescens*, *Sphaeralcea coccinea*, *Vicia americana*, *Lappula occidentalis* (= *Lappula redowskii*), *Lithophragma glabrum*, *Lupinus pusillus*, *Opuntia aurea* (= *Opuntia basilaris* var. *aurea*), *Opuntia polyacantha*, *Plantago patagonica*, *Pediomelum argophyllum*, *Artemisia campestris*, *Artemisia dracunculus*, *Artemisia ludoviciana*, and species of *Antennaria*, *Astragalus*, *Cryptantha*, *Eriogonum*, *Gilia*, and *Lappula*. Cryptogams are important in some stands with up to 40% ground cover on sites in the Colorado Plateau. Exotic species such as *Bromus tectorum*, *Draba verna*, *Lactuca serriola*, *Salsola tragus*, *Bassia scoparia* (= *Kochia scoparia*), *Onopordum acanthium*, *Poa pratensis*, *Sisymbrium altissimum*, and *Tragopogon dubius* are present in many of these stands.

ENVIRONMENT & DYNAMICS

Environmental Description: Low-elevation grasslands in the Intermountain West region occur in semi-arid to arid climates at approximately 1450 to 2320 m (4750-7610 feet) elevation, but can reach as low as 350 m in the Columbia Basin. These grasslands occur in lowland and upland areas and may occupy swales, playas, mesatops, plateau parks, alluvial flats, plains and extend into dry foothills. In the Columbia Plateau stands extend up into the Columbia and Snake river canyons on stream terraces and dry, rocky slopes. These grasslands typically occur on relatively xeric sites. This group experiences cold temperate conditions. Hot summers and cold winters with freezing temperatures and snow are common. Annual precipitation is usually from 20-40 cm (7.9-15.7 inches). A significant portion of the precipitation falls in July through October during the summer monsoon storms, with the rest falling as snow during the winter and early spring months. These grasslands occur on a variety of aspects and slopes. Sites may range from flat to moderately steep. Soils supporting this group also vary from deep to shallow, and from sandy to finer-textured. The substrate is typically derived from sandstone or shale. Some occurrences on sandy soils have a high cover of cryptogams on the soil surface. These cryptogams tend to increase the stability of the highly erodible sandy soils of these grasslands during torrential summer rains and heavy wind storms (Kleiner and Harper 1977).

Dynamics: *Achnatherum hymenoides* is one of the most drought-tolerant grasses in the western U.S. (USFS 1937). It is also a valuable forage grass in arid and semi-arid regions. Improperly managed livestock grazing could increase soil erosion, decrease cover of this palatable plant species and increase weedy species (USDA 1937). *Hesperostipa comata* is a deep-rooted grass that uses soil moisture below 0.5 m during the dry summers. Burning generally kills or severely damages *Hesperostipa comata* plants. After fire, regeneration of this non-rhizomatous bunchgrass is through seed and may take many years to reach prefire densities. *Pleuraphis jamesii* is both drought- and grazing-resistant (USFS 1937, Weaver and Albertson 1956, West et al. 1972). In parts of its range it increases under grazing, and in others parts it decreases. The grass is favored in mixedgrass stands because it is only moderately palatable to livestock, but decreases when heavily grazed during drought and in the more arid portions of its range where it is the dominant grass (West et al. 1972). This grass reproduces extensively from scaly rhizomes. These rhizomes make the plant resistant to trampling by livestock and have good soil binding properties (USFS 1937, Weaver and Albertson 1956, West et al. 1972). The cool-season annual grass *Bromus tectorum* can be an effective competitor for winter soil moisture because it can germinate in the fall, over-winter, then begin re-growing in the early spring before it is warm enough for many perennial grasses, completing its lifecycle and depleting soil moisture before the dry summer weather begins. This annual species also produces abundant fine fuels that carry fire well and increase the frequency of fires (FEIS 1998).

DISTRIBUTION

Geographic Range: This group occurs throughout the intermountain western U.S. on dry plains, foothills and mesas, at approximately 1450 to 2320 m (4750-7610 feet) elevation. Stands extend up into the Columbia and Snake river canyons on stream terraces and dry, rocky slopes. In the Bighorn Basin of north-central Wyoming, there may be some semi-desert grasslands, but this is uncertain.

Spatial Scale & Pattern [optional]: Large patch

Nations: MX?, US

States/Provinces: AZ, CA, CO, ID, MT?, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]: 4:C, 6:C, 8:C, 9:C, 10:C, 11:C, 18:C, 19:C, 20:C, 21:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313C:CC, 313D:CC, 315A:CC, 315H:CC, 321A:CC, 322A:CC, 331A:CC, 331J:CC, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M242D:CP, M261E:CC, M261G:CC, M313A:CC, M313B:CC, M331A:CC, M331B:C?, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CP, M331J:CP, M332G:CC, M333A:??, M341A:CC, M341B:CC, M341C:CC, M341D:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Arches); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > Grama - Galleta (502) (Shiflet 1994)
- = Southeastern Utah galleta-threawn shrub steppe (West 1983e)

LOWER LEVEL UNITS

Alliances:

- A1290 *Achnatherum speciosum* Grassland Alliance
- A3976 *Pseudoroegneria spicata* - *Opuntia polyacantha* Dry Canyon Slope Grassland Alliance
- A4216 *Sphaeralcea ambigua* - *Sphaeralcea coccinea* - *Sphaeralcea parvifolia* Dry Meadow Alliance
- A1262 *Achnatherum hymenoides* - *Pseudoroegneria spicata* - *Muhlenbergia pungens* Grassland Alliance
- A1287 *Pleuraphis jamesii* Grassland Alliance
- A1270 *Hesperostipa comata* Grassland Alliance
- A3977 *Sporobolus cryptandrus* - *Aristida purpurea* var. *longiseta* - *Poa secunda* Sandy Stream Terrace Grassland Alliance

AUTHORSHIP

Primary Concept Source: N.E. West (1983e)

Author of Description: M.E. Hall and M.S. Reid

Acknowledgments:

Version Date: 11/06/2015

Classif Resp Region: West

Internal Author: MEH/MSR 3-10, mod. KAS 4-15, 11-15, mod. GK 9-16

REFERENCES

References: Bowers 1982, Cable 1967, Cable 1969, Cable 1975b, Castle 1954, FEIS 1998, Faber-Langendoen et al. 2017a, Kleiner and Harper 1972, Kleiner and Harper 1977, McClaran and Van Devender 1995, Ramaley 1939b, Shiflet 1994, USFS 1937, Van Pelt 1978, Weaver and Albertson 1956, West 1983e, West et al. 1972

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G311. Intermountain Semi-Desert Grassland

A1262. *Achnatherum hymenoides* - *Pseudoroegneria spicata* - *Muhlenbergia pungens* Grassland Alliance

Type Concept Sentence: These grasslands are dominated by a variety of grasses, the most frequently occurring being *Achnatherum hymenoides*, *Muhlenbergia pungens*, and *Pseudoroegneria spicata*, and occur in the southern and middle Rocky Mountains and Colorado Plateau, into adjacent ecoregions.

OVERVIEW

Scientific Name: *Achnatherum hymenoides* - *Pseudoroegneria spicata* - *Muhlenbergia pungens* Grassland Alliance

Common Name (Translated Scientific Name): Indian Ricegrass - Bluebunch Wheatgrass - Sandhill Muhly Grassland Alliance

Colloquial Name: Indian Ricegrass - Bluebunch Wheatgrass - Sandhill Muhly Grassland

Type Concept: Vegetation of this alliance is characterized by a sparse to moderately dense herbaceous layer of graminoids, the most of common of which include *Achnatherum hymenoides*, *Muhlenbergia pungens*, and *Pseudoroegneria spicata*. Other common graminoid associates may include *Hesperostipa comata* (= *Stipa comata*), *Koeleria macrantha*, *Leucopoa kingii*, *Pascopyrum smithii*, *Pleuraphis jamesii* (= *Hilaria jamesii*), *Poa fendleriana*, *Poa secunda*, *Redfieldia flexuosa*, and *Schizachyrium scoparium*. Scattered shrubs may be found throughout stands. Forbs are rarely important, although cushion plants may be a prominent feature in some stands. These grasslands occur throughout the southern and middle Rocky Mountains and Colorado Plateau, into adjacent ecoregions. Habitats are variable and may include sand dunes and deposits, shale barrens, rocky or badland slopes, foothills, mesas, ridgetops, plateaus and saddles. Sites are flat to gently sloping between 1220 and 2700 m elevation.

Classification Comments: Some vegetation in this alliance may be too sparse in sandy sites to be classified as grassland. Renee Rondeau (CONHP pers. comm.) reported that *Ericameria nauseosa* is codominant in fire-suppressed stands in the San Luis Valley in Colorado. *Sphaeralcea (coccinea, parvifolia)* Grassland (CEGL005366) has been included in this alliance tentatively despite being forb-dominated as these stands exhibit floristic overlap with associations included here and may represent forb-dominated inclusions within these communities.

Internal Comments: GK 9-16: ID added for Minidoka. mjr 12-14: CA added for MOJN.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: *Achnatherum hymenoides*, *Muhlenbergia pungens*, or *Pseudoroegneria spicata* have >50 % relative cover in the herbaceous layer. Forbs are rarely important. Occurrences of these grasslands are extremely widespread throughout their range, and habitats vary widely, therefore diagnostic characters are difficult to determine.

VEGETATION

Physiognomy and Structure: Vegetation in this alliance is characterized by a sparse to dense cover of graminoids that is dominated by perennial bunch grasses less than 1 m tall. There is also sparse to moderate cover of perennial forbs. Occasional scattered shrubs and dwarf-shrubs may be present. Annual forbs and grasses are seasonally present.

Floristics: Vegetation of this alliance is characterized by a sparse to moderately dense herbaceous layer of graminoids, the most of common of which include *Achnatherum hymenoides*, *Muhlenbergia pungens*, and *Pseudoroegneria spicata*. Other common graminoid associates may include *Festuca idahoensis*, *Hesperostipa comata* (= *Stipa comata*), *Koeleria macrantha*, *Leucopoa kingii*, *Pascopyrum smithii*, *Pleuraphis jamesii* (= *Hilaria jamesii*), *Poa fendleriana*, *Poa secunda*, *Redfieldia flexuosa*, and *Schizachyrium scoparium*. Scattered shrubs may be found throughout stands, but only occur at low cover and may include *Artemisia frigida*, *Artemisia nova*, *Artemisia tridentata*, *Cercocarpus montanus*, *Ericameria* spp., *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, and *Tetradymia canescens*. A sparse layer of forbs is typically present. Cushion plants may be important in some stands and may include species of *Arenaria*, *Astragalus*, *Cryptantha*, *Heterotheca*, *Hymenoxys*, *Phlox*, and *Stenotus*.

ENVIRONMENT & DYNAMICS

Environmental Description: Climate is semi-arid with highly variable precipitation during the growing season. Mean annual precipitation ranges from 30-60 cm. Drought is not uncommon and contributes to the formation of blowouts. Habitats are variable and may include sand dunes and deposits, shale barrens, rocky or badland slopes, foothills, mesas, ridgetops, plateaus and saddles. Sites are flat to gently sloping between 1220 and 2700 m elevation. Stands occur on all aspects, but often on the drier southern and western slopes. Substrates are also variable and range from shallow, lithic soils with a rocky surface to moderately deep soils with little rock. Disturbance is usually a factor; upland sites often have blowing sand, and wash sites are subject to periodic flooding.

Dynamics: *Achnatherum hymenoides* is one of the most drought-tolerant grasses in the western U.S. and occurs on a variety of xeric sites (USFS 1937). It is also a valuable forage grass in arid and semi-arid regions. Improperly managed livestock grazing could increase soil erosion, decrease cover of this palatable plant species and increase weedy species (USFS 1937). Fire has variable effects on *Pseudoroegneria spicata*. Plants usually survive burning, and growth is often stimulated, except when fire occurs in the driest month when the crowns will burn because of low moisture in the vegetation, and the meristems are damaged (Johnson and Simon 1987). Grazing impacts are concentrated on the gentler slopes accessible to livestock. *Pseudoroegneria spicata* shows an inconsistent reaction to grazing, increasing on some grazed sites while decreasing on others. It seems to recover more quickly from overgrazing than *Festuca campestris* (Mueggler and Stewart 1980). It tolerates dormant-period grazing well, but is sensitive to defoliation during the growing season. Light spring use or fall grazing can help retain plant vigor. It is particularly sensitive to defoliation in late spring (Comer et al. 1999). The exotic species *Bromus tectorum* occurs in many stands of the alliance and contributes significant cover on sites disturbed by livestock.

DISTRIBUTION

Geographic Range: Stands of this grassland alliance occur in the Colorado Plateau, Wyoming Basins, Utah-Wyoming Mountains, southern and middle Rocky Mountains, in southern Idaho, and the Great Basin.

Nations: US

States/Provinces: CA, CO, ID, MT, UT, WY

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007): 322Ai:CCC, 341Fc:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Mojave); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- > *Achnatherum hymenoides* (Indian rice grass grassland) Alliance (Sawyer et al. 2009) [41.120.00]
- > *Achnatherum hymenoides* Alliance (Indian rice grass grassland) (Buck-Diaz et al. 2012)
- > *Achnatherum hymenoides* Herbaceous Alliance (Evens et al. 2014)

- > *Pseudoroegneria spicata* (Bluebunch wheat grass grassland) Alliance (Sawyer et al. 2009) [41.040.00]

LOWER LEVEL UNITS

Associations:

- CEGLO01674 *Pseudoroegneria spicata* - *Achnatherum hymenoides* Grassland
- CEGLO01651 *Achnatherum hymenoides* Shale Barren Grassland
- CEGLO01661 *Pseudoroegneria spicata* ssp. *inermis* Grassland
- CEPP006710 *Achnatherum hymenoides* - *Oenothera deltoides* Dune Grassland
- CEGLO01666 *Pseudoroegneria spicata* - Cushion Plants Grassland
- CEGLO02343 *Achnatherum hymenoides* Colorado Plateau Grassland
- CEGLO02363 *Muhlenbergia pungens* Grassland
- CEGLO05470 *Achnatherum thurberianum* - *Bromus tectorum* Ruderal Grassland
- CEGLO03300 *Achnatherum hymenoides* Shrub Grassland
- CEGLO01652 *Achnatherum hymenoides* - *Sporobolus contractus* Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz and J. Coles, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2016/09/29

REFERENCES

References: Buck-Diaz et al. 2012, Evens et al. 2014, Faber-Langendoen et al. 2017b, Keeler-Wolf and Thomas 2000, Sawyer et al. 2009, USFS 1937, VegCAMP and AIS 2013

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G311. Intermountain Semi-Desert Grassland

A1290. *Achnatherum speciosum* Grassland Alliance

Type Concept Sentence: This grassland is documented from the Mojave Desert and dominated by *Achnatherum speciosum*, which is the sole dominant or important plant in the herbaceous layer.

OVERVIEW

Scientific Name: *Achnatherum speciosum* Grassland Alliance

Common Name (Translated Scientific Name): Desert Needlegrass Grassland Alliance

Colloquial Name: Desert Needlegrass Grassland

Type Concept: Stands of this alliance are dominated by *Achnatherum speciosum* (= *Stipa speciosa*), which is the sole dominant or important plant in the herbaceous layer. Species composition varies among stands, but *Achnatherum speciosum* is the unifying species. Other graminoids which may be present include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Elymus elymoides*, *Nassella cernua*, *Nassella lepida*, and *Poa secunda*. Scattered emergent shrubs such as *Hymenoclea salsola* may be present. This uncommon grassland is documented from the Mojave Desert. It grows in very xeric conditions with hot summers and occasional freezes in the winter. This alliance requires well-drained rocky or sandy soils. It was formerly widespread, but overgrazing has decimated stands. Remaining stands occur from 600-1000 m elevation on flat ridges, lower slopes, valleys, and washes.

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Vegetation appears to be endemic to the Mojave Desert and is characterized by dominance or codominance of the perennial grass *Achnatherum speciosum* having >50% of the total herbaceous cover.

VEGETATION

Physiognomy and Structure: This graminoid-dominated alliance typically is less than 1 m in height. The herbaceous layer can vary from open to fairly continuous. Scattered, emergent shrubs may be present.

Floristics: Stands of this alliance are dominated by *Achnatherum speciosum* (= *Stipa speciosa*) which is the sole dominant or important plant in the herbaceous layer. Species composition varies among stands, but *Achnatherum speciosum* is the unifying species. Other graminoids which may be present include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Elymus elymoides*, *Nassella cernua*, *Nassella lepida*, and *Poa secunda*. Scattered emergent shrubs such as *Hymenoclea salsola* may be present.

ENVIRONMENT & DYNAMICS

Environmental Description: This grassland of the Mojave Desert grows in very xeric conditions with hot summers and occasional freezes in the winter. This alliance requires well-drained rocky or sandy soils. It was formerly widespread, but overgrazing has decimated stands. Remaining stands occur from 600 to 1000 m elevation on flat ridges, lower slopes, valleys, and washes.

Dynamics: Plants of this alliance evolved in a very xeric environment with infrequent disturbance. Fires were not well-supported by the light plant cover, and grazing pressure was very light due to the low carrying capacity of the environment. The impact of cattle and sheep grazing and the consequent introduction of exotic plants such as *Bromus tectorum* have reduced stands of this alliance to a few dozen across its range.

DISTRIBUTION

Geographic Range: This alliance was once widespread throughout the Mojave Desert but has been reduced to scattered stands by overgrazing. It is reported from California and Utah.

Nations: US

States/Provinces: CA, UT

TNC Ecoregions [optional]: 11:C, 12:C, 17:C

USFS Ecoregions (2007): 322Ag:CCC, 341Fc:CCC, 341Ff:CCC, M261Er:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Joshua Tree)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Achnatherum speciosum* (Desert needlegrass grassland) Alliance (Sawyer et al. 2009) [41.090.00]
- = *Achnatherum speciosum* Herbaceous Alliance (Evens et al. 2012)
- = *Achnatherum speciosum* Herbaceous Alliance (Evens et al. 2014)
- = *Achnatherum speciosum* Herbaceous Alliance (CNPS 2017) [41.090.00]
- < Desert needlegrass series (Sawyer and Keeler-Wolf 1995)
- >< Valley Needlegrass Grassland (#42110) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEG003112 *Achnatherum speciosum* Grassland
- CEG003113 *Achnatherum speciosum* Shrub Grassland

AUTHORSHIP

Primary Concept Source: R. F. Holland (1986b); J.O. Sawyer and T. Keeler-Wolf (1995)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: CNPS 2017, Evens et al. 2012, Evens et al. 2014, Faber-Langendoen et al. 2017b, Holland 1986b, Humphrey 1974, Keeler-Wolf and Thomas 2000, Pavek 1993c, Reid et al. 1999, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Thomas et al. 2004, Tueller et al. 1991, Vasek and Thorne 1977, VegCAMP and AIS 2013

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G311. Intermountain Semi-Desert Grassland

A1270. *Hesperostipa comata* Grassland Alliance

Type Concept Sentence: This grassland alliance is dominated or codominated by *Aristida purpurea*, *Bouteloua gracilis*, *Hesperostipa comata*, or *Sporobolus cryptandrus* and is found primarily from Wyoming Basins, Colorado Plateau and Great Basin.

OVERVIEW

Scientific Name: *Hesperostipa comata* Grassland Alliance

Common Name (Translated Scientific Name): Needle-and-Thread Grassland Alliance

Colloquial Name: Needle-and-Thread Grassland

Type Concept: Grasslands included in this alliance are characterized by a sparse to moderately dense herbaceous layer dominated by *Aristida purpurea*, *Bouteloua gracilis*, *Hesperostipa comata*, or *Sporobolus cryptandrus*. Other common to codominant graminoids include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Carex filifolia*, *Koeleria macrantha*, *Pleuraphis jamesii* (= *Hilaria jamesii*), *Poa secunda*, *Sporobolus contractus*, and *Sporobolus giganteus*. The invasive species *Bromus tectorum* is common in disturbed stands. Forb cover is also sparse, but can be relatively diverse. Common forbs are *Gaura coccinea*, *Lappula occidentalis* (= *Lappula redowskii*), *Lithophragma glabrum*, *Lithophragma glabrum*, *Lupinus pusillus*, *Opuntia aurea* (= *Opuntia basilaris* var. *aurea*), *Opuntia polyacantha*, *Plantago patagonica*, or *Pediomelum argophyllum* (= *Psoralea argophylla*). Cryptogams are important in some stands with up to 40% ground cover on sites in the Colorado Plateau. This grassland alliance is found primarily from Wyoming Basins, Colorado Plateau, and Great Basin. Sites are on flat to moderately steep, often south-facing slopes, but can occur on any aspect. Soils are shallow to moderately deep, well-drained, coarse-textured, and non-saline. Sites include intermountain basins, alluvial flats, alluvial terraces of large rivers, sandy upper stream terraces along intermittent washes, and on sand deposits on mesas and plains.

Classification Comments: More investigation is needed to clarify the concept of this alliance. Some stands described by Kleiner (1968) have less than 25% herbaceous cover and are better classified in a sparsely vegetated alliance. Stands containing a mix of *Bouteloua gracilis*, *Carex filifolia*, and moderate amounts of *Pascopyrum smithii* or *Hesperostipa comata* may present classification problems. *Bouteloua gracilis* increases with heavy grazing pressure as other species decline in many western plant communities, often resulting in difficulties in classification. *Sporobolus cryptandrus* is found throughout the western and northern U.S. where it usually occurs as a minor species in various grassland and shrubland vegetation types. It may be locally common in areas disturbed by drought and overgrazing in the plains (Weaver and Albertson 1956). Further survey may find other associations than are currently in the classification.

Internal Comments: GK 9-16: ID added for Minidoka.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Vegetation is characterized by dominance or codominance of the perennial bunch grasses *Aristida purpurea*, *Bouteloua gracilis*, *Hesperostipa comata*, or *Sporobolus cryptandrus* having >50% of the total herbaceous cover in association with other graminoids.

VEGETATION

Physiognomy and Structure: This vegetation has a sparse to dense herbaceous layer less than 1 m tall that is dominated by perennial mid- and shortgrass species. Sparse to scattered cover of shrubs may be present. Perennial forbs are common but are not abundant in most stands. Annual forbs and grasses are seasonally present.

Floristics: Grasslands included in this alliance are characterized by a sparse to moderately dense herbaceous layer dominated by the medium-tall, cool-season bunchgrasses *Aristida purpurea*, *Bouteloua gracilis*, *Hesperostipa comata*, or *Sporobolus cryptandrus*. Other common to codominant graminoids include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Carex filifolia*, *Koeleria macrantha*, *Pleuraphis jamesii* (= *Hilaria jamesii*), *Poa secunda*, *Sporobolus contractus*, and *Sporobolus giganteus*. The invasive species *Bromus tectorum* is common in disturbed stands. Shrubs and dwarf-shrubs are sparse and may include scattered *Artemisia cana*, *Artemisia frigida*, *Artemisia tridentata*, *Ericameria nauseosa* (= *Chrysothamnus nauseosus*), or *Gutierrezia sarothrae*. Forb cover is also sparse, but can be relatively diverse. Common forbs are *Gaura coccinea*, *Lappula occidentalis* (= *Lappula redowskii*), *Lithophragma glabrum*, *Lithophragma glabrum*, *Lupinus pusillus*, *Opuntia aurea* (= *Opuntia basilaris* var. *aurea*), *Opuntia polyacantha*, *Plantago patagonica*, or *Pediomelum argophyllum* (= *Psoralea argophylla*). Cryptogams are important in some stands with up to 40% ground cover on sites in the Colorado Plateau.

ENVIRONMENT & DYNAMICS

Environmental Description: Grasslands included in this alliance are found on sandy loam, loam, silty loam, or loamy clay soils (Weaver and Albertson 1956, Johnston 1987, Steinauer 1989) that are shallow to moderately deep, well-drained, coarse-textured, and non-saline. They are often derived of alluvium or eolian deposits. Climate is temperate, mostly continental and semi-arid to arid. Mean annual precipitation ranges from 25-35 cm. The year-to-year variation of annual precipitation is great. Sites are on flat to moderately steep, often south-facing slopes, but can occur on any aspect. Sites include intermountain basins, alluvial flats, alluvial terraces of large rivers, sandy upper stream terraces along intermittent washes, and on sand deposits on mesas and plains. Elevations range from 1100-2300 m.

Dynamics: These grasslands are dominated by relatively deep-rooted grasses that use soil moisture below 0.5 m during the typically dry summers. The coarse-textured soils allow for rapid infiltration and storage of winter and summer precipitation (Kleiner 1968, Daubenmire 1970, Kleiner and Harper 1977, Thilenius et al. 1995). Burning generally kills or severely damages *Hesperostipa comata* plants. After fire, regeneration of this non-rhizomatous bunchgrass is through seed and may take many years to reach prefire densities (FEIS 1998). Exotic species such as *Bromus tectorum*, *Draba verna*, *Lactuca serriola*, *Tragopogon dubius* are present in some these stands (Daubenmire 1970). The cool-season annual grass *Bromus tectorum* can be an effective competitor for winter soil moisture because it can germinate in the fall, overwinter, then begin regrowing in the early spring before it is warm enough for many perennial grasses, completing its lifecycle and depleting soil moisture before the dry summer weather begins. This annual species also produces abundant fine fuels that carry fire well and increase the frequency of fires (FEIS 1998). *Bouteloua gracilis* is an extremely drought- and grazing-tolerant shortgrass species. It is one of the most widely distributed grasses in the western U.S. and is present in many different grassland, shrubland and woodland communities. It evolved with grazing by large herbivores and generally forms a short sod. However, in some stands ungrazed plants develop the upright physiognomy of a bunchgrass.

DISTRIBUTION

Geographic Range: Vegetation included in this grassland alliance is found in the central Wyoming Basins, Utah-Wyoming Mountains, Colorado Plateau, Great Basin, on the Snake River plain and foothills of the Rocky Mountains in Idaho, and east to the fringe of the Great Plains.

Nations: US

States/Provinces: AZ, CO, ID, NM, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEGLO01703 *Hesperostipa comata* - *Achnatherum hymenoides* Grassland
- CEGLO05800 *Aristida purpurea* Grassland
- CEGLO02997 *Hesperostipa comata* - (*Bouteloua eriopoda*, *Pleuraphis jamesii*) Grassland
- CEGLO01705 *Hesperostipa comata* Great Basin Grassland
- CEGLO02932 *Bouteloua gracilis* - *Hesperostipa comata* Grassland
- CEGLO02691 *Sporobolus cryptandrus* Great Basin Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2016/09/29

REFERENCES

References: Daubenmire 1970, FEIS 1998, Faber-Langendoen et al. 2017b, Kleiner 1968, Kleiner and Harper 1977, Thilenius et al. 1995

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G311. Intermountain Semi-Desert Grassland

A1287. *Pleuraphis jamesii* Grassland Alliance

Type Concept Sentence: This alliance is dominated or codominated by *Bouteloua eriopoda*, *Bouteloua gracilis*, *Pleuraphis jamesii*, or *Sporobolus airoides*. It occurs in arid and semi-arid regions in the southwestern Great Plains, Colorado Plateau, southern Rocky Mountains, Great Basin, and northern Chihuahuan Desert.

OVERVIEW

Scientific Name: *Pleuraphis jamesii* Grassland Alliance

Common Name (Translated Scientific Name): James' Galleta Grassland Alliance

Colloquial Name: James' Galleta Grassland

Type Concept: The vegetation is characterized by an herbaceous layer with sparse to moderately dense cover of perennial grasses that is usually dominated or codominated by *Bouteloua eriopoda*, *Bouteloua gracilis*, *Pleuraphis jamesii*, or *Sporobolus airoides*. Other common perennial grasses may include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Aristida purpurea*, *Bouteloua curtipendula*, *Bouteloua dactyloides* (= *Buchloe dactyloides*), *Elymus elymoides*, *Hesperostipa neomexicana* (= *Stipa neomexicana*), *Muhlenbergia porteri*, *Muhlenbergia torreyi*, *Pascopyrum smithii*, and *Sporobolus cryptandrus*. The sparse forb layer may include *Artemisia carruthii*, *Artemisia dracuncululus*, *Astragalus* spp., *Chaenactis stevioides*, *Cryptantha* sp., *Cymopterus newberryi*, *Grindelia squarrosa*, *Lappula occidentalis*, *Machaeranthera pinnatifida*, *Plantago patagonica*, *Ratibida* spp., *Scleropogon brevifolius*, *Sphaeralcea coccinea*, and *Zinnia grandiflora*. This alliance occurs in arid and semi-arid regions in the southwestern Great Plains, Colorado Plateau, Great Basin, and northern Chihuahuan Desert. These grasslands occur on a variety of landforms, including plains, mesas, alluvial flats, floodplains, swales, hillslopes, dunes, badlands and bajadas. Soils are variable and range from sand to clay textures. Stands occur on all slopes and aspects. Substrates are variable and range from sand- to clay-textured soils. Parent materials include alluvium, colluvium and eolian deposits derived from igneous, metamorphic and, most commonly, sedimentary rocks, especially shale and sandstone. Elevation ranges from 1200-2800 m.

Classification Comments: Stands containing a mix of *Bouteloua gracilis*, *Carex filifolia*, and moderate amounts of *Pascopyrum smithii* or *Hesperostipa comata* may present classification problems. *Bouteloua gracilis* increases with heavy grazing pressure as other species decline in many western plant communities, often resulting in difficulties in classification.

Internal Comments: mjr 12-14: CA added for MOJN.

Other Comments:

Similar NVC Types:

- A3186 *Sporobolus airoides* - *Sporobolus wrightii* - *Panicum obtusum* Lowland Desert Grassland Alliance

Diagnostic Characteristics: Vegetation is characterized by dominance or codominance of the perennial grasses *Bouteloua eriopoda*, *Bouteloua gracilis*, *Pleuraphis jamesii*, and *Sporobolus airoides* having >50% of the total herbaceous cover. These grasslands have their main area of distribution in the Colorado Plateau and southern Rocky Mountains and have a broad ecological amplitude.

VEGETATION

Physiognomy and Structure: Vegetation in this alliance has a sparse to moderately dense herbaceous layer is dominated by perennial bunch grasses. A sparse to moderately dense forb layer is often present. Annuals may be seasonally abundant.

Floristics: The vegetation is characterized by an herbaceous layer with sparse to moderately dense cover of perennial grasses that is usually dominated or codominated by *Bouteloua eriopoda*, *Bouteloua gracilis*, *Pleuraphis jamesii*, or *Sporobolus airoides*. Other common perennial grasses may include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Aristida purpurea*, *Bouteloua curtipendula*, *Bouteloua dactyloides* (= *Buchloe dactyloides*), *Elymus elymoides*, *Hesperostipa neomexicana* (= *Stipa neomexicana*), *Muhlenbergia porteri*, *Muhlenbergia torreyi*, *Pascopyrum smithii*, and *Sporobolus cryptandrus*. The sparse forb layer may include *Artemisia carruthii*, *Artemisia dracuncululus*, *Astragalus* spp., *Chaenactis stevioides*, *Cryptantha* sp., *Cymopterus newberryi*, *Grindelia squarrosa*, *Lappula occidentalis*, *Machaeranthera pinnatifida*, *Plantago patagonica*, *Ratibida* spp., *Scleropogon brevifolius*, *Sphaeralcea coccinea*, and *Zinnia grandiflora*. Occasional shrubs and dwarf-shrubs, such as *Artemisia bigelovii*, *Atriplex canescens*, *Atriplex confertifolia*, *Atriplex obovata*, *Ericameria nauseosa*, *Ephedra* spp., *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Opuntia* spp., or *Yucca* spp., may occur with less than 10% total cover.

ENVIRONMENT & DYNAMICS

Environmental Description: These grasslands occur on a variety of landforms, including plains, mesas, alluvial flats, floodplains, swales, hillslopes, dunes, badlands and bajadas. Soils are variable and range from sand to clay textures. Stands occur on all slopes and aspects. Parent materials include alluvium, colluvium and eolian deposits derived from igneous, metamorphic and, most commonly, sedimentary rocks, especially shale and sandstone. Elevation ranges from 1200-2800 m. The climate is semi-arid with highly variable, bimodally distributed precipitation. Approximately two-thirds of the 20-40 cm mean annual precipitation occurs in the late summer and early fall, usually as localized high-intensity thunderstorms.

Dynamics: *Pleuraphis jamesii* is both drought- and grazing-resistant (USFS 1937, Weaver and Albertson 1956, West et al. 1972). In parts of its range it increases under grazing, and in others parts it decreases. The grass is favored in mixedgrass stands because it is only moderately palatable to livestock, but decreases when heavily grazed during drought and in the more arid portions of its range where it is the dominant grass (West et al. 1972). This grass reproduces extensively from scaly rhizomes. These rhizomes make the plant resistant to trampling by livestock and have good soil-binding properties (USFS 1937, Weaver and Albertson 1956, West et al. 1972). The abundance of *Bouteloua eriopoda*-dominated grasslands has declined significantly in the last 50 years (Nelson 1934, Gardner 1950, Buffington and Herbel 1965, Herbel et al. 1972, Hennessy et al. 1983). These grasslands have been replaced largely by

shrublands dominated by *Prosopis glandulosa* in Trans-Pecos Texas, southern New Mexico, and southeastern Arizona. Studies on the Jornada Experimental Range suggest that combinations of drought, overgrazing by livestock, wind and water erosion, seed dispersal by livestock, fire suppression, shifting dunes, and changes in the seasonal distribution of precipitation have caused this recent, dramatic shift in vegetation physiognomy (Buffington and Herbel 1965, Herbel et al. 1972, Humphrey 1974, McLaughlin and Bowers 1982, Gibbens et al. 1983, Hennessy et al. 1983, Schlesinger et al. 1990, McPherson 1995). *Prosopis* spp. and other shrubs have extensive root systems that allow them to exploit deep soil water that is unavailable to shallower-rooted grasses and cacti (Burgess 1995). This strategy works well, except on sites that have well-developed argillic or calcic soil horizons that limit infiltration and storage of winter moisture in the deeper soil layers (McAuliffe 1995). McAuliffe (1995) found *Prosopis* spp. invasion on these sites to be limited to a few small individuals. This has implications in plant geography and grassland revegetation work in the southwestern United States. *Bouteloua gracilis* is an extremely drought- and grazing-tolerant shortgrass species. It is one of the most widely distributed grasses in the western U.S. and is present in many different grassland, shrubland and woodland communities. It evolved with grazing by large herbivores and generally forms a short sod. However, in some stands ungrazed plants develop the upright physiognomy of a bunchgrass.

DISTRIBUTION

Geographic Range: The distribution of this southwestern alliance is centered in the Colorado Plateau region of Colorado, New Mexico, Arizona, and Utah. It is also found in the shortgrass steppe in eastern Colorado and New Mexico (and possibly the panhandles of Oklahoma and Texas), north to Wyoming, south to the northern Chihuahuan Desert and west to the Great Basin.

Nations: US

States/Provinces: AZ, CA, CO, NM, NV, OK?, TX?, UT, WY

TNC Ecoregions [optional]: 17:C

USFS Ecoregions (2007): 322Ai:CCC, 322Al:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Hilaria jamesii* - *Sporobolus airoides* Plant Community (Francis 1986) [Plant community #37]
- = *Pleuraphis jamesii* (James' galleta shrub-steppe) Alliance (Sawyer et al. 2009) [41.610.00]
- = *Pleuraphis jamesii* Herbaceous Alliance (Evens et al. 2014)

LOWER LEVEL UNITS

Associations:

- CEGLO01751 *Bouteloua eriopoda* - *Pleuraphis jamesii* Grassland
- CEGLO01759 *Bouteloua gracilis* - *Pleuraphis jamesii* Grassland
- CEGLO01760 *Bouteloua gracilis* Grassland
- CEGLO06755 *Scleropogon brevifolius* - *Pleuraphis jamesii* - *Bouteloua eriopoda* Grassland
- CEGLO01778 *Pleuraphis jamesii* - *Sporobolus airoides* Grassland
- CEGLO01777 *Pleuraphis jamesii* Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, B. Hoagland, D. Diamond, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Evens et al. 2014, Faber-Langendoen et al. 2017b, Francis 1986, Francis and Aldon 1983, Keeler-Wolf and Thomas 2000, Sawyer et al. 2009, Thomas et al. 2004, USFS 1937, VegCAMP and AIS 2013, Weaver and Albertson 1956, West et al. 1972

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G311. Intermountain Semi-Desert Grassland

A3976. *Pseudoroegneria spicata* - *Opuntia polyacantha* Dry Canyon Slope Grassland Alliance

Type Concept Sentence: These dry grasslands occur in the canyons and valleys of the northern Great Basin and in the Columbia Basin and are characterized by a sparse to moderately dense graminoid layer of *Pseudoroegneria spicata* codominated by *Aristida purpurea* var. *longiseta* and/or *Poa secunda*. *Pseudoroegneria spicata* is sometimes absent or has low cover, and *Sporobolus cryptandrus* and *Opuntia polyacantha* may be especially abundant on disturbed or harsh windswept sites.

OVERVIEW

Scientific Name: *Pseudoroegneria spicata* - *Opuntia polyacantha* Dry Canyon Slope Grassland Alliance

Common Name (Translated Scientific Name): Bluebunch Wheatgrass - Plains Prickly-pear Dry Canyon Slope Grassland Alliance

Colloquial Name: Dry Canyon Slope Wheatgrass - Prickly-pear Grassland

Type Concept: The vegetation of this dry grassland alliance is characterized by a sparse to moderately dense graminoid layer of *Pseudoroegneria spicata* codominated by *Aristida purpurea* var. *longiseta* and/or *Poa secunda*. *Pseudoroegneria spicata* is sometimes absent or has low cover. *Sporobolus cryptandrus* and *Opuntia polyacantha* are especially abundant on disturbed sites or harsh windswept ridgetops and steep upper slopes. Important forbs include *Achillea millefolium*, *Allium acuminatum*, *Arnica sororia*, *Balsamorhiza sagittata*, *Castilleja* spp., *Calochortus* spp., *Crepis acuminata*, *Erigeron pumilus*, *Eriophyllum lanatum*, *Lupinus* spp., *Plantago patagonica*, and *Sedum stenopetalum*. Deciduous shrubs such as *Holodiscus discolor*, *Physocarpus malvaceus*, *Ribes* spp., *Rhus glabra*, and *Symphoricarpos* spp. are occasionally present and may increase in abundance with fire exclusion. These grasslands occur in the canyons and valleys of the northern Great Basin and in the Columbia Basin, particularly along the Snake River canyon, the lower foothill slopes of the Blue Mountains, Wallowa Mountains, Hells Canyon, Seven Devil Mountains, and Salmon River Mountains of eastern Oregon, Washington and Idaho and along the main stem of the Columbia River in eastern Washington. Stands occur on gentle to steep mid and upper slopes and ridgetops in highly dissected foothills and canyon slope terrain and on stream terraces, alluvial fans, and benchlands in lower canyons. Sites are as low as 240 m and up to 1130 m elevation. Soils are typically shallow with a high percentage of rock fragments.

Classification Comments: These grasslands are floristically similar to other lower montane and foothill grasslands of the Central Rockies, but are found in environmental settings that tend to be drier than the "matrix" grasslands. Some of the dominant species (*Aristida*, *Sporobolus*, and *Opuntia*) are not particularly common in other Central Rockies grasslands, and forb taxa are also different.

Internal Comments: KAS 2-14: *Aristida purpurea* var. *longiseta* - *Pseudoroegneria spicata* - *Sporobolus cryptandrus* Herbaceous Vegetation (CEGL001589) is included in this alliance because of codominance of *Pseudoroegneria spicata*, but it occurs in similar river terrace habitats and the grasslands in the *Sporobolus cryptandrus* - *Aristida purpurea* var. *longiseta* - *Poa secunda* Sandy Stream Terrace Grassland Alliance (A3977).

Other Comments:

Similar NVC Types: Alliances in Central Rocky Mountain Lower Montane, Foothill & Valley Grassland Group (G273) and Central Rocky Mountain Montane Grassland Group (G267) may share some of the widespread dominant grass species. This alliance typically occurs in drier, often lower elevation sites.

Diagnostic Characteristics: This alliance has a sparse to moderately dense graminoid layer characterized by diagnostic and often dominant species *Pseudoroegneria spicata* codominated by *Aristida purpurea* var. *longiseta* and/or *Poa secunda*. *Pseudoroegneria spicata* is sometimes absent or has low cover with *Aristida purpurea* var. *longiseta* and *Poa secunda* dominating. Indicator species *Sporobolus cryptandrus* and *Opuntia polyacantha* are especially abundant on disturbed sites or harsh windswept ridgetops and steep upper slopes.

VEGETATION

Physiognomy and Structure: Vegetation in this alliance is characterized by a sparse to dense cover of graminoids that is dominated by perennial bunch grasses less than 1 m tall. There is also sparse to moderate cover of perennial forbs. Occasional scattered shrubs and dwarf-shrubs may be present. Annual forbs and grasses are seasonally present. Nonvascular cover is important in some stands.

Floristics: The vegetation is characterized by a sparse to moderately dense graminoid layer of *Pseudoroegneria spicata* codominated by *Aristida purpurea* var. *longiseta* and/or *Poa secunda*. *Pseudoroegneria spicata* is sometimes absent or has low cover. *Sporobolus cryptandrus* and *Opuntia polyacantha* are especially abundant on disturbed sites or harsh windswept ridgetops and steep upper slopes. Other associated grasses include *Danthonia unispicata*, *Elymus elymoides*, and *Hesperostipa comata*. Important forbs include *Achillea millefolium*, *Allium acuminatum*, *Antennaria* spp., *Arnica sororia*, *Balsamorhiza sagittata*, *Castilleja* spp., *Calochortus* spp., *Crepis acuminata*, *Erigeron pumilus*, *Eriophyllum lanatum*, *Lomatium cous*, *Lupinus* spp., *Plantago patagonica*, *Scutellaria angustifolia*, and *Sedum stenopetalum*. Deciduous shrubs such as *Holodiscus discolor*, *Phlox longifolia*, *Physocarpus malvaceus*, *Ribes* spp., *Rhus glabra*, and *Symphoricarpos* spp. are occasionally present and may increase in abundance with fire exclusion. The shrub *Ericameria nauseosa* (= *Chrysothamnus nauseosus*) is present in some stands, and will increase with overgrazing and other disturbance (Daubenmire 1970). The introduced annual grasses *Bromus tectorum*, *Bromus arvensis* (= *Bromus japonicus*), and *Bromus briziformis* and diverse non-native forbs such as *Hypericum perforatum* and *Erodium cicutarium* are abundant in many stands.

ENVIRONMENT & DYNAMICS

Environmental Description: These dry grasslands occur in the canyons and valleys of the northern Great Basin and in the Columbia Basin, particularly along the Snake River canyon, the lower foothill slopes of the Blue Mountains, Wallowa Mountains, Hells Canyon, Seven Devil Mountains, and Salmon River Mountains of eastern Oregon, Washington and Idaho and along the main stem of the Columbia River in eastern Washington. Climate is temperate continental. Mean annual precipitation ranges from 33-60 cm. Precipitation primarily occurs in the winter as snow or rain. Stands occur on gentle to steep mid and upper slopes and ridgetops in highly dissected foothills and canyon slope terrain and on stream terraces, alluvial fans, and benchlands in lower canyons. Sites are as low as 240 m and up to 1130 m elevation. This moisture is stored in the soil profile and utilized during the typically dry summers. Sites include soil pockets between rocks on cliffs lining the sides of ravines. This grassland occurs on all aspects, but is more common on southern slopes. Soils are typically shallow with a high percentage of rock fragments and exposed rock (lithic), but also may be moderately deep on some sites. They are moderately well-drained, non-calcareous, sandy to clay soils with pH of 5.8-7.2, and are derived from alluvium, colluvium, residuum or loess. Parent materials include basalt, andesite, rhyolite and tuff. Rock and moss cover significant amounts of the ground surface often with over 40% cover of each.

Dynamics: Fire has variable effects on *Pseudoroegneria spicata*. Plants usually survive burning, and growth is often stimulated, except when fire occurs in the driest month when the crowns will burn because of low moisture in the vegetation, and the meristems are damaged (Johnson and Simon 1987). Grazing impacts are concentrated on the gentler slopes accessible to livestock. *Pseudoroegneria spicata* shows an inconsistent reaction to grazing, increasing on some grazed sites while decreasing on others. It seems to recover more quickly from overgrazing than *Festuca campestris* (Mueggler and Stewart 1980). It tolerates dormant-period grazing well, but is sensitive to defoliation during the growing season. Light spring use or fall grazing can help retain plant vigor. It is particularly sensitive to defoliation in late spring (Comer et al. 1999).

Poa secunda-dominated grasslands usually have relatively shallow, rocky soils with limited water-holding capacity. The winter precipitation wets these soils, but they typically dry out completely to bedrock by midsummer (Ganskopp 1979). *Poa secunda* is well-adapted to these conditions because it starts growing early in the spring and completes its reproductive cycle early while there is still moisture in the soil (Daubenmire 1970). If there is late summer or fall precipitation, dominant *Poa secunda* can green up quickly again. Shrubs are uncommon. Daubenmire (1970) and Johnson and Simon (1987) suggest that bedrock present under these grasslands is not fractured enough to support deeper-rooted shrubs. In addition to drought tolerance, *Poa secunda* is also tolerant of grazing and trampling by livestock (Daubenmire 1970, Ganskopp 1979).

Stands in this alliance are generally considered to be late-seral with species composition controlled by the harsh edaphic conditions of the site (Daubenmire 1970, Johnson and Simon 1987). However, some stands, especially stands of *Aristida purpurea* var. *longiseta* - *Poa secunda* Grassland (CEGL001781) that occur on deeper soils, may be early-seral forms of a *Pseudoroegneria spicata* grassland, because *Poa secunda* increases under moderate grazing (Daubenmire 1970).

Sporobolus cryptandrus occurs throughout the western U.S. as a minor species, occasionally becoming locally dominant in disturbed or sandy sites in the midgrass prairie (Weaver and Albertson 1956). In the headwaters of the Columbia River basin these stands occur as climax grasslands in canyons on river bars and terraces, and on upland benches and terraces as grazing disclimax and edaphic climax grasslands (Daubenmire 1970, Johnson and Simon 1987, Tisdale 1986).

Many of these grasslands have been severely disturbed by grazing livestock and exotic weeds (Daubenmire 1970, Johnson and Simon 1987, Tisdale 1986). Early-season grazing reduces the abundance of the very palatable cool-season bunchgrass *Pseudoroegneria spicata* and favors the warm-season *Sporobolus cryptandrus* that greens up later in the season. Also, *Sporobolus cryptandrus* is a C4 plant that grows on sites that stay moist when it is hot, giving the C4 the advantage over the cool-season (C3) bunchgrasses. *Poa secunda*, another cool-season grass, is also affected by early grazing, but is better able to withstand it because of its short stature. *Aristida purpurea* var. *longiseta* is an unpalatable warm-season grass that increases as the palatable grasses decline. As native perennial grasses decline, exotic species fill the gaps (Tisdale 1986). Exotic annual grasses (*Bromus tectorum*, *Bromus arvensis*, and *Bromus briziformis*) and others may make up 20-50% of the vegetation cover. These annual grasses are especially abundant during wet years (Ganskopp 1979, Tisdale 1986).

Other disturbances such as frost heaving also favor exotic species invasion. Frost heaving causes local soil disturbance in the winter when these thin, saturated soils freeze and push soil and plants up out of the ground. Exotic forbs, both perennials such as *Hypericum perforatum*, and annuals such as *Arenaria serpyllifolia*, *Epilobium brachycarpum*, *Erodium cicutarium*, *Draba verna*, *Holosteum umbellatum*, *Lactuca serriola*, *Lepidium perfoliatum*, *Myosotis stricta*, *Tragopogon dubius*, and *Veronica arvensis* make up significant cover and diversity in many stands. The newest exotic threats are four species of *Centaurea* that are invading large areas in this region. Fire appears to have little effect on the species composition of these grasslands (Tisdale 1986).

DISTRIBUTION

Geographic Range: These dry grasslands occur in the canyons and valleys of the northern Great Basin and in the Columbia Basin, particularly along the Snake River canyon, the lower foothill slopes of the Blue Mountains, Wallowa Mountains, Hells Canyon, Seven Devil Mountains, and Salmon River Mountains of eastern Oregon, Washington and Idaho and along the main stem of the Columbia River in eastern Washington.

Nations: US

States/Provinces: ID, NV, OR, WA

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- >< *Agropyron spicatum* Series (Johnson and Simon 1987)
- >< *Agropyron spicatum* Series (Tisdale 1986)
- >< *Pseudoroegneria spicata* Grasslands (Chappell et al. 1997)
- >< *Sporobolus cryptandrus* - *Aristida purpurea* var. *longiseta* Grasslands (Chappell et al. 1997)
- >< Bluebunch Wheatgrass - Sand Dropseed - Red Three Awn Plant Community Type - Sand (Johnson and Simon 1987)
- = Bluebunch Wheatgrass Series (Johnson and Simon 1987) [roughly includes types in this alliance.]
- >< Bluegrass Scabland (Volland 1976)
- >< Bluegrass Scabland (Hall 1973)
- >< River Terrace Canyon Grasslands (Kagan 1997)
- ? Sand Dropseed Plant Association (Johnson and Simon 1987)

LOWER LEVEL UNITS

Associations:

- CEGLO01781 *Aristida purpurea* var. *longiseta* - *Poa secunda* Grassland
- CEGLO01673 *Pseudoroegneria spicata* - *Opuntia polyacantha* - (*Poa secunda*) Grassland
- CEGLO01589 *Aristida purpurea* var. *longiseta* - *Pseudoroegneria spicata* - *Sporobolus cryptandrus* Grassland

AUTHORSHIP

Primary Concept Source: C.G. Johnson and S.A. Simon (1987)

Author of Description: K.A. Schulz

Acknowledgments: This alliance is based in part on Columbia Basin Foothill and Canyon Dry Grassland (CES304.993), ecological system concept (authored by R. Crawford, J. Kagan, and M. Reid).

Version Date: 2015/09/21

REFERENCES

References: Anderson 1956, Chappell et al. 1997, Christensen 1963, Copeland 1980a, Daubenmire 1970, Daubenmire 1992, Faber-Langendoen et al. 2017b, Fisser et al. 1965, Francis 1983, Ganskopp 1979, Hall 1973, Johnson and Clausnitzer 1992, Johnson and Simon 1985, Johnson and Simon 1987, Kagan 1997, Manning and Padgett 1992, Poulton 1955, Reid et al. 1994, Tisdale 1979, Tisdale 1986, USFS 1937, Volland 1976, Winward and Youtie 1976

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G311. Intermountain Semi-Desert Grassland

A4216. *Sphaeralcea ambigua* - *Sphaeralcea coccinea* - *Sphaeralcea parvifolia* Dry Meadow Alliance [Low - Poorly Documented]

Type Concept Sentence:

OVERVIEW

Scientific Name: *Sphaeralcea ambigua* - *Sphaeralcea coccinea* - *Sphaeralcea parvifolia* Dry Meadow Alliance

Common Name (Translated Scientific Name): Desert Globemallow - Scarlet Globemallow - Small-leaf Globemallow Dry Meadow Alliance

Colloquial Name: Globemallow Dry Meadow

Type Concept:

Classification Comments:

Internal Comments: mjr 12-16: AZ & CA added based on child records (MOJN).

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure:

Floristics:

ENVIRONMENT & DYNAMICS

Environmental Description:

Dynamics:

DISTRIBUTION

Geographic Range:

Nations: US

States/Provinces: AZ, CA, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEPP009532 *Sphaeralcea ambigua* Dry Meadow
- CEGLO05366 *Sphaeralcea (coccinea, parvifolia)* Grassland

AUTHORSHIP

Primary Concept Source: M. Reid, in Faber-Langendoen et al.

Author of Description:

Acknowledgments:

REFERENCES

3. Desert & Semi-Desert
3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland
G311. Intermountain Semi-Desert Grassland

A3977. Sporobolus cryptandrus - Aristida purpurea var. longiseta - Poa secunda Sandy Stream Terrace Grassland Alliance

Type Concept Sentence: This dry grassland alliance is characterized by a moderately dense graminoid layer dominated by *Sporobolus cryptandrus*, often codominant with *Aristida purpurea* var. *longiseta* or *Poa secunda*. It occurs on gentle lower slopes, river terraces and alluvial bars on hot, dry sites in the Columbia Basin and lower Snake and Clearwater rivers in Oregon and Washington, and in the lowest elevations of Hells Canyon within the Blue Mountains in Idaho, and the Bighorn Basin in Montana.

OVERVIEW

Scientific Name: *Sporobolus cryptandrus* - *Aristida purpurea* var. *longiseta* - *Poa secunda* Sandy Stream Terrace Grassland Alliance
Common Name (Translated Scientific Name): Sand Dropseed - Red Three-awn - Sandberg Bluegrass Sandy Stream Terrace Grassland Alliance

Colloquial Name: Sandy Stream Terrace Sand Dropseed Grassland

Type Concept: The vegetation of this grassland alliance is characterized by a moderately dense graminoid layer dominated by *Sporobolus cryptandrus*. *Poa secunda* or *Aristida purpurea* var. *longiseta* often codominate the graminoid layer. *Hesperostipa comata* (= *Stipa comata*) may be present in low abundance; *Pseudoroegneria spicata* is generally absent. Forb cover is typically low, but *Astragalus inflexus*, *Calochortus macrocarpus*, and *Heterotheca villosa* (= *Chrysopsis villosa*) are often present. *Bromus tectorum* (and several other exotic species) is common. This grassland alliance is described for the Columbia Basin and lower Snake and

Clearwater rivers in Oregon and Washington, and in the lowest elevations of Hells Canyon within the Blue Mountains in Idaho, and the Bighorn Basin in Montana. Stands occur on lower slopes, river terraces and alluvial bars on hot, dry sites. Sites are flat to gentle (to 30%) and occur on all aspects. Substrates are excessively drained soils with sand or sandy loam texture.

Classification Comments: *Sporobolus cryptandrus* is found throughout the western and northern U.S. where it usually occurs as a minor species in various grassland and shrubland vegetation types. It may be locally common in areas disturbed by drought and overgrazing in the plains (Weaver and Albertson 1956). Further survey may find other associations than are currently in the classification.

Johnson and Simon (1987) describe a similar community with *Sporobolus cryptandrus* dominant, but *Poa secunda* is not present in any of the stands they sampled. It is not certain if these stands represent distinct environmental conditions or if *Poa secunda* has simply been eliminated by grazing pressure. Most stands are in poor condition in canyons in eastern Washington. Overgrazed stands develop a significant shrub layer of *Ericameria nauseosa* and may be better classified in a shrubland alliance (Daubenmire 1970).

Internal Comments:

Other Comments:

Similar NVC Types: Alliances in Central Rocky Mountain Lower Montane, Foothill & Valley Grassland Group (G273) and Central Rocky Mountain Montane Grassland Group (G267) may share some of the widespread dominant grass species.

Diagnostic Characteristics: The vegetation is characterized by a moderately dense graminoid layer dominated by diagnostic species *Sporobolus cryptandrus*. *Poa secunda* or *Aristida purpurea* var. *longiseta* often codominate. *Hesperostipa comata* may be present in low abundance; *Pseudoroegneria spicata* is generally absent. Forb cover is typically low, but *Astragalus inflexus*, *Calochortus macrocarpus*, and *Heterotheca villosa* are often present. *Bromus tectorum* and several other exotic species are common.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a sparse to moderately dense layer of medium-tall graminoids, primarily perennial bunch grasses. Forbs are present but usually not abundant. Shrubs are rarely present except in livestock-grazed sites.

Floristics: Vegetation in this alliance is sparse to moderately dense grassland communities that are dominated or codominated by the perennial medium-tall, warm-season bunchgrasses *Sporobolus cryptandrus* and *Aristida purpurea* var. *longiseta* and cool-season bunchgrass *Poa secunda*. Cool-season bunchgrass *Hesperostipa comata* may be present in lesser amounts, especially on the more upland sites. *Pseudoroegneria spicata* is generally absent or has low cover. Associated perennial forbs include *Achillea millefolium*, *Astragalus inflexus*, *Calochortus macrocarpus*, *Erigeron pumilus*, *Heterotheca villosa*, and *Opuntia polyacantha*. Common annuals are the forbs *Epilobium brachycarpum* (= *Epilobium paniculatum*) and *Plantago patagonica*, and the grasses *Vulpia octoflora* (= *Festuca octoflora*) and *Vulpia microstachys* var. *pauciflora* (= *Festuca pacifica*). The shrub *Ericameria nauseosa* (= *Chrysothamnus nauseosus*) is present in some stands, and will increase with overgrazing (Daubenmire 1970). The introduced annual grasses *Bromus tectorum*, *Bromus arvensis* (= *Bromus japonicus*), and *Bromus briziformis* and diverse non-native forbs such as *Hypericum perforatum* and *Erodium cicutarium* are abundant in many stands. Diagnostic of this grassland alliance is the dominance or codominance of *Sporobolus cryptandrus*.

ENVIRONMENT & DYNAMICS

Environmental Description: Grasslands in this alliance are found in the lower Salmon and Snake river canyons of Idaho, Oregon and Washington, and the Columbia River in central Washington. Stands occur on dry alluvial bars, river terraces, footslopes of benches and alluvial fans. The elevation ranges from 240-1630 m. Sites are flat to gentle (to 30%) and occur on all aspects. Climate in the canyon bottoms is relatively hot and dry with as little as 25 cm mean annual precipitation. Substrates are derived from loess and alluvium-colluvium. Soils are moderately deep (0.75-1.5 m), and surface soil texture varies from sandy loam to silt loam. This alliance includes grasslands in two successional stages. The first is later seral and is found on river terraces and alluvial bars. *Celtis laevigata* var. *reticulata* communities are often adjacent. The second is a grazing disclimax and occurs on terraces, alluvial fans and benchlands within the more mesic *Pseudoroegneria spicata* zone. Daubenmire (1970) also described it as an edaphic climax where it occurs on sandy sites adjacent to *Pseudoroegneria spicata*-dominated grasslands. His research found these soils deficient in magnesium and possibly potassium. He hypothesized that the low levels prevented *Pseudoroegneria spicata* from becoming dominant.

Dynamics: *Sporobolus cryptandrus* occurs throughout the western U.S. as a minor species, occasionally becoming locally dominant in disturbed or sandy sites in the midgrass prairie (Weaver and Albertson 1956). In the headwaters of the Columbia River basin these stands occur as climax grasslands in canyons on river bars and terraces, and on upland benches and terraces as grazing disclimax and edaphic climax grasslands (Daubenmire 1970, Johnson and Simon 1987, Tisdale 1986). Many of these grasslands have been severely disturbed by grazing livestock and exotic weeds (Daubenmire 1970, Johnson and Simon 1987, Tisdale 1986). Early-season grazing

reduces the abundance of the very palatable cool-season bunchgrass *Pseudoroegneria spicata* and favors the warm-season *Sporobolus cryptandrus* that greens up later in the season. Also, *Sporobolus cryptandrus* is a C4 plant that grows on sites that stay moist when it is hot giving the C4 the advantage over the cool-season (C3) bunch grasses. *Poa secunda*, another cool-season grass, is also affected by early grazing, but is better able to withstand it because of its short stature. *Aristida purpurea* var. *longiseta* is an unpalatable warm-season grass that increases as the palatable grasses decline. As native perennial grasses decline, exotic species fill the gaps (Tisdale 1986). Exotic annual grasses (*Bromus tectorum*, *Bromus arvensis*, and *Bromus briziformis*) and others may make up 20-50% of the vegetation cover. These annual grasses are especially abundant during wet years (Ganskopp 1979, Tisdale 1986). Exotic forbs, both perennials, such as *Hypericum perforatum*, and annuals, such as *Arenaria serpyllifolia*, *Epilobium brachycarpum*, *Erodium cicutarium*, *Draba verna*, *Holosteum umbellatum*, *Lactuca serriola*, *Lepidium perfoliatum*, *Myosotis stricta*, *Tragopogon dubius*, and *Veronica arvensis*, make up significant cover and diversity in many stands. The newest exotic threats are four species of *Centaurea* that are invading large areas in this region. Fire appears to have little effect on the species composition of these grasslands (Tisdale 1986).

DISTRIBUTION

Geographic Range: This dry grassland alliance is described for the Columbia Basin and lower Snake and Clearwater rivers in Oregon and Washington, and in the lowest elevations of Hells Canyon within the Blue Mountains in Idaho.

Nations: US

States/Provinces: ID, MT, OR, WA, WY?

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- >< River Terrace Canyon Grasslands (Kagan 1997)
- = Sand Dropseed Plant Association (Johnson and Simon 1987)

LOWER LEVEL UNITS

Associations:

- C EGL001514 *Sporobolus cryptandrus* Shrub Grassland
- C EGL001516 *Sporobolus cryptandrus* - *Poa secunda* Grassland
- C EGL001515 *Aristida purpurea* var. *longiseta* - *Sporobolus cryptandrus* Grassland

AUTHORSHIP

Primary Concept Source: C.G. Johnson and S.A. Simon (1987)

Author of Description: K.A. Schulz

Acknowledgments: This alliance is based in part on Columbia Basin Foothill and Canyon Dry Grassland (CES304.993), an ecological system concept (authored by R. Crawford, J. Kagan, and M. Reid).

Version Date: 2014/03/14

REFERENCES

References: Chappell et al. 1997, Daubenmire 1970, Faber-Langendoen et al. 2017b, Ganskopp 1979, Johnson and Simon 1985, Johnson and Simon 1987, Kagan 1997, Reid et al. 1994, Tisdale 1986, USFS 1937, Weaver and Albertson 1956

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

3.B.1.Ne.1.d. M171 Great Basin-Intermountain Dry Shrubland & Grassland

G310. Intermountain Semi-Desert Steppe & Shrubland

Type Concept Sentence: This widespread dwarf-shrubland, shrubland and shrub-steppe group occurs throughout the semi-arid western U.S. on a variety of sites and disturbance regimes and is characterized by an open to moderately dense woody layer composed of diverse woody species such as *Chamaebatiaria millefolium*, *Chrysothamnus albidus*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Ephedra viridis*, *Ephedra torreyana*, *Glossopetalon spinescens*, *Gutierrezia sarothrae*, *Gutierrezia microcephala*, *Ericameria nana*, *Ericameria parryi*, *Ericameria teretifolia*, *Krascheninnikovia lanata*, *Mahonia fremontii*, *Opuntia polyacantha*, and *Tetradymia canescens* with or without an herbaceous layer.

OVERVIEW

Scientific Name: *Chrysothamnus viscidiflorus* - *Ericameria nauseosa* - *Krascheninnikovia lanata* Steppe & Shrubland Group

Common Name (Translated Scientific Name): Yellow Rabbitbrush - Rubber Rabbitbrush - Winterfat Steppe & Shrubland Group
Colloquial Name: White-flower Rabbitbrush Shrubland

Type Concept: This group occurs throughout the semi-arid western U.S., including areas in the western Great Plains. This group can either be shrub-, dwarf-shrub-, or grass-dominated with an open (5-25% cover) woody layer. Stands dominated by *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Gutierrezia microcephala*, and *Gutierrezia sarothrae* are often associated with disturbance. Other common shrubs may include *Chamaebatiaria millefolium*, *Chrysothamnus albidus*, *Ephedra viridis*, *Ephedra torreyana*, *Glossopetalon spinescens*, *Ericameria nana*, *Ericameria parryi*, *Ericameria teretifolia*, *Krascheninnikovia lanata*, *Mahonia fremontii*, *Opuntia fragilis*, *Opuntia polyacantha*, *Opuntia phaeacantha*, and *Tetradymia canescens*. Herbaceous species include *Achnatherum hymenoides*, *Aristida purpurea*, *Hesperostipa comata*, and *Pleuraphis jamesii*. Scattered *Juniperus* spp. are common, but rarely attain more than 5% cover. Landforms include alluvial flats and fans, talus slopes, plateaus, and bluffs. Slopes range from gentle to steep, and substrates are variable and include sandstone talus, fine-textured alluvium, sand, clay, loams, cinder, cobbles, and coarse gravels. Disturbance and grazing have impacted many occurrences, and in some cases may be important in maintaining these communities.

Classification Comments: This group encompasses a somewhat broad range of semi-desert shrublands in the Intermountain West. Many of these communities are somewhat disturbance-maintained, early-seral types. Additional data and analysis are needed to clarify the associations that should be placed here. Shrub communities occurring over talus included in this group are part of a continuum and can be highly variable, and some dwarf-shrub communities can technically be defined as herbaceous types.

Similar NVC Types:

Diagnostic Characteristics: This group occurs as open shrub, dwarf-shrub, or shrub herbaceous communities. Shrub canopy ranges from 10-60% shrub cover with herbaceous layer usually sparse but ranging from dense to absent. Dominant/diagnostic shrubs in this group include *Chamaebatiaria millefolium*, *Chrysothamnus albidus*, *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ephedra torreyana*, *Ericameria nauseosa*, *Ericameria nana*, *Ericameria parryi*, *Ericameria teretifolia*, *Glossopetalon spinescens*, *Gutierrezia sarothrae*, *Gutierrezia microcephala*, *Krascheninnikovia lanata*, *Mahonia fremontii*, *Opuntia fragilis*, *Opuntia phaeacantha*, *Opuntia polyacantha*, *Tetradymia canescens*, and *Tetradymia tetrameres*. Characteristic herbaceous species may include *Achnatherum hymenoides*, *Aristida purpurea*, *Bouteloua curtipendula*, *Bouteloua eriopoda*, *Bouteloua gracilis*, *Hesperostipa comata*, *Pleuraphis jamesii*, *Poa secunda*, *Sphaeralcea coccinea*, and *Sporobolus cryptandrus*. Scattered *Juniperus* spp. are common, but rarely attain more than 5% cover.

VEGETATION

Physiognomy and Structure: Open shrub, dwarf-shrub, or shrub herbaceous communities dominated by cold-deciduous, broad-leaved shrub, dwarf-shrub species, or perennial grasses with an open shrub layer.

Floristics: The most important, widespread shrubs in this group include *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Gutierrezia microcephala*, *Krascheninnikovia lanata*, *Opuntia polyacantha*, and *Opuntia phaeacantha*. Other dominant/diagnostic shrubs with narrower ranges are *Chrysothamnus albidus*, *Chamaebatiaria millefolium*, *Ericameria nana*, *Ericameria parryi*, *Ericameria teretifolia*, *Glossopetalon spinescens*, *Mahonia fremontii*, *Opuntia phaeacantha*, and *Opuntia polyacantha*. Other commonly present to codominant species include *Artemisia* spp., *Ephedra torreyana*, *Ephedra viridis*, *Coleogyne ramosissima*, *Fallugia paradoxa*, *Isocoma drummondii*, *Eriogonum* spp., *Grayia spinosa*, *Holodiscus dumosus*, *Lycium pallidum*, *Opuntia fragilis*, *Purshia tridentata*, *Tetradymia canescens*, and *Tetradymia tetrameres*. Semi-desert grasses are common, including *Achnatherum hymenoides*, *Aristida purpurea*, *Aristida purpurea*, *Bouteloua curtipendula*, *Bouteloua eriopoda*, *Bouteloua gracilis*, *Elymus elymoides*, *Hesperostipa comata*, *Leymus salinus*, *Muhlenbergia pungens*, *Pascopyrum smithii*, *Pleuraphis jamesii*, *Poa secunda*, *Pseudoroegneria spicata*, *Sporobolus airoides*, and *Sporobolus cryptandrus*. Perennial forbs may include *Achillea millefolium*, *Astragalus purshii*, *Calochortus macrocarpus*, *Chamaesyce* spp., *Erigeron* spp., *Penstemon deustus*, *Phlox hoodii*, *Sphaeralcea coccinea*, and *Sphaeralcea munroana*. Annuals may be seasonally present to abundant depending on precipitation and disturbance. Exotic annuals such as *Bromus tectorum* or *Salsola kali* can be abundant.

ENVIRONMENT & DYNAMICS

Environmental Description: This group occurs throughout the Intermountain West from the western Great Basin to the Northern Rocky Mountains and Colorado Plateau at elevations ranging from 300 m up to 2500 m. The climate where this group occurs is generally hot in summers and cold in winters with low annual precipitation, ranging from 18-40 cm and high inter-annual variation. Much of the precipitation falls as snow, and growing-season drought is characteristic. Temperatures are continental with large annual and diurnal variations. Sites are generally alluvial fans and flats with moderate to deep soils. Some sites can be flat, poorly drained and intermittently flooded with a shallow or perched water table often within 1 m depth (West 1983e). Substrates are generally shallow, calcareous, fine-textured soils (clays to silt-loams), derived from alluvium; deep, fine to medium-textured alluvial

CBR alliances

soils with some source of subirrigation during the summer season, or sandstone talus over shale. Soils may be alkaline and typically moderately saline (West 1983e).

Dynamics:

DISTRIBUTION

Geographic Range: This group occurs throughout the semi-arid western U.S., including areas in the western Great Plains.

Spatial Scale & Pattern [optional]: Large patch

Nations: CA?, US

States/Provinces: AZ, CA, CO, ID, KS, MT, NM, NV, OR, SD, TX, UT, WY

TNC Ecoregions [optional]: 4:C, 6:C, 8:C, 9:C, 10:C, 11:C, 18:C, 19:C, 20:C, 21:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313C:CC, 313D:CC, 315A:CC, 315B:CC, 315H:CC, 321A:CC, 322A:CC, 331B:CC, 331H:CC, 331I:CC, 331J:CC, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CP, 342J:CC, M242C:CC, M261E:CC, M261G:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332E:CP, M332G:CC, M333A:??, M341A:CC, M341B:CC, M341C:CC, M341D:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Arches); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = Southeastern Utah galleta-threawn shrub steppe (West 1983e)

LOWER LEVEL UNITS

Alliances:

- A2650 *Opuntia* spp. Colorado Plateau Shrubland Alliance
- A2540 *Ericameria teretifolia* Shrubland Alliance
- A3197 *Ericameria parryi* Shrubland Alliance
- A3196 *Ericameria nauseosa* Steppe & Shrubland Alliance
- A3203 *Gutierrezia sarothrae* - *Gutierrezia microcephala* Dwarf-shrubland Alliance
- A1032 *Glossopetalon spinescens* Shrubland Alliance
- A0834 *Chrysothamnus albidus* Shrubland Alliance
- A3202 *Krascheninnikovia lanata* Steppe & Dwarf-shrubland Alliance
- A3195 *Chrysothamnus viscidiflorus* Steppe & Shrubland Alliance

AUTHORSHIP

Primary Concept Source: N.E. West (1983e)

Author of Description: M.E. Hall, M.S. Reid, K.A. Schulz

Acknowledgments: P. Comer

Version Date: 11/06/2015

Classif Resp Region: West

Internal Author: MEH/MSR 3-10, mod. PC 4-13, mod. KAS 11-15

REFERENCES

References: Branson et al. 1976, Faber-Langendoen et al. 2017a, Hanson 1929, Shiflet 1994, Stout et al. 2013, Tuhy et al. 2002, West 1983e

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G310. Intermountain Semi-Desert Steppe & Shrubland

A0834. *Chrysothamnus albidus* Shrubland Alliance

Type Concept Sentence: Stands included in this shrubland alliance have a sparse woody layer dominated by the microphyllous evergreen shrub *Chrysothamnus albidus* and occur around seeps, saline meadows and flats, and around pluvial lakes in the Great Basin.

OVERVIEW

Scientific Name: *Chrysothamnus albidus* Shrubland Alliance

Common Name (Translated Scientific Name): White-flower Rabbitbrush Shrubland Alliance

Colloquial Name: White-flower Rabbitbrush Shrubland

Type Concept: Stands have a sparse woody layer dominated by the microphyllous evergreen shrub *Chrysothamnus albidus*. The herbaceous layer is sparse to possibly moderately dense, but no cover values are available. The most frequent species are the graminoids *Muhlenbergia richardsonis* and *Puccinellia nuttalliana*. Other scattered species include *Crepis runcinata*, *Distichlis spicata*, and *Nitrophila occidentalis*. Adjacent vegetation includes sparse shrublands dominated by *Atriplex confertifolia*, *Pyrrocoma uniflora* var. *uniflora*, and *Distichlis spicata* or *Sarcobatus vermiculatus*-dominated herbaceous community. Stands included in this shrubland alliance occur around seeps, saline meadows and flats, and around pluvial lakes in the Great Basin. The climate is arid; mean annual precipitation is generally less than 15 cm. Summers are hot and winters are cold. Elevations range from 1450-1900 m. Described stands occur on mesic sites on the nearly flat lakeplain where groundwater reaches the soil surface at some time during the growing season. Soils are generally deep, fine-textured (silty clay), poorly drained, calcareous, alkaline and saline.

Classification Comments: Stands described by Young et al. (1986) on the lakeplain had only 3% cover of the shrub canopy and would be better classified in a shrub herbaceous or a sparsely vegetated alliance. Data from other stands are not available.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Shrublands inhabiting saline environments of the Great Basin dominated by *Chrysothamnus albidus*. Total stand cover may be sparse to dense and is often composed of species adapted to saline conditions.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a sparse shrub layer dominated by microphyllous evergreen shrubs (0.3-1.5 m tall). A sparse to moderately dense herbaceous layer is dominated by perennial grasses. Scattered forbs may be present.

Floristics: Stands have a sparse woody layer dominated by the microphyllous evergreen shrub *Chrysothamnus albidus*. The herbaceous layer is sparse to possibly moderately dense, but no cover values are available. The most frequent species are the graminoids *Muhlenbergia richardsonis* and *Puccinellia nuttalliana*. Other scattered species include *Crepis runcinata*, *Distichlis spicata*, *Nitrophila occidentalis*, and *Pyrrocoma uniflora* var. *uniflora*.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands included in this shrubland alliance occur around seeps, saline meadows and flats, and around pluvial lakes in the Great Basin. Climate is arid; mean annual precipitation is generally less than 15 cm. Summers are hot and winters are cold. Elevations range from 1450-1900 m. Stands described by Young et al. (1986) occur on mesic sites on the nearly flat lakeplain where groundwater reaches the soil surface at some time during the growing season. Soils are generally deep, fine-textured (silty clay), poorly drained, calcareous, alkaline and saline.

Dynamics: Access to the water table is necessary for plants in this mesic vegetation type in the arid Great Basin. Where it occurs on playas, there is likely temporary flooding. *Puccinellia nuttalliana* is a valuable forage grass and may be depleted where heavy livestock grazing is allowed.

DISTRIBUTION

Geographic Range: Stands included in this minor shrubland alliance occur in the Great Basin. It has been reported from Utah and Nevada and likely occurs in eastern California.

Nations: US

States/Provinces: CA?, NV, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- ? *Chrysothamnus albidus* / *Puccinellia* plant community (Young et al. 1986) [occurs on the lake plain of a pluvial lake in Nevada]
- ? Saltgrass Series (Sawyer and Keeler-Wolf 1995) [*Chrysothamnus albidus* was mentioned in text.]

LOWER LEVEL UNITS

Associations:

- CEG001328 *Chrysothamnus albidus* / *Puccinellia nuttalliana* Shrubland
- CEG005596 *Ericameria nana* - *Holodiscus dumosus* / *Penstemon deustus* Shrubland
- CEG005597 *Ericameria nana* / *Poa secunda* - *Penstemon deustus* Sparse Vegetation

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Faber-Langendoen et al. 2017b, Sawyer and Keeler-Wolf 1995, Young et al. 1986

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G310. Intermountain Semi-Desert Steppe & Shrubland

A3195. *Chrysothamnus viscidiflorus* Steppe & Shrubland Alliance

Type Concept Sentence: This alliance is characterized by a sparse to dense layer of *Chrysothamnus viscidiflorus* and sparse to dense layer of graminoids and is known from in the southern San Luis Valley of Colorado, the lower slopes of mountains in western Wyoming and northern Utah, and on mesas and high plateaus of the Colorado Plateau.

OVERVIEW

Scientific Name: *Chrysothamnus viscidiflorus* Steppe & Shrubland Alliance

Common Name (Translated Scientific Name): Yellow Rabbitbrush Steppe & Shrubland Alliance

Colloquial Name: Yellow Rabbitbrush Steppe & Shrubland

Type Concept: The vegetation is characterized by an open to moderate shrub layer dominated by *Chrysothamnus viscidiflorus* with 3-35% cover. Other shrub species may be present with low cover, such as *Amelanchier utahensis*, *Artemisia bigelovii*, *Artemisia tridentata*, *Atriplex canescens*, *Atriplex confertifolia*, *Eriogonum corymbosum*, *Ephedra viridis*, *Ericameria nauseosa*, *Gutierrezia sarothrae*, *Mahonia fremontii*, *Shepherdia rotundifolia*, *Symphoricarpos oreophilus*, *Tetradymia canescens*, and *Yucca baccata*. The herbaceous layer is variable and ranges from being moderately dense, diverse and bunchgrass-dominated to sparse and often depauperate. In some stands the herbaceous layer is dominant over shrubs. Dominant and common grasses may include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Bouteloua gracilis*, *Elymus elymoides*, *Hesperostipa comata*, *Koeleria macrantha*, *Leymus salinus* ssp. *salinus*, *Pascopyrum smithii*, *Poa fendleriana*, *Poa secunda*, *Pseudoroegneria spicata*, and the introduced annuals *Bromus briziformis* and *Bromus tectorum*. *Leymus cinereus* may be present in mesic gully bottoms in Utah. Scattered forbs are present, such as *Antennaria* spp., *Astragalus bisulcatus*, *Castilleja* spp., *Cirsium undulatum*, *Cryptantha humilis*, *Linanthus pungens* (= *Leptodactylon pungens*), and *Linanthus watsonii* (= *Leptodactylon watsonii*). Stands of the alliance occur in the southern San Luis Valley of Colorado, the lower slopes of mountains in western Wyoming and northern Utah, and on mesas and high plateaus of the Colorado Plateau. Stands occur on a variety of sites and range from level to moderately sloping, disturbed sites on ridges and in valleys. Elevations range from 1300 to 2440 m (4250-8000 feet). Substrates include eolian sands, alluvium, metamorphic rocks, granite or limestone, and the soil is likewise variable, with textures ranging from silt loam, sandy loam, loamy sand and silty clay loam.

Classification Comments: This alliance has one association that is based on the Van Pelt (1978) description of *Chrysothamnus viscidiflorus* / *Leymus salinus* ssp. *salinus* Plant Association on Bridger Jack Mesa. Information on other occurrences is needed to describe the full range of this alliance.

Internal Comments: mjr 12-14: CA added for MOJN.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Shrublands of the Colorado Plateau and southern Rocky Mountains where *Chrysothamnus viscidiflorus* is the dominant species ranging from 3-35% cover or some stands with <10% cover and graminoid layer with 5-25% cover.

VEGETATION

Physiognomy and Structure: The vegetation in this alliance has a sparse to dense graminoid layer dominated by medium-tall bunch grasses with a sparse to dense short xeromorphic shrub layer.

Floristics: Vegetation included in this shrub herbaceous alliance is characterized by a sparse to moderate shrub layer dominated by *Chrysothamnus viscidiflorus* with 3-20% cover. Other shrub species may be present with low cover, such as *Amelanchier utahensis*, *Artemisia tridentata*, *Artemisia bigelovii*, *Atriplex canescens*, *Atriplex confertifolia*, *Ephedra viridis*, *Ericameria nauseosa*, *Eriogonum corymbosum*, *Gutierrezia sarothrae*, *Mahonia fremontii*, *Shepherdia rotundifolia*, *Symphoricarpos oreophilus*, *Tetradymia canescens*, and *Yucca baccata*. Occasional *Pinus edulis* and *Juniperus osteosperma* trees or seedlings may be present in the stand. The herbaceous layer is variable and ranges from being moderately dense, diverse and bunchgrass-dominated to sparse and sometimes depauperate. Common dominant graminoid species include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Bouteloua gracilis*, *Elymus elymoides*, *Hesperostipa comata*, *Koeleria macrantha*, *Leymus salinus ssp. salinus*, *Pascopyrum smithii*, *Poa fendleriana*, *Poa secunda*, *Pseudoroegneria spicata*, and introduced annuals *Bromus briziformis* and *Bromus tectorum*. *Leymus cinereus* may be present in mesic gully bottoms in Utah. Forbs may be diverse but typically contribute very little cover. Associate species may include *Antennaria* spp., *Arenaria* sp., *Astragalus bisulcatus*, *Castilleja* spp., *Chenopodium leptophyllum*, *Cirsium undulatum*, *Crepis acuminata*, *Cryptantha cinerea var. jamesii*, *Cryptantha humilis*, *Erigeron* spp., *Eriogonum* sp., *Heterotheca villosa*, *Linanthus pungens* (= *Leptodactylon pungens*), *Linanthus watsonii* (= *Leptodactylon watsonii*), *Lupinus caudatus*, *Packera tridenticulata*, *Sedum lanceolatum*, *Schoenocrambe linifolia*, *Stenotus armerioides var. armerioides*, and cacti such as *Mammillaria* spp. and *Opuntia* spp.

ENVIRONMENT & DYNAMICS

Environmental Description: This shrubland alliance includes associations found in the Colorado Plateau extending east into the southern Rocky Mountains. Stands occur on a variety of sites and range from level to moderately sloping, disturbed sites on ridges and in valleys. Elevations range from 1300 to 2440 m (4250-8000 feet). Substrates include eolian sands, alluvium, metamorphic rocks, granite or limestone, and the soil is likewise variable, with textures ranging from silt loam to sandy loam to loamy sand. Ground surface is variable and has low to high cover of gravel, bare soil, litter and duff.

Dynamics: Disturbance by fire may be important in the creation and maintenance of these stands. Burned tree snags indicate these stands were created by fire that burned openings in the *Pinus edulis* and *Juniperus osteosperma* woodland (Van Pelt 1978). Van Pelt (1978) reported that young *Pinus edulis* are slowly invading the park and in time will convert it back to woodland unless fire reurns the site. Lightning likely starts these fires. With past fire suppression policies on some federal lands and livestock grazing which removes the necessary fine fuels needed to carry fire through woodlands, these parks may be disappearing. More information is needed to understand their current status and management needs.

DISTRIBUTION

Geographic Range: Stands of the alliance occur in the southern San Luis Valley of Colorado, the lower slopes of mountains in western Wyoming and northern Utah, and on mesas and high plateaus of the Colorado Plateau.

Nations: US

States/Provinces: CA, CO, ID, MT, NV, UT, WY

TNC Ecoregions [optional]: 11:C

USFS Ecoregions (2007): 341Fc:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Chrysothamnus viscidiflorus* Shrubland Alliance (Evens et al. 2014)
- ? Salina Wildrye/Douglas Rabbitbrush Community (Van Pelt 1978)

LOWER LEVEL UNITS

Associations:

- CEG005594 *Chrysothamnus viscidiflorus* / *Pseudoroegneria spicata* Shrubland
- CEG002781 *Chrysothamnus viscidiflorus* - *Ericameria parryi* Shrub Grassland
- CEG001501 *Chrysothamnus viscidiflorus* / *Leymus salinus ssp. salinus* Shrub Grassland
- CEPP005695 *Chrysothamnus viscidiflorus* / Disturbed Understory Shrubland
- CEG002530 *Chrysothamnus viscidiflorus* Shrub Grassland
- CEG002799 *Chrysothamnus viscidiflorus* / *Hesperostipa comata* Shrubland
- CEG005592 *Chrysothamnus viscidiflorus* / *Pascopyrum smithii* Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: M.E. Hall**Version Date:** 2014/03/14**REFERENCES****References:** Evens et al. 2014, Faber-Langendoen et al. 2017b, Van Pelt 1978

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G310. Intermountain Semi-Desert Steppe & Shrubland

A3196. *Ericameria nauseosa* Steppe & Shrubland Alliance**Type Concept Sentence:** This alliance is characterized by shrub and shrub herbaceous vegetation where *Ericameria nauseosa* is dominant and includes both natural and semi-natural stands from localized areas across the northern Great Plains and throughout the western U.S.

OVERVIEW**Scientific Name:** *Ericameria nauseosa* Steppe & Shrubland Alliance**Common Name (Translated Scientific Name):** Rubber Rabbitbrush Steppe & Shrubland Alliance**Colloquial Name:** Rubber Rabbitbrush Steppe & Shrubland**Type Concept:** The vegetation is characterized by a sparse to moderately dense, short-shrub layer (5-60% cover) that is dominated by *Ericameria nauseosa*. Depending on geography, associated shrubs may include scattered *Artemisia filifolia*, *Artemisia tridentata*, *Chrysothamnus viscidiflorus*, *Gutierrezia sarothrae*, *Opuntia* spp., *Prunus virginiana*, *Rhus trilobata*, *Symphoricarpos occidentalis*, and *Yucca* spp. The herbaceous layer can vary from sparse to moderately dense, being more prominent in some stands than shrubs, and dominated by graminoids. Common native grasses include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Bouteloua* spp., *Elymus trachycaulus* ssp. *trachycaulus*, *Leymus flavescens* (= *Elymus flavescens*), *Pascopyrum smithii*, *Pleuraphis jamesii*, *Pseudoroegneria spicata*, and *Sporobolus cryptandrus*. Native forbs generally have low cover. Disturbed stands typically have high cover of introduced annual *Bromus* species. This alliance includes both natural and semi-natural stands from localized areas across the northern Great Plains and throughout the western U.S. Elevations range from 1100 to 2200 m. Soils are variable but generally well-drained and coarse-textured. Sites are flat to gently sloping, occurring on all aspects. The semi-natural stands included in this alliance are seral shrubland communities resulting from overgrazing by livestock, road building, or other cultural disturbance of typically grass-dominated communities.**Classification Comments:** Further study is needed on the effects of livestock grazing on vegetation structure in these stands and on the relationship between *Ericameria nauseosa* shrub herbaceous associations and shrubland associations. *Mahonia fremontii* Shrubland (CEGL003967) has been placed in this alliance tentatively until further studies can be completed on this association.**Internal Comments:** GK 9-16: ID added for Minidoka.**Other Comments:****Similar NVC Types:****Diagnostic Characteristics:** Very widespread shrub and shrub herbaceous vegetation where *Ericameria nauseosa* ranges in cover from 15-60% cover and where herbaceous component is sparse or absent. Cover of *Ericameria nauseosa* is 5-25% in cover when graminoids are more abundant.**VEGETATION****Physiognomy and Structure:** Vegetation in this alliance has a sparse to dense layer of microphyllous evergreen shrubs (<2 m tall) with a sparse to moderately dense herbaceous layer dominated by perennial medium-tall and short grasses. Perennial forbs are sparse. Annual forbs and grasses may be present seasonally.**Floristics:** The vegetation is characterized by a sparse to moderately dense, short-shrub layer (5-60% cover) that is dominated by *Ericameria nauseosa*. Depending on geography, associated shrubs may include scattered *Artemisia filifolia*, *Artemisia tridentata*, *Chrysothamnus viscidiflorus*, *Gutierrezia sarothrae*, *Opuntia* spp., *Prunus virginiana*, *Rhus trilobata*, *Symphoricarpos occidentalis*, and *Yucca* spp. The herbaceous layer can vary from sparse to dense and is dominated by graminoids. In some stands, the herbaceous component may surpass that of shrubs. Common native grasses include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Aristida purpurea*, *Bouteloua* spp., *Elymus trachycaulus* ssp. *trachycaulus*, *Leymus flavescens* (= *Elymus flavescens*), *Pascopyrum smithii*, *Pleuraphis jamesii*, *Pseudoroegneria spicata*, and *Sporobolus cryptandrus*. Native forbs generally have low cover, but may include species such as *Lygodesmia grandiflora*, *Machaeranthera canescens* (= *Aster canescens*), *Phacelia hastata* (= *Phacelia leucophylla*), and *Psoralidium lanceolatum* (= *Psoralea lanceolata*). Disturbed stands typically have high cover of introduced annual

Bromus species such as *Bromus tectorum*, *Bromus arvensis* (= *Bromus japonicus*), and *Bromus rubens*. Introduced forbs may include *Bassia scoparia* (= *Kochia scoparia*), *Melilotus officinalis*, and *Salsola kali*.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance includes both natural and semi-natural stands from localized areas across the northern Great Plains and throughout the western U.S. Stands occur in the a variety of habitats such as gentle or steep slopes, dunes, and washes. Elevations range from 1100 to 2200 m elevation. Substrates may be eolian, alluvial, or colluvial with soils that are generally well-drained and coarse-textured. The semi-natural stands included in this alliance are seral shrubland communities resulting from overgrazing by livestock, road building, or other cultural disturbance of typically grass-dominated communities.

Dynamics: Grazing has significantly impacted much of the vegetation in this region, which has had a long history of settlement and heavy livestock use. With proper livestock management and time, palatable species such as *Achnatherum hymenoides*, *Artemisia tridentata*, *Elymus elymoides*, *Pascopyrum smithii*, *Schedonnardus paniculatus*, and *Sporobolus cryptandrus* may increase, and *Gutierrezia sarothrae* and *Ericameria nauseosa* may decline in abundance (Francis 1986).

DISTRIBUTION

Geographic Range: This alliance includes shrublands from localized areas across the northern Great Plains and throughout much of the western U.S.

Nations: US

States/Provinces: AZ, CO, ID, MT, ND, NM, NV, SD, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- >< *Chrysothamnus* Subformation (Francis 1986)

LOWER LEVEL UNITS

Associations:

- CEG002713 *Ericameria nauseosa* Shrubland
- CEG002918 *Ericameria nauseosa* / *Sporobolus airoides* Shrubland
- CEG002996 *Ericameria nauseosa* / *Pleuraphis jamesii* - (*Hesperostipa comata*) Shrub Grassland
- CEPP006725 *Lepidospartum latisquamum* Shrubland
- CEG003495 *Ericameria nauseosa* / *Bouteloua gracilis* Shrub Grassland
- CEG003967 *Mahonia fremontii* Shrubland
- CEG001330 *Ericameria nauseosa* / *Pseudoroegneria spicata* Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Faber-Langendoen et al. 2017b, Francis 1986

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G310. Intermountain Semi-Desert Steppe & Shrubland

A3197. *Ericameria parryi* Shrubland Alliance

Type Concept Sentence: Vegetation included in this shrubland alliance is characterized by having a sparse to dense shrub layer dominated by *Ericameria parryi*. It occurs in the Great Basin, Arizona-New Mexico Mountains, Colorado Plateau and in isolated locations in the northern Coast Ranges of California.

OVERVIEW

Scientific Name: *Ericameria parryi* Shrubland Alliance

Common Name (Translated Scientific Name): Parry's Rabbitbrush Shrubland Alliance

Colloquial Name: Parry's Rabbitbrush Shrubland

Type Concept: Vegetation included in this shrubland alliance is characterized by having a sparse to dense shrub layer dominated by *Ericameria parryi* (= *Chrysothamnus parryi*). Shrub associates include *Artemisia tridentata*, *Ephedra* spp., *Krascheninnikovia lanata*, and *Purshia tridentata*. The sparse to moderate herbaceous layer is dominated by graminoids such as *Achnatherum occidentale* ssp. *pubescens* (= *Stipa occidentalis* var. *pubescens*), *Bouteloua gracilis*, *Elymus elymoides*, *Pleuraphis jamesii* (= *Hilaria jamesii*), and *Sporobolus airoides*. Perennial forbs are generally sparse. Some stands may have scattered *Juniperus* spp. and *Pinus* spp. trees. This alliance occurs in the Great Basin, Arizona-New Mexico Mountains, Colorado Plateau and in isolated locations in the northern Coast Ranges of California. These shrublands occur on bajadas, pediments and valleys, including pumice flats. Substrates and parent materials are variable. Soils are shallow, well-drained, calcareous, alkaline and often gravelly.

Classification Comments: This alliance includes all shrublands dominated by any of the 12 subspecies of *Ericameria parryi* that occur in the western U.S. Vegetation included in this alliance may be too sparse to be classified as a shrubland. Further study is needed throughout its range, especially to assess the effects of livestock grazing on vegetation structure and to describe stands of different subspecies.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Sparse to dense shrublands dominated by *Ericameria parryi* found in the Great Basin and Colorado Plateau. The sparse to moderate herbaceous layer is dominated by graminoids.

VEGETATION

Physiognomy and Structure: Vegetation in this alliance is dominated by sparse to moderately dense microphyllous evergreen shrubs and graminoids in the understory.

Floristics: These shrublands have a sparse to dense shrub layer with a sparse to moderate herbaceous layer dominated by grasses. Some stands have a sparse tree layer of scattered *Juniperus* spp. and *Pinus* spp. *Ericameria parryi* dominates the shrub layer. Associated species vary greatly with geography. Other shrubs present may include *Artemisia tridentata*, *Ephedra* spp., *Krascheninnikovia lanata*, and *Purshia tridentata*. Common perennial grasses include *Achnatherum occidentale* ssp. *pubescens* (= *Stipa occidentalis* var. *pubescens*), *Bouteloua gracilis*, *Elymus elymoides*, *Pleuraphis jamesii* (= *Hilaria jamesii*), and *Sporobolus airoides*. Perennial forbs are generally sparse (Taylor 1980, Francis 1986, Sawyer and Keeler-Wolf 1990).

ENVIRONMENT & DYNAMICS

Environmental Description: The alliance is found on alluvial flats, on bajadas, pediments and valleys, including pumice flats from 1800-2400 m elevation. Substrates and parent materials are variable (Taylor 1980, Sawyer and Keeler-Wolf 1995). Soils are shallow, poorly developed, well-drained, calcareous, alkaline and often gravelly. They are typically derived from sedimentary rocks. Textures range from fine sandy loams to silty clay loams (Taylor 1980, Francis 1986, Sawyer and Keeler-Wolf 1995).

Dynamics: Grazing has significantly impacted much of the vegetation in this region with its long history of settlement and heavy livestock use (Griffiths 1902, Francis 1986). With proper livestock management and time, palatable species such as *Krascheninnikovia lanata* and *Sporobolus airoides* may increase in abundance (Francis 1986). This alliance may respond positively to disturbance because many species of *Chrysothamnus* in the Great Basin increase in abundance with excessive livestock grazing and accelerated fire frequencies (West 1988).

DISTRIBUTION

Geographic Range: This alliance occurs in the Great Basin, Arizona-New Mexico Mountains, Colorado Plateau and in isolated locations in the northern Coast Ranges of California.

Nations: US

States/Provinces: CA, CO, NM, NV?

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- ? *Ericameria parryi* (Parry's rabbitbrush scrub) Alliance (Sawyer et al. 2009) [35.340.00]
- ? Parry Rabbitbrush Series (Sawyer and Keeler-Wolf 1995) [includes shrubland dominated by any of the 6 subspecies that occur in California.]
- ? Rabbitbrush Scrub (#35400) (Holland 1986b) [includes all *Chrysothamnus*-dominated scrub in California.]

LOWER LEVEL UNITS**Associations:**

- CEG003040 *Ericameria parryi* Shrubland
- CEG003751 *Ericameria parryi* / *Achnatherum hymenoides* Shrubland
- CEG001331 *Ericameria parryi* / *Pleuraphis jamesii* - *Bouteloua gracilis* Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Faber-Langendoen et al. 2017b, Francis 1986, Griffiths 1902, Holland 1986b, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Taylor 1990, West 1988

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G310. Intermountain Semi-Desert Steppe & Shrubland

A2540. *Ericameria teretifolia* Shrubland Alliance [Low - Poorly Documented]

Type Concept Sentence: This xeromorphic shrubland alliance is dominated by *Ericameria teretifolia* and occurs from southern California mountains and valleys to the Mojave Desert, north into the southeastern Great Basin.

OVERVIEW

Scientific Name: *Ericameria teretifolia* Shrubland Alliance

Common Name (Translated Scientific Name): Green Rabbitbrush Shrubland Alliance

Colloquial Name: Green Rabbitbrush Shrubland

Type Concept: The vegetation of this alliance is characterized by an open, xeromorphic, short-shrub layer (<2 m tall) that is dominated by *Ericameria teretifolia*. Other shrubs and dwarf-shrubs present may include *Ephedra viridis*, *Eriogonum fasciculatum*, *Grayia spinosa*, *Gutierrezia sarothrae*, *Cylindropuntia acanthocarpa* (= *Opuntia acanthocarpa*), *Opuntia chlorotica*, *Prunus fasciculata*, *Salazaria mexicana*, *Salvia dorrii*, *Sphaeralcea ambigua*, or *Stephanomeria pauciflora*. The generally sparse herbaceous layer is dominated by perennial graminoids. This xeromorphic shrubland alliance occurs from southern California mountains and valleys to the Mojave Desert, north into the southeastern Great Basin. Stands are found on ridges, slopes and valleys above *Larrea tridentata*- and *Ambrosia dumosa*-dominated desert scrub and below *Artemisia tridentata*-dominated shrublands and *Pinus monophylla* woodlands. Substrates are coarse-textured soils derived from bedrock or alluvium. Habitats include disturbed areas, including burns, washes, road cuts, and heavily grazed sites. Soils are variable in parent material and usually coarse, well-drained, and moderately acidic to slightly saline.

Classification Comments: This description is based on classification work done by Keeler-Wolf and Thomas (2000) on the Mojave Ecosystem Mapping Project. *Ericameria teretifolia* nearly always shares the shrub canopy with other shrub species. Stands occur above *Larrea tridentata* alliance and below *Pinus monophylla* and *Artemisia tridentata* alliances. Stands are adjacent to those of the *Atriplex confertifolia*, *Coleogyne ramosissima*, *Grayia spinosa*, *Juniperus californica*, and *Juniperus osteosperma* alliances.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: *Ericameria teretifolia* cover greater than or equal to other species (such as *Eriogonum fasciculatum*, *Gutierrezia sarothrae*, or *Opuntia chlorotica*) in relative cover in the shrub canopy (Keeler-Wolf et al. 1998, Thomas et al. 2004).

VEGETATION

Physiognomy and Structure:

Floristics: The vegetation is characterized by an open, xeromorphic, short-shrub layer (<2 m tall) that is dominated by *Ericameria teretifolia*. Other shrubs and dwarf-shrubs present may include *Ephedra viridis*, *Eriogonum fasciculatum*, *Grayia spinosa*, *Gutierrezia sarothrae*, *Cylindropuntia acanthocarpa* (= *Opuntia acanthocarpa*), *Opuntia chlorotica*, *Prunus fasciculata*, *Salazaria mexicana*, *Salvia dorrii*, *Sphaeralcea ambigua*, or *Stephanomeria pauciflora*. The generally sparse herbaceous layer is dominated by perennial graminoids such as *Achnatherum speciosum*, *Muhlenbergia porteri*, *Pleuraphis jamesii*, *Pleuraphis rigida*, and *Poa secunda* (Keeler-Wolf and Thomas 2000).

ENVIRONMENT & DYNAMICS

Environmental Description: This xeromorphic shrubland alliance occurs from southern California mountains and valleys to the Mojave Desert, north into the southeastern Great Basin. Elevation ranges from 800 to 1700 m. Stands are found on ridges, slopes and valleys above *Larrea tridentata*- and *Ambrosia dumosa*-dominated desert scrub and below *Artemisia tridentata*-dominated shrublands and *Pinus monophylla* woodlands. Habitats include disturbed areas, including burns, washes, road cuts, and heavily grazed sites. Soils are variable in parent material and usually coarse, well-drained, and moderately acidic to slightly saline. Substrates are coarse-textured soils derived from bedrock or alluvium (Keeler-Wolf and Thomas 2000).

Dynamics: Disturbance appears to be important to the maintenance of this seral shrubland as it is found in burned-over *Juniperus californica* stands, road cuts, and heavily grazed areas, and in intermittent washes (Keeler-Wolf and Thomas 2000).

DISTRIBUTION

Geographic Range: This alliance is found in the Mojave Desert and extends into the southern California mountains and southeastern Great Basin.

Nations: US

States/Provinces: CA

TNC Ecoregions [optional]: 11:C, 12:C, 16:C, 17:C

USFS Ecoregions (2007): 322Ab:CCC, 322Ad:CCC, 322Af:CCC, 322Al:CCC, 341D:CC, 341Ff:CCC, M261E:CC, M262B:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Joshua Tree, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

- = *Ericameria teretifolia* (Needleleaf rabbitbrush scrub) Alliance (Sawyer et al. 2009) [35.330.00]
- = *Ericameria teretifolia* Shrubland Alliance (Evens et al. 2014)
- = *Ericameria teretifolia* Shrubland Alliance (Evens et al. 2012)
- = *Ericameria teretifolia* Shrubland Alliance (CNPS 2017) [35.330.00]
- >> Blackbush Scrub (#34300) (Holland 1986b)
- >> Mojave Mixed Woody Scrub (#34210) (Holland 1986b)
- >> Mojave Mixed Woody and Succulent Scrub (#34240) (Holland 1986b)
- >> Mojavean Juniper Woodland and Scrub (#72220) (Holland 1986b)
- >> Peninsular Juniper Woodland and Scrub (#72320) (Holland 1986b)
- >> Sonoran Mixed Woody and Succulent Scrub (#33220) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- C EGL002963 *Ericameria teretifolia* Shrubland

AUTHORSHIP

Primary Concept Source: M.S. Reid and K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: CNPS 2017, Evens et al. 2012, Evens et al. 2014, Faber-Langendoen et al. 2017b, Holland 1986b, Keeler-Wolf and Thomas 2000, Keeler-Wolf et al. 1998a, Sawyer et al. 2009, Thomas et al. 2004, Thorne 1982, VegCAMP and AIS 2013

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G310. Intermountain Semi-Desert Steppe & Shrubland

A1032. *Glossopetalon spinescens* Shrubland Alliance

Type Concept Sentence: These sparse shrublands are dominated by the xeromorphic shrub *Glossopetalon spinescens* and occur along the rims of the Snake River and Imnaha River canyons in Idaho and eastern Oregon.

OVERVIEW

Scientific Name: *Glossopetalon spinescens* Shrubland Alliance

Common Name (Translated Scientific Name): Spiny Greasebush Shrubland Alliance

Colloquial Name: Spiny Greasebush Shrubland

Type Concept: Vegetation included in this minor alliance has a sparse woody layer (usually less than 1 m tall) that is dominated by the xeromorphic shrub *Glossopetalon spinescens* (15-23% cover). The herbaceous layer is also relatively sparse (typically 10-20% cover). It is dominated by the perennial bunchgrass *Pseudoroegneria spicata*. Other characteristic species include the annual grass *Vulpia myuros* and forbs such as *Achillea millefolium*, *Cerastium arvense*, *Erigeron pumilus*, *Opuntia polyacantha*, and *Phacelia heterophylla*. Moss and lichen cover is moderate and averages 22% cover. Exotic species, namely *Bromus tectorum*, *Bromus arvensis* (= *Bromus japonicus*), and *Bromus briziformis*, are often present. These sparse shrublands occur along the rims of the Snake River and Imnaha River canyons in Idaho and eastern Oregon. Elevations range from 550-900 m, and the climate is temperate continental. Mean annual precipitation is approximately 25-30 cm. Precipitation primarily occurs in the winter as snow or rain. This moisture is stored in the soil and in fractures in the highly weathered bedrock, and utilized during the usually dry summers. Stands are typically found on steep upper canyon slopes, but may occur on the lower canyon slopes. Sites are predominantly on hot, dry southwestern aspects, although the alliance may occur on all aspects. Soils are shallow, well-drained loams or sandy loams with a high percentage of rock fragments (greater than 35% by volume and 40% ground cover), and derived from loess and various bedrock types.

Classification Comments: Some stands in this alliance may be too sparse to be classified as dwarf-shrublands (Johnson and Simon 1987).

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Nearly dwarf-shrublands with low to open cover dominated by *Glossopetalon spinescens* in association with a sparse to open herbaceous layer composed of grasses.

VEGETATION

Physiognomy and Structure: Vegetation in this alliance has sparse to moderate cover of shrubs (usually less than 1 m tall). There is also a sparse herbaceous layer that is dominated by perennial bunch grasses with sparse scattered perennial forbs. Annual forbs and grasses are seasonally present in small amounts.

Floristics: Vegetation included in this minor alliance has a sparse woody layer (usually less than 1 m tall) that is dominated by the xeromorphic shrub *Glossopetalon spinescens* (15-23% cover). The herbaceous layer is also relatively sparse (typically 10-20% cover). It is dominated by the perennial bunchgrass *Pseudoroegneria spicata*. Other characteristic species include the annual grass *Vulpia myuros* and forbs such as *Achillea millefolium*, *Cerastium arvense*, *Erigeron pumilus*, *Opuntia polyacantha*, and *Phacelia heterophylla*. Moss and lichen cover is moderate and averages 22% cover. Exotic species, namely *Bromus tectorum*, *Bromus arvensis* (= *Bromus japonicus*), and *Bromus briziformis* are often present.

ENVIRONMENT & DYNAMICS

Environmental Description: These sparse shrublands occur along the rims of the Snake and Imnaha River canyons in Idaho and eastern Oregon. Elevations range from 550-900 m, and the climate is temperate continental. Mean annual precipitation is approximately 25-30 cm. Precipitation primarily occurs in the winter as snow or rain. This moisture is stored in the soil and in fractures in the highly weathered bedrock, and utilized during the usually dry summers. Stands are typically found on steep upper canyon slopes, but may occur on the lower canyon slopes. Sites are predominantly on hot, dry southwest aspects, although the alliance may occur on all aspects. Soils are shallow, well-drained loam or sandy loam with a high percentage of rock fragments (greater than 35% by volume and 40% ground cover), and derived from loess and various bedrock types.

Dynamics: Stands occur on steep hot, dry, canyon slopes. *Glossopetalon spinescens* appears restricted to these areas with weathered, fractured bedrock that provides deeper rooting for these shrubs and other plants. Fire is infrequent because stands are isolated on rims and rock outcrops (Johnson and Simon 1987). The biggest threat is exotic plants that have invaded many stands.

DISTRIBUTION

Geographic Range: This is a minor alliance found on rocky slopes in the Snake and Imnaha river canyons in Idaho and Oregon. It may also occur in Washington.

Nations: US

States/Provinces: ID, OR, WA?

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY**LOWER LEVEL UNITS****Associations:**

- CEGL001100 *Glossopetalon spinescens* var. *aridum* / *Pseudoroegneria spicata* Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Faber-Langendoen et al. 2017b, Johnson and Simon 1987

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G310. Intermountain Semi-Desert Steppe & Shrubland

A3203. *Gutierrezia sarothrae* - *Gutierrezia microcephala* Dwarf-shrubland Alliance

Type Concept Sentence: This alliance represents shrub and shrub herbaceous vegetation of the Colorado Plateau and southern Rocky Mountains with shrub layers most often dominated by *Gutierrezia sarothrae* with an open to dense herbaceous layer composed of perennial graminoids.

OVERVIEW

Scientific Name: *Gutierrezia sarothrae* - *Gutierrezia microcephala* Dwarf-shrubland Alliance

Common Name (Translated Scientific Name): Broom Snakeweed - Threadleaf Snakeweed Dwarf-shrubland Alliance

Colloquial Name: Snakeweed Dwarf-shrubland

Type Concept: The vegetation is characterized by an open (10-30% cover) woody layer dominated by *Gutierrezia sarothrae* with a sparse to luxuriant perennial graminoid layer. *Atriplex canescens* and *Krascheninnikovia lanata* may codominate the shrub layer in some stands. Other shrub associates may include *Artemisia tridentata*, *Ephedra viridis*, *Eriogonum corymbosum*, *Ericameria nauseosa*, *Fallugia paradoxa*, *Isocoma drummondii*, and *Opuntia* spp. Trees are absent or represented by scattered individuals of *Juniperus monosperma* or *Pinus edulis*, mostly as seedlings or saplings. The most common dominant graminoids include *Bouteloua gracilis*, *Bouteloua eriopoda*, *Elymus elymoides*, *Pleuraphis jamesii*, and *Sporobolus airoides*. Other herbaceous associates include *Aristida purpurea*, *Hesperostipa comata*, *Muhlenbergia porteri*, *Pleuraphis rigida* (= *Hilaria rigida*), *Sphaeralcea coccinea*, and *Sporobolus cryptandrus*. Introduced species such as *Bromus tectorum* or *Salsola kali* may dominate the herbaceous layer of some disturbed stands. This alliance represents shrub and shrub herbaceous vegetation of the Colorado Plateau and southern Rocky Mountains. It most commonly occurs on level to gently sloping sites, including gently rolling mesatops, terraces, hillslopes, plateaus, sand deposits, bluffs and occasionally along canyon footslopes on sites with moderate solar exposure. Elevation ranges from 1300 to 2230 m.

Classification Comments:

Internal Comments: mjr 12-14: CA added for MOJN.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: *Gutierrezia sarothrae* or *Atriplex obovata* have 10-25% cover with an herbaceous layer composed of *Bouteloua gracilis*, *Pleuraphis jamesii*, *Sporobolus airoides*, or *Sporobolus cryptandrus*.

VEGETATION

Physiognomy and Structure: Vegetation in this alliance has a sparse to dense layer of microphyllous evergreen shrubs (<2 m tall) with a sparse to moderately dense herbaceous layer dominated by perennial medium-tall and short grasses. Perennial forbs are sparse. Annual forbs and grasses may be present seasonally.

Floristics: The vegetation is characterized by an open (10-30% cover) woody layer dominated by *Gutierrezia sarothrae* with a sparse to luxuriant perennial graminoid layer. *Atriplex canescens* and *Krascheninnikovia lanata* may codominate the shrub layer in some stands. Other shrub associates may include *Artemisia tridentata*, *Ephedra viridis*, *Eriogonum corymbosum*, *Ericameria nauseosa*, *Fallugia paradoxa*, *Isocoma drummondii*, and *Opuntia* spp. Trees are absent or represented by scattered individuals of *Juniperus monosperma* or *Pinus edulis*, mostly as seedlings or saplings. The most common dominant graminoids include *Bouteloua gracilis*, *Bouteloua eriopoda*, *Elymus elymoides*, *Pleuraphis jamesii*, and *Sporobolus airoides*. Other graminoids may include *Aristida purpurea*, *Hesperostipa comata*, *Muhlenbergia porteri*, *Pleuraphis rigida* (= *Hilaria rigida*), and *Sporobolus cryptandrus*. Introduced species such as *Bromus tectorum* or *Salsola kali* may dominate the herbaceous layer of some disturbed stands. Other types of herbaceous species are not consistent, but may include *Chamaesyce* spp., *Opuntia phaeacantha*, *Opuntia polyacantha*, and *Sphaeralcea coccinea*.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance most commonly occurs on level to gently sloping sites, including gently rolling mesatops, terraces, hillslopes, plateaus, sand deposits, bluffs and occasionally along canyon footslopes on sites with moderate solar exposure. Elevation ranges from 1300 to 2230 m. Aspects are reported from the southeast, south and southwest. Soils are variable and range from sandy to clayey texture and may occur over gravel, cinders and cobbles or talus.

Dynamics: Grazing has significantly impacted much of the vegetation in this region, which has had a long history of settlement and heavy livestock use. With proper livestock management and time, palatable species such as *Krascheninnikovia lanata* and *Sporobolus airoides* may increase, and *Gutierrezia sarothrae* and *Opuntia* spp. may decline in abundance (Francis 1986).

DISTRIBUTION

Geographic Range: This alliance is known from the Colorado Plateau and southern Rocky Mountains.

Nations: US

States/Provinces: AZ, CA, NM, UT

TNC Ecoregions [optional]: 17:C

USFS Ecoregions (2007): 322Af:CCC, 322Aj:CCC, 322Ak:CCC, 322Al:CCC

Omerik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Gutierrezia (microcephala, sarothrae)* Shrubland Alliance (Evens et al. 2014)
- = *Gutierrezia sarothrae* (Broom snake weed scrub) Provisional Alliance (Sawyer et al. 2009) [32.043.00]
- ? Grama Grass - Scrub Series (Warren et al. 1982)

LOWER LEVEL UNITS

Associations:

- CEG001776 *Gutierrezia sarothrae* / *Sporobolus airoides* - *Pleuraphis jamesii* Shrub Grassland
- CEG002690 *Gutierrezia sarothrae* - (*Opuntia* spp.) / *Pleuraphis jamesii* Dwarf-shrubland
- CEG001733 *Gutierrezia sarothrae* - *Krascheninnikovia lanata* - *Atriplex canescens* / *Bouteloua eriopoda* Shrub Grassland
- CEG001543 *Gutierrezia sarothrae* / *Pleuraphis rigida* - *Sphaeralcea ambigua* Shrub Grassland
- CEPP005693 *Gutierrezia (microcephala, sarothrae)* - (*Encelia frutescens*, *Brickellia microphylla*) / *Stephanomeria pauciflora* Dwarf-shrubland
- CEG005382 *Gutierrezia sarothrae* / *Bouteloua gracilis* Dwarf-shrub Grassland
- CEPP009523 *Gutierrezia (microcephala, sarothrae)* Dwarf-shrubland
- CEG005130 *Gutierrezia (sarothrae, microcephala)* - *Ephedra* spp. - *Agave utahensis* Dwarf-shrubland
- CEG002787 *Bouteloua eriopoda* Coconino Plateau Shrub Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Evens et al. 2014, Faber-Langendoen et al. 2017b, Francis 1986, Sawyer et al. 2009, Warren et al. 1982

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G310. Intermountain Semi-Desert Steppe & Shrubland

A3202. *Krascheninnikovia lanata* Steppe & Dwarf-shrubland Alliance

Type Concept Sentence: This alliance represents vegetation of the interior western U.S. characterized by a sparse to dense layer of *Krascheninnikovia lanata*.

OVERVIEW

Scientific Name: *Krascheninnikovia lanata* Steppe & Dwarf-shrubland Alliance

Common Name (Translated Scientific Name): Winterfat Steppe & Dwarf-shrubland Alliance

Colloquial Name: Winterfat Steppe & Dwarf-shrubland

Type Concept: This alliance includes dwarf-shrublands dwarf-shrub herbaceous vegetation scattered across the interior western U.S. Shrub layers are characterized by a sparse to moderately dense dwarf-shrub layer dominated by *Krascheninnikovia lanata*. Other woody species may include scattered *Artemisia frigida*, *Artemisia nova*, *Artemisia tridentata*, *Chrysothamnus* spp., *Gutierrezia sarothrae*, *Opuntia polyacantha*, *Rhus trilobata*, and *Yucca glauca*. In the Mojave Desert, *Ambrosia dumosa*, *Atriplex polycarpa*, *Larrea tridentata*, and *Lycium andersonii* may also be present. The herbaceous layer has sparse to very dense cover dominated by graminoids with scattered perennial forbs which in some stands may take prominence over shrubs. Graminoids such as *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Bouteloua gracilis*, *Hesperostipa comata* (= *Stipa comata*), *Pascopyrum smithii*, *Pleuraphis jamesii* (= *Hilaria jamesii*), *Poa secunda*, and *Pseudoroegneria spicata* are most abundant. Perennial forbs may include *Achillea millefolium*, *Astragalus purshii*, *Calochortus macrocarpus*, *Erigeron* spp., *Phlox hoodii*, *Sphaeralcea coccinea*, and *Sphaeralcea munroana*. Annuals may be seasonally present to abundant depending on precipitation and disturbance. Exotic annuals, such as *Bromus tectorum*, can be abundant. Elevations range from 100-2700 m. Stands occur on plateaus, plains, mesas, hillslopes, alkaline flats around playas and along drainages. Some habitats are intermittently flooded wetlands. Sites are typically flat to gently sloping, occurring on any aspect, but stands have also been reported from moderately steep slopes. Soils are calcareous, moderately alkaline and sometimes saline. Soil texture is typically stony, sandy loam, but may be coarser textured. The ground cover is mostly bare soil.

Classification Comments: The vegetation is sparse in many of these stands, and they would be better classified in a sparsely vegetated alliance. Only stands described by Daubenmire (1970) and DeVelice et al. (1991) have the necessary woody cover to be dwarf-shrublands.

Internal Comments: mjr 12-14: CA confirmed for MOJN.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Shrublands of the interior western U.S. where *Krascheninnikovia lanata* is the dominant species ranging from 3-35% cover or some stands with <10% cover and graminoid layer with cover 5-25%.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance is dominated by a sparse to moderately dense evergreen, dwarf-shrub layer often with scattered shrubs. Also present is a sparse to moderately dense herbaceous layer dominated by perennial graminoids with scattered perennial forbs. Annual grasses and forbs are seasonally present to abundant.

Floristics: Vegetation included in this alliance has a sparse to moderately dense dwarf-shrub layer dominated by *Krascheninnikovia lanata*. Other woody species may include scattered *Artemisia frigida*, *Artemisia nova*, *Artemisia tridentata*, *Chrysothamnus* spp., *Gutierrezia sarothrae*, *Opuntia polyacantha*, *Rhus trilobata*, and *Yucca glauca*. In the Mojave Desert, *Ambrosia dumosa*, *Atriplex polycarpa*, *Larrea tridentata*, and *Lycium andersonii* may also be present. The herbaceous layer has sparse to moderately dense cover dominated by graminoids with scattered perennial forbs. In some stands, shrubs may be very widely spaced and graminoids take prominence over shrub cover. Graminoids such as *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Bouteloua gracilis*, *Hesperostipa comata* (= *Stipa comata*), *Muhlenbergia torreyi*, *Pascopyrum smithii*, *Pleuraphis jamesii* (= *Hilaria jamesii*), *Poa secunda*,

and *Pseudoroegneria spicata* are most abundant. Scattered *Carex filifolia*, *Koeleria macrantha*, *Nassella viridula*, and *Sporobolus airoides* are also often present. Perennial forbs may include *Achillea millefolium*, *Astragalus purshii*, *Calochortus macrocarpus*, *Erigeron* spp., *Phlox hoodii*, *Sphaeralcea coccinea*, and *Sphaeralcea munroana*. Annuals may be seasonally present to abundant depending on precipitation and disturbance. Common native annual are *Chenopodium* spp., *Descurainia pinnata*, *Lappula occidentalis* (= *Lappula redowskii*), and *Plantago patagonica*. Exotic annuals may include *Bromus arvensis* (= *Bromus japonicus*), *Bromus tectorum*, *Halogeton glomeratus*, *Melilotus officinalis*, *Salsola kali*, and many others.

ENVIRONMENT & DYNAMICS

Environmental Description: Elevations range from 100-2700 m. Climate is semi-arid with about half the annual precipitation occurring in July to September often as high-intensity, convective storms. Sites include plains, alkaline flats, mesas and plateaus, hillslopes, alkaline flats around playas and along drainages. Sites are typically flat to gentle-sloped, but occasionally occur on moderate slopes up to 45%. Sites include all aspects. Soil textures are typically stony, sandy loams, but range to fine-textured silty clays and are typically shallow to moderate deep.

Dynamics: Stands dominated by *Krascheninnikovia lanata* occur locally. They often have sharp ecotones with other vegetation types and are thought to be an edaphic community type by Daubenmire (1970). However, edaphic factors separating these stands from adjacent stands have yet to be found. Soil characteristics, such as excessive amounts of calcium carbonate or lack of the nutrients N, P, K or S, have been studied and do not appear to control the occurrence of this alliance (Daubenmire 1970, DeVelice et al. 1995). *Krascheninnikovia lanata* is also important range forage. It is highly palatable in the winter and is tolerant of heavy browsing (Daubenmire 1970). Many stands have long histories of grazing impacts and are thought to be in a degraded state (Francis 1986, DeVelice et al. 1995). These stands often have low perennial herbaceous cover and many have high cover of the exotic annual grass *Bromus tectorum* (Daubenmire 1970, Francis 1986). DeVelice et al. (1995) described stands dominated by *Krascheninnikovia lanata* and *Hesperostipa comata*, which they considered to be a seral stage of a *Krascheninnikovia lanata* / *Pseudoroegneria spicata* community type that is not currently described in the National Vegetation Classification. Francis (1986) predicts that with protection from grazing, *Gutierrezia sarothrae* cover will decrease and *Krascheninnikovia lanata*, *Sporobolus airoides*, and *Achnatherum hymenoides* will increase in cover.

DISTRIBUTION

Geographic Range: Stands in this minor dwarf-shrubland alliance occur on the Columbia Plateau and Great Basin, and extend east to the northwestern Great Plains and south to the Mojave Desert, northern Chihuahuan Desert and Colorado Plateau. It is reported from eastern Washington and Oregon, Idaho, Montana, Nevada, New Mexico, Colorado and likely occurs in Utah, California, and Saskatchewan, Canada.

Nations: CA?, US

States/Provinces: AZ, CA, CO, ID, KS, MT, NM, NV, OR, SK?, TX, UT, WA, WY

TNC Ecoregions [optional]: 6:C, 11:C, 13:C, 15:C, 17:C

USFS Ecoregions (2007): 262A:CC, 322Al:CCC, 322Av:CCC, 341D:CC, 341Fa:CCC, 341Fb:CCC, 341Fc:CCC, 341Fe:CCC, 341Ff:CCC, 342B:CC, M262A:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Lake Mead, Mojave); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Eurotia lanata* - *Poa secunda* habitat type (Daubenmire 1970)
- ? *Eurotia lanata* Series (Johnston 1987) [includes the *Eurotia lanata*/*Hilaria jamesii* plant association.]
- = *Krascheninnikovia lanata* (Winterfat scrubland) Alliance (Sawyer et al. 2009) [36.500.00]
- = *Krascheninnikovia lanata* Shrubland Alliance (Evens et al. 2014)
- = *Krascheninnikovia lanata* Shrubland Alliance (CNPS 2017) [36.500.00]
- >< Mixed Saltdesert Shrub - Playa (Chappell et al. 1997)
- >< Shadscale Scrub (#36140) (Holland 1986b)
- ? Winterfat Series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS

Associations:

- CEGLO01321 *Krascheninnikovia lanata* / *Bouteloua gracilis* Dwarf-shrub Grassland
- CEGLO01327 *Krascheninnikovia lanata* / *Hesperostipa comata* Dwarf-shrubland
- CEGLO01325 *Krascheninnikovia lanata* / *Phlox* spp. Dwarf-shrubland
- CEGLO01326 *Krascheninnikovia lanata* / *Poa secunda* Dwarf-shrubland
- CEGLO01324 *Krascheninnikovia lanata* / *Pascopyrum smithii* - *Bouteloua gracilis* Dwarf-shrub Grassland

- CEGLO01320 *Krascheninnikovia lanata* Dwarf-shrubland
- CEGLO01323 *Krascheninnikovia lanata* / *Achnatherum hymenoides* Dwarf-shrubland
- CEGLO01322 *Krascheninnikovia lanata* / *Pleuraphis jamesii* Dwarf-shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: CNPS 2017, Carey 1995, Chappell et al. 1997, Daubenmire 1970, DeVelice et al. 1991, DeVelice et al. 1995, Evens et al. 2014, Faber-Langendoen et al. 2017b, Francis 1986, Holland 1986b, Johnston 1987, Keeler-Wolf and Thomas 2000, MacMahon 1988, Reid et al. 1999, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Stout et al. 2013, Thomas et al. 2004, Turner 1982c, VegCAMP and AIS 2013, West 1988, Young et al. 1977, Young et al. 2007b

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G310. Intermountain Semi-Desert Steppe & Shrubland

A2650. *Opuntia* spp. Colorado Plateau Shrubland Alliance

Type Concept Sentence: This alliance is dominated by clumps of *Opuntia* cacti and occurs in disturbed or extremely xeric sites with coarse soils throughout the Colorado Plateau.

OVERVIEW

Scientific Name: *Opuntia* spp. Colorado Plateau Shrubland Alliance

Common Name (Translated Scientific Name): Prickly-pear species Colorado Plateau Shrubland Alliance

Colloquial Name: Colorado Plateau Prickly-pear Shrubland

Type Concept: Clumps of *Opuntia* cacti dominate the community, with sparse to moderate cover by grasses and forbs growing within and between clumps. *Bromus tectorum* is the most common and abundant herbaceous species in this community, but even disturbed examples generally include some cover of native grasses and forbs, including *Achnatherum hymenoides*, *Bouteloua gracilis*, *Hesperostipa comata*, *Pleuraphis jamesii*, and *Sphaeralcea* spp. Cryptobiotic soil crusts may be well-developed in undisturbed sites. This alliance occurs throughout the Colorado Plateau in disturbed or extremely xeric sites with coarse soils. Many stands occur on eolian or alluvial deposits on gentle to moderate slopes.

Classification Comments: This is a Colorado Plateau-centric alliance that is placed within an ecological group with alliances that span multiple ecoregions.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Low shrublands composed of one or more species of *Opuntia*, most typically in association with native and non-native grasses and disturbed sites of the Colorado Plateau.

VEGETATION

Physiognomy and Structure:

Floristics: This is often a somewhat sparse community, with total perennial vegetation cover rarely exceeding 30%. In wet years, weedy and native annual herbaceous species may provide more than 50% cover. *Opuntia polyacantha* and *Opuntia phaeacantha* are the most common dominant cacti in this alliance, occurring in patches or clumps throughout the community. Scattered individuals of other shrub species may also occur in this community, particularly *Atriplex canescens*. Other shrubs present may include *Artemisia tridentata* ssp. *wyomingensis*, *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Ephedra* spp., *Gutierrezia sarothrae*, *Grayia spinosa*, and *Sarcobatus vermiculatus*. The exotic annual grass *Bromus tectorum* frequently dominates the herbaceous layer along with weedy and exotic forbs such as *Astragalus nuttallianus* and *Erodium cicutarium*; however, even in the most disturbed sites, some native forbs and grasses may persist, including *Achnatherum hymenoides*, *Bouteloua gracilis*, *Hesperostipa comata*, *Pleuraphis jamesii*, and *Sphaeralcea* spp.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance occurs on alluvial terraces, slopes and ridges throughout the Colorado Plateau. Sites are often disturbed or, if undisturbed, are extremely xeric. Slopes range from gently sloping to moderately steep, and elevations range from 1450 to 1750 m (4757-5740 feet). Substrates include sandy alluvium, eolian sands, and coarse black migmatitic gravels. Soils are usually coarse-textured, either sandy or gravelly. At Canyon de Chelly, Arizona, this alliance often indicates the location of Anasazi ruins that have become buried by eolian sands.

Dynamics: In all but the most xeric habitats, dominance by *Opuntia* species generally indicates heavy, chronic disturbance, such as grazing by domestic livestock (Rice and Westoby 1978). However, in some extremely xeric habitats, such as sandsheets or coarse dark metamorphic gravels, *Opuntia* will dominate a community that otherwise shows few signs of disturbance and may have a well-developed cryptobiotic soil crust.

DISTRIBUTION

Geographic Range: This alliance is currently known from the Colorado Plateau of western Colorado, northern Arizona and southeastern Utah.

Nations: US

States/Provinces: AZ, CO, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY**LOWER LEVEL UNITS****Associations:**

- CEG002299 *Opuntia polyacantha* / *Pleuraphis jamesii* Shrubland
- CEG004009 *Opuntia (fragilis, polyacantha, phaeacantha)* Shrubland

AUTHORSHIP

Primary Concept Source: J. Coles and K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Faber-Langendoen et al. 2017b, Rice and Westoby 1978

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

3.B.1.Ne.1.e. M171 Great Basin-Intermountain Dry Shrubland & Grassland

G775. Intermountain Sparsely Vegetated Dune Scrub & Grassland

Type Concept Sentence: This shrubby and herbaceous group occurs on sandy sites in the intermountain western U.S. and is characterized by a sparse to open vegetation layer composed of shrubs *Ericameria nauseosa*, *Eriogonum leptocladon*, or *Tetradymia tetrameres* and herbaceous species *Achnatherum hymenoides*, *Leymus flavescens*, *Psoralidium lanceolatum*, and *Redfieldia flexuosa*, which may dominate solely or in a combination on active and stable dunes and sandsheets.

OVERVIEW

Scientific Name: Intermountain Sparsely Vegetated Dune Scrub & Grassland Group

Common Name (Translated Scientific Name): Intermountain Sparsely Vegetated Dune Scrub & Grassland Group

Colloquial Name: Rubber Rabbitbrush - Sand Buckwheat - Four-part Horsebrush Sparse Scrub

Type Concept: This group occurs on sandy sites in the intermountain western U.S. from the Columbia Basin, Great Basin, and Centennial Valley in Montana, Wyoming Basins, Colorado Plateau and the San Luis Valley of southern Colorado. This group is characterized by open to sparse (<15% total cover) shrub and/or herbaceous vegetation. Characteristic shrubs include *Ericameria nauseosa*, *Eriogonum leptocladon*, or *Tetradymia tetrameres*. Diagnostic herbaceous species are *Achnatherum hymenoides*, *Leymus flavescens*, *Muhlenbergia pungens*, *Psoralidium lanceolatum*, and *Redfieldia flexuosa*, which may dominate solely or in a

combination. There are several associated species, including graminoids such as *Calamovilfa gigantea*, *Hesperostipa comata* (= *Stipa comata*), *Schizachyrium scoparium*, and forbs *Heliotropium convolvulaceum*, *Machaeranthera canescens* (= *Aster canescens*), *Oxytheca dendroidea* (= *Eriogonum dendroideum*), *Polanisia dodecandra* ssp. *trachysperma*, *Polanisia jamesii*, *Reverchonia arenaria*, *Sophora stenophylla*, *Scabrethia scabra* (= *Wyethia scabra*), and the annual forb *Eriogonum deflexum*. Stands occur on active and stable dunes and sandsheets. Elevations range from 1500-2400 m. All sites have cool, semi-arid continental climates. Substrates are eolian sand.

Classification Comments: The majority of this group occurs in the intermountain western U.S.; however, two of the associations may extend out into the shortgrass region of the western Great Plains. These associations need further review as far as floristic composition and range such as on "blowout" sites where sandy plains or stabilized dunes have been disturbed (Ramaley 1939b). Shrubby semi-arid dune communities in this group need further review.

Similar NVC Types:

- G675 North American Warm Semi-Desert Dune & Sand Flats: also occurs on dunes and sandsheets, but in warm, semi-arid climate.

Diagnostic Characteristics: This group is characterized by a sparse to open shrub and/or herbaceous layer composed of shrubs *Ericameria nauseosa*, *Eriogonum leptocladon*, *Tetradymia tetrameres*, and perennial grasses and forbs *Achnatherum hymenoides*, *Leymus flavescens*, *Psoraleidum lanceolatum*, and *Redfieldia flexuosa*, which may dominate solely or in a combination on rapidly drained sands.

VEGETATION

Physiognomy and Structure: Vegetation has a sparse cover of xeromorphic shrubs and dwarf-shrubs less than 2 m tall and/or a short herbaceous layer that is typically sparse and is dominated by perennial graminoids, with ephemeral forbs and grasses present seasonally.

Floristics: This group occurs on sandy sites in the intermountain western U.S. from the Columbia Basin, Great Basin, and Centennial Valley in Montana, Wyoming Basins, Colorado Plateau and the San Luis Valley of southern Colorado. This group is characterized by open to sparse (<15% total cover) shrub and/or herbaceous vegetation. Dominant shrubs include *Ericameria nauseosa*, *Eriogonum leptocladon*, or *Tetradymia tetrameres*. Diagnostic herbaceous species are *Achnatherum hymenoides*, *Leymus flavescens*, *Muhlenbergia pungens*, *Psoraleidum lanceolatum*, and *Redfieldia flexuosa*, which may dominate solely or in a combination. There are several associated species, including graminoids such as *Calamovilfa gigantea*, *Hesperostipa comata* (= *Stipa comata*), *Schizachyrium scoparium*, and forbs *Heliotropium convolvulaceum*, *Machaeranthera canescens* (= *Aster canescens*), *Oxytheca dendroidea* (= *Eriogonum dendroideum*), *Polanisia dodecandra* ssp. *trachysperma*, *Polanisia jamesii*, *Reverchonia arenaria*, *Sophora stenophylla*, *Scabrethia scabra* (= *Wyethia scabra*), and the annual forb *Eriogonum deflexum*. On the Colorado Plateau, active dune sites have codominants such as *Calamovilfa gigantea*, *Psoraleidum lanceolatum*, *Reverchonia arenaria*, *Sophora stenophylla*, and *Scabrethia scabra* (Castle 1954, Bowers 1982).

ENVIRONMENT & DYNAMICS

Environmental Description: This group occurs on sandy sites in the intermountain western U.S. from the Columbia Basin, Great Basin, and Centennial Valley in Montana, Wyoming Basins, Colorado Plateau and the San Luis Valley of southern Colorado. Elevations range from 1500-2400 m. Stands occur on active and stable dunes and sandsheets. In the San Luis Valley in Colorado, at approximately 2400 m elevation, stands occur on a sandsheet on the windward side of dunes (R. Rondeau, CONHP, pers. comm.). In semi-arid dune systems in the Colorado Plateau and Great Basin, stands occur in active dunes (Van Pelt 1978, Bowers 1982). They are early-seral communities that colonize bare sand in interdune valleys. The plants adapt to sand deposition by stem elongation but eventually will be buried or dug up as the dunes move. On dune margins, stabilization may occur as other sand-adapted species colonize, eventually succeeding into the adjacent desert scrub community. In the Colorado Plateau of southeastern Utah and western Colorado, this vegetation is often limited to small stands on sandy point bars, islands or terraces in the beds of intermittent streams. These stands are subject to periodic flooding but are usually isolated from the water table. A few Colorado Plateau stands occupy unconsolidated sands in areas with active dunes. Additional review is needed to characterize the environments in its full range.

Climate: This group occurs in a cool, semi-arid continental climate. *Soil/substrate/hydrology:* Substrates are eolian sands.

Dynamics: *Achnatherum hymenoides* is one of the most drought-tolerant grasses in the western U.S. and occurs on a variety of xeric sites (USFS 1937). It is also a valuable forage grass in arid and semi-arid regions. Improperly managed livestock grazing could increase soil erosion, decrease cover of this palatable plant species and increase weedy species (USFS 1937).

Dunes gradually become smaller and reach a threshold of size, below which they become stabilized by vegetation. This vegetation occurs on recent sand deposits, but over time, if deposition slows, it will succeed to shrubland or grassland vegetation types.

DISTRIBUTION

Geographic Range: This group occurs on sandy sites in the intermountain western U.S. from the Columbia Basin, Great Basin, Centennial Valley in Montana, Wyoming Basins, Colorado Plateau and the San Luis Valley of southern Colorado.

Spatial Scale & Pattern [optional]:

Nations: US

States/Provinces: AZ, CO, ID, MT, NV, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Alliances:

- A4011 *Redfieldia flexuosa* - *Leymus flavescens* - *Achnatherum hymenoides* Grassland Alliance
- A4149 *Ericameria nauseosa* - *Eriogonum leptocladon* - *Tetradymia tetrameres* Sparse Scrub Alliance

AUTHORSHIP

Primary Concept Source: Faber-Langendoen et al. (2015)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 04/16/2015

Classif Resp Region: West

Internal Author: MSR 8-13, mod. KAS 4-15

REFERENCES

References: Faber-Langendoen et al. 2017a

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G775. Intermountain Sparsely Vegetated Dune Scrub & Grassland

A4149. *Ericameria nauseosa* - *Eriogonum leptocladon* - *Tetradymia tetrameres* Sparse Scrub Alliance

Type Concept Sentence: Sparsely vegetated scrub of sand dunes, sandsheets and sand blowouts of the western U.S. dominated by *Ericameria nauseosa*, *Eriogonum leptocladon*, and/or *Tetradymia tetrameres*, with understory of herbaceous species such as *Achnatherum hymenoides*, *Leymus flavescens*, *Muhlenbergia pungens*, and/or *Psoralidium lanceolatum*.

OVERVIEW

Scientific Name: *Ericameria nauseosa* - *Eriogonum leptocladon* - *Tetradymia tetrameres* Sparse Scrub Alliance

Common Name (Translated Scientific Name): Rubber Rabbitbrush - Sand Buckwheat - Four-part Horsebrush Sparse Scrub Alliance

Colloquial Name: Rubber Rabbitbrush - Sand Buckwheat - Four-part Horsebrush Sparse Scrub

Type Concept: This sparse shrubland alliance of the western U.S. has open and low vegetative cover from 15 to 50%. Dominant diagnostic shrub species are *Ericameria nauseosa*, *Eriogonum leptocladon*, and/or *Tetradymia tetrameres*. Dominant and consistently present understory herbaceous species include *Achnatherum hymenoides*, *Leymus flavescens*, *Muhlenbergia pungens*, and/or *Psoralidium lanceolatum*. This sparse community is characteristic of flat to rolling areas of sandsheets, stabilized or moving sand dunes, sand blowouts, or colluvial slopes, between 1220 and 2505 m (4000-8218 feet) elevation. Sites include valley floors, floodplains, and stream terraces, are gentle to moderately sloping, but range from flat to steep and may occur on any aspect. Soils are sands, loamy sands and sandy loams derived from local eroding sandstone or eolian sands. Most of the unvegetated surface is bare soil, although incipient biological soil crusts (consisting mostly of dark cyanobacteria) may cover up to 20% of the ground in more stable sites.

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure: Open and sparse low shrubland (<2 m height).

Floristics: This sparse shrubland has open and low vegetative cover from 15 to 60%. Dominant diagnostic shrub species are *Ericameria nauseosa*, *Eriogonum leptocladon*, and/or *Tetradymia tetrameres*. Dominant and consistently present understory herbaceous species include *Achnatherum hymenoides*, *Leymus flavescens*, *Muhlenbergia pungens*, and *Psoralidium lanceolatum*. Other common shrub associates include *Chrysothamnus viscidiflorus*, *Ephedra torreyana*, *Artemisia bigelovii*, *Atriplex canescens*, *Eriogonum corymbosum*, *Gutierrezia sarothrae*, *Ipomopsis congesta*, *Opuntia polyacantha*, *Sarcobatus vermiculatus*, and *Yucca elata* (= var. *utahensis*). Associated herbaceous species that have very low cover include graminoids such as *Aristida purpurea*, *Hesperostipa comata*, *Pleuraphis jamesii*, and *Sporobolus airoides*, and forbs such as *Abronia fragrans*, *Chamaesyce glyptosperma*, *Cirsium calcareum*, *Cirsium* spp., *Eriogonum cernuum*, *Gayophytum humile* (= *Gayophytum nuttallii*), *Heterotheca villosa*, *Lygodesmia grandiflora*, *Lygodesmia juncea*, *Machaeranthera canescens* (= *Aster canescens*), *Oenothera pallida*, *Oxytheca dendroidea* (= *Eriogonum dendroideum*), *Penstemon palmeri*, *Phacelia hastata* var. *hastata* (= *Phacelia leucophylla*), *Phacelia heterophylla*, *Salsola tragus*, *Sophora stenophylla*, *Sphaeralcea coccinea*, *Streptanthella longirostris*, and *Tragopogon dubius*.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance occurs on sandsheets, sand blowouts, and sand dunes both moving and stabilized. Soils are sands, loamy sands and sandy loams derived from local eroding sandstone or eolian sands.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is found on southeastern Idaho Snake River basalts, Great Sand Dunes of south-central Colorado, and on the Colorado Plateau of southern and eastern Utah, northeastern Arizona and western Colorado.

Nations: US

States/Provinces: AZ, CO, ID, NV, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: NPS (Canyonlands, Capitol Reef, Dinosaur, Glen Canyon, Great Sand Dunes, Navajo, Zion); USFWS (Minidoka, Ouray)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEGLO02980 *Ericameria nauseosa* Sand Deposit Sparse Shrubland
- CEGLO02759 *Tetradymia tetrameres* Dune Sparse Vegetation
- CEGLO02821 *Eriogonum leptocladon* / *Muhlenbergia pungens* Dwarf-shrubland
- CEGLO02921 *Ericameria nauseosa* / *Muhlenbergia pungens* - *Achnatherum hymenoides* Shrub Grassland
- CEGLO02822 *Eriogonum leptocladon* Sparse Vegetation
- CEGLO01329 *Ericameria nauseosa* / *Leymus flavescens* / *Psoralidium lanceolatum* Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2014)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2016/09/27

REFERENCES

References: Faber-Langendoen et al. 2017b

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G775. Intermountain Sparsely Vegetated Dune Scrub & Grassland

A4011. Redfieldia flexuosa - Leymus flavescens - Achnatherum hymenoides Grassland Alliance

Type Concept Sentence: This herbaceous alliance occurs on sandy sites in the intermountain western U.S. and is characterized by a sparse to an open herbaceous layer composed of *Redfieldia flexuosa*, *Leymus flavescens*, *Achnatherum hymenoides*, and *Psoralidium lanceolatum*, which may dominate solely or in combination on active and stable dunes and sandsheets.

OVERVIEW

Scientific Name: *Redfieldia flexuosa* - *Leymus flavescens* - *Achnatherum hymenoides* Grassland Alliance

Common Name (Translated Scientific Name): Blowout Grass - Yellow Wildrye - Indian Ricegrass Grassland Alliance

Colloquial Name: Blowout Grass - Yellow Wildrye - Indian Ricegrass Grassland

Type Concept: This herbaceous alliance occurs on sandy sites in the intermountain western U.S. from the Columbia Basin, Great Basin, Centennial Valley in Montana, Wyoming Basins, Colorado Plateau and the San Luis Valley of southern Colorado. This herbaceous layer is characterized by a sparsely vegetated to open herbaceous layer composed of *Redfieldia flexuosa*, *Leymus flavescens*, *Achnatherum hymenoides*, and *Psoralidium lanceolatum*, which may dominate solely or in combination. There are several associated species, including graminoids *Muhlenbergia pungens*, *Hesperostipa comata* (= *Stipa comata*), *Schizachyrium scoparium*, *Calamovilfa gigantea*, forbs *Heliotropium convolvulaceum*, *Machaeranthera canescens* (= *Aster canescens*), *Oxytheca dendroidea* (= *Eriogonum dendroideum*), *Polanisia dodecandra* ssp. *trachysperma*, *Polanisia jamesii*, *Reverchonia arenaria*, *Sophora stenophylla*, *Scabrethia scabra* (= *Wyethia scabra*), and the annual forb *Eriogonum deflexum*. Stands occur on active and stable dunes, sand blowouts and sandsheets. Elevations range from 1500-2400 m. All sites have semi-arid climates. Substrates are eolian sands.

Classification Comments: The majority of this alliance occurs in the intermountain western U.S.; however, two of the associations may extend out into the shortgrass region of the western Great Plains. These associations need further review of floristic composition and range, such as on "blowout" sites where sandy plains or stabilized dunes have been disturbed (Ramaley 1939b).

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: This alliance is characterized by a sparse to open herbaceous layer composed of *Redfieldia flexuosa*, *Leymus flavescens*, *Achnatherum hymenoides*, and *Psoralidium lanceolatum*, which may dominate solely or in combination on rapidly drained sands.

VEGETATION

Physiognomy and Structure: The vegetation in this alliance has a sparse to moderate graminoid cover dominated by medium-tall bunchgrasses. Forb cover is generally sparse.

Floristics: This intermountain western U.S. herbaceous alliance is characterized by a sparsely vegetated to open herbaceous layer composed of *Redfieldia flexuosa*, *Leymus flavescens*, *Achnatherum hymenoides*, and *Psoralidium lanceolatum*, which may dominate solely or in combination. There are several associated species, including graminoids *Muhlenbergia pungens*, *Hesperostipa comata* (= *Stipa comata*), *Schizachyrium scoparium*, *Calamovilfa gigantea*, forbs *Heliotropium convolvulaceum*, *Machaeranthera canescens* (= *Aster canescens*), *Oxytheca dendroidea* (= *Eriogonum dendroideum*), *Polanisia dodecandra* ssp. *trachysperma*, *Polanisia jamesii*, *Reverchonia arenaria*, *Sophora stenophylla*, *Scabrethia scabra* (= *Wyethia scabra*), and the annual forb *Eriogonum deflexum*. On the Colorado Plateau, active dune sites have codominants such as *Calamovilfa gigantea*, *Psoralidium lanceolatum*, *Reverchonia arenaria*, *Sophora stenophylla*, and *Scabrethia scabra* (Castle 1954, Bowers 1982).

ENVIRONMENT & DYNAMICS

Environmental Description: Stands of this herbaceous alliance occur in the intermountain western U.S. on active and stable dunes, sandsheets, and small isolated sand blowouts. Elevations range from 1500-2400 m. All sites have semi-arid climates. Substrates are eolian sands. In the San Luis Valley in Colorado, at approximately 2400 m elevation, stands occur on a sandsheet on the windward side of dunes (R. Rondeau, CONHP, pers. comm.). In semi-arid dune systems in the Colorado Plateau and Great Basin, stands of this alliance occur in active dunes (Van Pelt 1978, Bowers 1982). They are early-seral communities that colonize bare sand in interdune

valleys. The plants adapt to sand deposition by stem elongation but eventually will be buried or dug up as the dunes move. On dune margins, stabilization may occur as other sand-adapted species colonize, eventually succeeding into the adjacent desert scrub community. In the Colorado Plateau of southeastern Utah and western Colorado, this alliance is often limited to small stands on sandy point bars, islands or terraces in the beds of intermittent streams. These stands are subject to periodic flooding but are usually isolated from the water table. A few Colorado Plateau stands occupy unconsolidated sands in areas with active dunes. In the Snake River Valley, this community has been documented in sand blowouts in the rolling hills of sagebrush. Additional review is needed to characterize the environments of this alliance in its full range.

Dynamics: *Achnatherum hymenoides* is one of the most drought-tolerant grasses in the western U.S. and occurs on a variety of xeric sites (USFS 1937). It is also a valuable forage grass in arid and semi-arid regions. Improperly managed livestock grazing could increase soil erosion, decrease cover of this palatable plant species and increase weedy species (USFS 1937).

Dunes gradually become smaller and reach a threshold of size, below which they become stabilized by vegetation. This alliance occurs on recent sand deposits, but over time, if deposition slows, it will succeed to shrubby vegetation types.

DISTRIBUTION

Geographic Range: This alliance occurs on sandy sites in the intermountain western U.S. from the Columbia Basin, Great Basin, Centennial Valley in Montana, Wyoming Basins, Colorado Plateau and the San Luis Valley of southern Colorado.

Nations: CA?, US

States/Provinces: CO, ID, MT, NV, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- C EGL001650 *Achnatherum hymenoides* - *Psoralidium lanceolatum* Grassland
- C EGL002917 *Redfieldia flexuosa* - (*Psoralidium lanceolatum*) Grassland
- C EGL001563 *Leymus flavescens* Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, Faber-Langendoen et al. (2014)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by M.S. Reid.

Version Date: 2016/10/17

REFERENCES

References: Bowers 1982, Bowers 1984, Burgess and Northington 1977, Castle 1954, Chadwick and Dalke 1965, Daubenmire 1970, Faber-Langendoen et al. 2017b, Franklin and Dyrness 1973, Ramaley 1937, Ramaley 1939b, Ramaley 1942, Reid 1980, Reid et al. 1994, Strong 1980, Terwilliger and Tiedemann 1978, Tiedemann et al. 1987, USFS 1937, Van Pelt 1978, WNDD unpubl. data

M170. Great Basin-Intermountain Dwarf Sagebrush Steppe & Shrubland

This semi-arid intermountain western U.S. macrogroup is characterized by short sagebrush taxa that form an open to moderately dense dwarf-shrub layer on shallow, rocky, calcareous or alkaline soils. Stands are dominated by one of several diagnostic *Artemisia* taxa depending on location and habitat, including *Artemisia arbuscula* ssp. *arbuscula*, *Artemisia arbuscula* ssp. *longiloba*, *Artemisia arbuscula* ssp. *longicaulis*, *Artemisia arbuscula* ssp. *thermopola*, *Artemisia bigelovii*, *Artemisia frigida*, *Artemisia nova*, *Artemisia rigida*, or *Artemisia tripartita* ssp. *rupicola*.

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

3.B.1.Ne.2.a. M170 Great Basin-Intermountain Dwarf Sagebrush Steppe & Shrubland

G307. Columbia Plateau Scabland Dwarf-shrubland

Type Concept Sentence: This group is found in the Columbia Plateau region and forms extensive low shrublands dominated by diagnostic dwarf-shrub, *Artemisia rigida* along with other species, particularly diagnostic *Eriogonum* spp. such as *Eriogonum compositum*, *Eriogonum douglasii*, *Eriogonum microthecum*, *Eriogonum niveum*, *Eriogonum sphaerocephalum*, *Eriogonum strictum*, and *Eriogonum thymoides*, which sometimes dominate the dwarf-shrub layer without *Artemisia rigida*.

OVERVIEW

Scientific Name: *Artemisia rigida* - *Eriogonum* spp. Dwarf-shrubland & Steppe Group

Common Name (Translated Scientific Name): Scabland Sagebrush - Buckwheat species Dwarf-shrubland & Steppe Group

Colloquial Name: Scabland Sagebrush Steppe & Shrubland

Type Concept: This scabland group is found in the Columbia Plateau region and forms extensive low shrublands. Total vegetation cover is typically low, generally less than 50% and often much less than that. Vegetation is characterized by an open dwarf-shrub canopy dominated by *Artemisia rigida* or *Salvia dorrii* along with other dwarf-shrub and suffrutescent species, particularly diagnostic *Eriogonum* spp. such as *Eriogonum compositum*, *Eriogonum douglasii*, *Eriogonum microthecum*, *Eriogonum niveum*, *Eriogonum sphaerocephalum*, *Eriogonum strictum*, and *Eriogonum thymoides*, which sometimes dominate the dwarf-shrub layer without *Artemisia rigida* or *Salvia dorrii*. Other shrubs, especially shrubby *Artemisia* spp., are uncommon in this group. These stands are characterized by low cover of perennial bunchgrasses, primarily *Poa secunda*, but may include *Danthonia unispicata*, *Elymus elymoides*, *Festuca idahoensis*, or *Pseudoroegneria spicata*, as well as scattered forbs, including species of *Allium*, *Antennaria*, *Balsamorhiza*, *Lomatium*, *Phlox*, and *Sedum*. Individual sites can be dominated by grasses and semi-woody forbs, such as *Physaria oregona* or *Nestotus stenophyllus* (= *Stenotus stenophyllus*). Annuals may be seasonally abundant, and cover of moss and lichen is often high in undisturbed areas (1-60% cover). These xeric shrublands occur under relatively extreme soil-moisture conditions. Substrates are typically shallow lithic soils with limited water-holding capacity over fractured basalt. Because of poor drainage through basalt, these soils are often saturated from fall to spring by winter precipitation but typically dry out completely to bedrock by midsummer.

Classification Comments:

Similar NVC Types:

Diagnostic Characteristics: This group is characterized by an open dwarf-shrub canopy dominated or codominated by diagnostic species *Artemisia rigida*, *Eriogonum compositum*, *Eriogonum douglasii*, *Eriogonum microthecum*, *Eriogonum niveum*, *Eriogonum sphaerocephalum*, *Eriogonum strictum*, *Eriogonum thymoides*, and/or *Salvia dorrii*. *Poa secunda* and other dry-site grasses and forbs may be present usually with low cover.

VEGETATION

Physiognomy and Structure: Vegetation structure is a sparse to moderately dense dwarf-shrub canopy (10-25% cover and <0.5 m tall). Occasionally, woody cover may exceed 25%. If present, the herbaceous layer typically has low cover.

Floristics: This group is found in the Columbia Plateau region and forms extensive low shrublands. These xeric shrublands occur under relatively extreme soil-moisture conditions. Vegetation is characterized by an open dwarf-shrub canopy dominated by *Artemisia rigida* or *Salvia dorrii* along with other dwarf-shrub species, particularly *Eriogonum* spp. which sometimes dominates the dwarf-shrub layer without *Artemisia rigida* or *Salvia dorrii*. Diagnostic species of *Eriogonum* include *Eriogonum compositum*, *Eriogonum douglasii*, *Eriogonum microthecum*, *Eriogonum niveum*, *Eriogonum sphaerocephalum*, *Eriogonum strictum*, and *Eriogonum thymoides*. Other shrubs are uncommon. This group does not include mixed stands codominated by *Artemisia rigida* and other *Artemisia* species such as *Artemisia tridentata*. Low cover of perennial bunchgrasses, such as *Danthonia unispicata*, *Elymus elymoides*, *Festuca idahoensis*, or primarily *Poa secunda*, as well as scattered forbs, including species of *Allium*, *Antennaria*, *Balsamorhiza*, *Lomatium*, *Phlox*, and *Sedum*, characterize these sites. Individual sites can be dominated by grasses and semi-woody forbs, such as *Nestotus stenophyllus* (= *Stenotus stenophyllus*). Annuals may be seasonally abundant, and cover of moss and lichen is often high in undisturbed areas (1-60% cover).

ENVIRONMENT & DYNAMICS

Environmental Description: This scabland group is found in the Columbia Plateau region and forms extensive low shrublands. These xeric shrublands occur under relatively extreme soil-moisture conditions. Substrates are typically shallow lithic soils with limited water-holding capacity over fractured basalt. Because of poor drainage through basalt, these soils are often saturated from fall to spring by winter precipitation but typically dry out completely to bedrock by midsummer. Total vegetation cover is typically low, generally less than 50% and often much less than that.

Dynamics:

DISTRIBUTION

Geographic Range: This group occurs in the Columbia Plateau region of southern Idaho, eastern Oregon and eastern Washington, and extreme northern Nevada.

Spatial Scale & Pattern [optional]: Matrix

Nations: US

States/Provinces: CA, ID, NV, OR, UT?, WA

TNC Ecoregions [optional]: 6:C, 7:C, 68:C

USFS Ecoregions (2007): 331A:CC, 341E:C?, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M242D:CC, M261D:C?, M261G:CC, M332G:CC, M333A:PP, M341A:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate. USNVC Confidence from peer reviewer, not AE.

SYNONYMY

- = Edaphic Series - Lithosols (Daubenmire 1970)

LOWER LEVEL UNITS

Alliances:

- A1568 *Eriogonum* spp. / *Poa secunda* Dwarf-shrub Steppe Alliance
- A1129 *Salvia dorrii* Dwarf-shrubland Alliance
- A1574 *Artemisia rigida* Steppe & Shrubland Alliance
- A1107 *Eriogonum microthecum* Dwarf-shrubland Alliance

AUTHORSHIP

Primary Concept Source: R.F. Daubenmire (1970)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 11/06/2015

Classif Resp Region: West

Internal Author: KAS 3-10, 11-15

REFERENCES

References: Copeland 1980a, Daubenmire 1970, Faber-Langendoen et al. 2017a, Franklin and Dyrness 1973, Ganskopp 1979, Hall 1973, Johnson and Simon 1985, Poulton 1955, Shiflet 1994

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G307. Columbia Plateau Scabland Dwarf-shrubland

A1574. Artemisia rigida Steppe & Shrubland Alliance

Type Concept Sentence: This alliance is characterized by a woody layer of scattered *Artemisia rigida* and occurs in scablands east of the Cascade Range in the Columbia Basin steppe and on the Snake River plateau of Oregon, Washington and Idaho.

OVERVIEW

Scientific Name: *Artemisia rigida* Steppe & Shrubland Alliance

Common Name (Translated Scientific Name): Scabland Sagebrush Steppe & Shrubland Alliance

Colloquial Name: Scabland Sagebrush Steppe & Shrubland

Type Concept: A sparse (10-25% cover) woody layer of scattered *Artemisia rigida* is diagnostic of stands of this shrub-herbaceous alliance. Occasionally this dwarf-shrub layer exceeds 25% cover and may include woody *Eriogonum* spp. Stands have a sparse to moderately dense herbaceous layer (<0.5 m tall) that is dominated by either of the cool-season, perennial bunchgrasses *Poa secunda* or *Pseudoroegneria spicata*. Moss and lichen cover in undisturbed stands is often high and ranges from 1-60% cover. This alliance occurs in scablands east of the Cascade Range in the Columbia Basin steppe and on the Snake River plateau of Oregon, Washington and Idaho. Elevations range from 190-1830 m. Stands are found on flat to undulating to rolling plateaus, plains, ridgetops and brows. The key environmental indicator is the fact that soils are shallow with a high percentage of rock fragments (10-70%) (lithic). Parent material is restricted to colluvium and residuum derived from basalt and acidic lava. The soil surface is mostly rock, erosion pavement (pebble surface), bare ground, and moss.

Classification Comments: Vegetation included in this dwarf-shrub herbaceous alliance is very similar to the stands in *Eriogonum* spp. / *Poa secunda* Dwarf-shrub Steppe Alliance (A1568) except for dominance of *Artemisia rigida* instead of *Eriogonum* spp. in the woody layer. Both have high cover and constancy of *Poa secunda* in the herbaceous layer and occur in similar habitats (e.g., shallow, lithic soils over fractured basalt). Daubenmire (1970) described as many stands in an intermediate habitat type between the *Artemisia rigida* - *Poa* and *Eriogonum thymoides* - *Poa* habitat types as in each of the "parent" types which suggests a large ecotone between stands in the two alliances. In addition, woody cover in some stands in this alliance is dense enough to be classified as a shrubland (Daubenmire 1970, Johnson and Simon 1987), but most average between 10-25%.

Internal Comments:

Other Comments:

Similar NVC Types:

- A1568 *Eriogonum* spp. / *Poa secunda* Dwarf-shrub Steppe Alliance: is dominated *Eriogonum* spp. in the woody layer.

Diagnostic Characteristics: Sparse to moderately dense grassy herbaceous vegetation with a dominant woody layer of *Artemisia rigida* ranging from 10-25% cover occurring in scablands east of the Cascade Range in the Columbia Basin steppe and on the Snake River plateau of Oregon, Washington and Idaho.

VEGETATION

Physiognomy and Structure: Vegetation in this alliance has a sparse to moderately dense herbaceous layer that is dominated by perennial bunch grasses less than 0.5 m tall. There is also a sparse, deciduous dwarf-shrub layer that is diagnostic of this type, and a sparse layer of perennial forbs. Mosses and lichens may be common (<0.1 m tall). Annual forbs and grasses are seasonally present.

Floristics: Vegetation included in this alliance is typically open with total vascular cover much less than 60%. A sparse (10-25% cover) woody layer of scattered *Artemisia rigida*, a cold-deciduous dwarf-shrub, is diagnostic of these stands. Occasionally this dwarf-shrub layer exceeds 25% cover and may include woody *Eriogonum* spp. Stands have a sparse to moderately dense herbaceous layer (<0.5 m tall) that is dominated by either of the cool-season, perennial bunchgrasses *Poa secunda* or *Pseudoroegneria spicata*. Other characteristic species may include occasional graminoids such as *Danthonia unispicata*, *Elymus elymoides*, or *Festuca idahoensis*; perennial forbs such as *Achillea millefolium*, *Allium* spp., *Antennaria* spp., *Balsamorhiza incana*, *Erigeron chrysopsidis*, *Eriogonum* spp., *Lithophragma glabrum*, *Lomatium* spp., *Phlox hoodii*, *Sedum lanceolatum*, *Sedum stenopetalum*, or *Trifolium macrocephalum*; and the annuals *Collinsia parviflora*, *Epilobium brachycarpum*, *Idahoia scapigera*, *Microsteris gracilis* (= *Phlox gracilis*), *Plantago patagonica*, and *Vulpia microstachys* var. *pauciflora*. Moss and lichen cover in undisturbed stands is often high and ranges from 1-60% cover.

ENVIRONMENT & DYNAMICS

Environmental Description: These sparse shrublands/grasslands are characteristic of the scablands in the Columbia Basin and portions of the Snake River plain. Elevations range from 190-1830 m. The climate is temperate, with a winter precipitation peak. Mean annual precipitation ranges from 25-50 cm, and occurs primarily in the winter as snow or rain. This moisture is stored in the soil profile and utilized during the typically dry summers. Stands are found on flat to undulating to rolling plateaus, plains, ridgetops and brows. Sites are nearly level to moderately sloping (to 30%). The alliance occurs on all aspects, but is more common on southern slopes, although given that most sites are flat, aspect is not very significant. The key environmental indicator is the fact that soils are shallow (7-30 cm) with a high percentage of rock fragments (10-70%) (lithic). They are moderately to well-drained, non-calcareous, sandy to clay loams, with pH of 6.3-6.6. Parent material is restricted to colluvium and residuum derived from basalt and acidic lava. Soil surface is mostly rock, erosion pavement (pebble surface), bare ground, and moss. Litter accumulates under the scattered *Artemisia rigida* plants forming moss-covered mounds up to 20 cm deep. These hummocks persist several years after the death of the dwarf-shrub (Daubenmire 1970, 1992). Moss and lichen cover a significant amount of the ground surface, often with up to 50% cover.

Dynamics: This xeric shrubland vegetation occurs under relatively extreme soil-moisture conditions. Stands are found on shallow rocky soils with limited water-holding capacity. These soils are often saturated from fall to spring by winter precipitation, but they typically dry out completely to bedrock by mid-summer (Daubenmire 1970, 1992, Johnson and Simon 1987). *Poa secunda* is well-adapted to these conditions because it starts growing early in the spring and completes its reproductive cycle early while there is still moisture in the soil (Daubenmire 1970, 1992, Johnson and Simon 1987). Also, if there is late-summer or early-fall precipitation, dormant *Poa secunda* can respond quickly and green up. Daubenmire (1970) and Johnson and Simon (1987) suggest that the basalt bedrock present under these dwarf-shrub/grassland stands is fractured enough to support deeper-rooted dwarf-shrubs. Moss does well in this habitat. In addition to drought tolerance, *Poa secunda* is also tolerant of grazing and trampling by livestock (Daubenmire 1970, Ganskopp 1979). *Artemisia rigida* is favored winter browse for elk and deer, and moderately palatable to livestock (Johnson and Clausnitzer 1992). The saturated spring soils are vulnerable to trampling, but the rocky soils discourage livestock (Daubenmire

1992). However, in areas excluded from grazing entirely, *Pseudoroegneria spicata* and *Festuca idahoensis* may dominate with *Artemisia rigida* in portions of the alliance's range, also growing in rock fractures.

Stands in this alliance are generally considered to be late-seral with species composition controlled by the harsh edaphic conditions of the site (Daubenmire 1970, Johnson and Simon 1987). With disturbance, such as livestock impacts, comes an increase in erosion pavement and bare ground, and a decrease in moss and lichen cover (Daubenmire 1970, Johnson and Simon 1987). Frost heaving may be severe, causing local soil disturbance in the winter when these thin, saturated soils freeze and push soil and plants up out of the ground. Pedestalled *Artemisia rigida* plants and bunch grasses are common (Daubenmire 1970, Hironaka et al. 1983). Exotic plants have invaded many stands especially where disturbed (Tisdale 1986, Daubenmire 1992). Common exotics may include annual grasses such as *Bromus tectorum*, *Bromus arvensis*, and *Bromus briziformis*, which may be abundant during wet years, and annual forbs such as *Epilobium brachycarpum*, *Erodium cicutarium*, *Lactuca serriola*, *Tragopogon dubius*, and the perennial forb *Hypericum perforatum*.

Fire is thought to be unimportant because it is unlikely that the sparse vegetation in these stands could carry a fire. However, if it did occur, the *Artemisia rigida* plants are not tolerant and would be killed (Johnson and Simon 1987, Daubenmire 1992, Johnson and Clausnitzer 1992).

DISTRIBUTION

Geographic Range: These sparse dwarf-shrublands occur in the Columbia Basin of eastern Washington, eastern Oregon and Idaho.

Nations: US

States/Provinces: ID, OR, WA

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- ? *Artemisia rigida-Poa secunda* habitat type (Daubenmire 1970) [includes an association by the same name.]
- ? *Artemisia rigida-Poa secunda* habitat type (Hironaka et al. 1983)
- ? *Artemisia rigida* Series (Tisdale 1986)
- = SRM Cover Type #407 - Stiff Sagebrush (Shiflet 1994)
- ? Scabland Sage (Shantz 1924)
- ? Stiff Sage Scabland (Hall 1973) [*Artemisia rigida-Poa sandbergii* scabland]

LOWER LEVEL UNITS

Associations:

- CEG001528 *Artemisia rigida* / *Poa secunda* Shrub Grassland
- CEG002995 *Artemisia rigida* / *Festuca idahoensis* Shrub Grassland
- CEG001529 *Artemisia rigida* / *Pseudoroegneria spicata* Shrub Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz and J. Kagan, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Daubenmire 1970, Daubenmire 1992, Faber-Langendoen et al. 2017b, Ganskopp 1979, Hall 1973, Hironaka et al. 1983, Johnson and Clausnitzer 1992, Johnson and Simon 1987, Shantz 1924, Shiflet 1994, Tisdale 1986

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G307. Columbia Plateau Scabland Dwarf-shrubland

A1107. *Eriogonum microthecum* Dwarf-shrubland Alliance

Type Concept Sentence: This minor dwarf-shrubland alliance is dominated by dwarf-shrub *Eriogonum microthecum* and occurs in portions of the Snake and Imnaha river canyons in Idaho and eastern Oregon and Washington.

OVERVIEW

Scientific Name: *Eriogonum microthecum* Dwarf-shrubland Alliance

Common Name (Translated Scientific Name): Slender Buckwheat Dwarf-shrubland Alliance

Colloquial Name: Slender Buckwheat Dwarf-shrubland

Type Concept: Vegetation included in this alliance has a sparse woody layer that is dominated by the dwarf-shrub *Eriogonum microthecum* and occurs in rather fine-scale mosaic patterns. Some stands may have *Eriogonum strictum* instead of, or in addition to, *Eriogonum microthecum*. The herbaceous layer is also sparse and composed of a relatively even mix of forbs and grasses. Other characteristic species include forbs, such as *Achillea millefolium*, *Chaenactis douglasii*, *Erysimum asperum*, *Oenothera caespitosa*, *Phacelia heterophylla*, *Polygonum douglasii*, *Physaria oregona*, and the grass *Pseudoroegneria spicata*. Moss and lichen are nearly absent, likely because of the instability of the slopes. Exotic species, namely *Bromus tectorum*, often make up a significant portion of the vegetation cover in these stands. This minor dwarf-shrubland alliance occurs in portions of the Snake and Imnaha river canyons in Idaho and eastern Oregon and Washington. Precipitation primarily occurs in the winter as snow or rain. This moisture is stored in the soil profile and utilized during the typically dry summers. Stands are typically found on highly weathered basalt outcrops in the canyons. Sites are very hot and dry, occurring on moderate to steep slopes with southern or western aspects. Soils are very shallow, coarse-textured, and well-drained with a high percentage of rock fragments. The soil surface has a high cover of pea-sized gravel and sand with cobbles. Parent material is colluvium and residuum derived from a unique, highly fractured, hydrothermally altered basalt lava. Chemically, this substrate is alkaline with low organic matter and high cation-exchange capacity of calcium and soluble sodium.

Classification Comments: Stands in this alliance may be too sparse to be classified as dwarf-shrublands (Daubenmire 1970, Johnson and Simon 1987).

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Largely unvegetated sites (90%) characterized by nearly sparsely vegetated dwarf-shrublands of portions of the Snake and Imnaha river canyons in Idaho and eastern Oregon and Washington with *Eriogonum microthecum* as the most consistent dominant. Some stands may have *Eriogonum strictum* as the dominant species.

VEGETATION

Physiognomy and Structure: Vegetation in this alliance has sparse to moderately sparse cover of dwarf-shrubs. There is also a sparse cover of perennial forbs. Annual forbs and grasses are seasonally present in small amounts.

Floristics: Vegetation included in this minor alliance has a sparse woody layer (usually less than 0.5 m tall) that is dominated by the dwarf-shrub *Eriogonum microthecum*. Some stands may have *Eriogonum strictum* instead of, or in addition to, *Eriogonum microthecum*. The herbaceous layer is also sparse (typically <10% cover). It is composed of a relatively even mix of forbs and grasses. Other characteristic species include forbs, such as *Achillea millefolium*, *Chaenactis douglasii*, *Erysimum asperum*, *Oenothera caespitosa*, *Phacelia heterophylla*, *Polygonum douglasii*, *Physaria oregona*, and the grass *Pseudoroegneria spicata*. *Poa bulbosa* is common in spring. Moss and lichen are nearly absent, likely because of the instability of the slopes. Exotic species, namely *Bromus tectorum*, often make up a significant portion of the vegetation cover in these stands.

ENVIRONMENT & DYNAMICS

Environmental Description: These sparse dwarf-shrublands occur in portions of the Snake and Imnaha river canyons in Idaho and eastern Oregon and Washington. Elevations range from 230-730 m, and the climate is temperate continental. Mean annual precipitation is approximately 25-30 cm. Precipitation primarily occurs in the winter as snow or rain. This moisture is stored in the soil profile and utilized during the typically dry summers. Stands are typically found on highly weathered basalt outcrops in the canyons. Sites are very hot and dry, occurring on moderate to steep (30-60%) slopes with southern or western aspects. Soils are very shallow (less than 15 cm), well-drained, with a high percentage of rock fragments (approximately 35%) (lithic). Soil texture ranges from gravelly sand to gravelly sandy loam. The soil surface has a high cover of pea-sized gravel and sand (approximately 70%) with cobbles. Parent material is colluvium and residuum derived from a unique, highly fractured, hydrothermally altered basalt lava. Chemically, this substrate is alkaline (pH 7-7.9) with low organic matter and high cation-exchange capacity of calcium and soluble sodium.

Dynamics: Stands are restricted to hot/dry, moderately steep slopes with a coarse-textured unstable substrate. The native vegetation is too sparse to carry fire, and the sites are too steep to be accessible to livestock (Daubenmire 1970, Johnson and Simon 1987). The biggest threat is exotic plants that have invaded many stands. Common exotics include annual grasses such as *Bromus tectorum*, *Bromus briziformis*, and annual forbs such as *Erodium cicutarium*, *Lactuca serriola*, and *Holosteum umbellatum*. *Bromus tectorum* is moderately dense on some stands and could possibly be dense enough to carry a fire.

DISTRIBUTION

Geographic Range: This is a minor alliance found on a limited and unique substrate in the vicinity of the Snake River Canyon at the boundaries of Idaho, Oregon, and Washington states.

Nations: US

States/Provinces: ID, OR, WA

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Eriogonum microthecum-Physaria oregana* habitat type (Daubenmire 1970)
- ? *Eriogonum* spp./*Physaria oregana* Habitat Type (Johnson and Simon 1987)

LOWER LEVEL UNITS

Associations:

- CEGL001737 *Eriogonum microthecum* - *Physaria oregana* Dwarf-shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Daubenmire 1970, Faber-Langendoen et al. 2017b, Johnson and Simon 1987

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G307. Columbia Plateau Scabland Dwarf-shrubland

A1568. Eriogonum spp. / Poa secunda Dwarf-shrub Steppe Alliance

Type Concept Sentence: Grasslands included in this alliance occur in the Columbia Basin of eastern Washington, eastern Oregon, Idaho and into western Wyoming. The herbaceous layer is dominated or codominated by the cool-season, perennial bunchgrass *Poa secunda*. Codominant species may include one or more *Eriogonum* dwarf-shrub species.

OVERVIEW

Scientific Name: *Eriogonum* spp. / *Poa secunda* Dwarf-shrub Steppe Alliance

Common Name (Translated Scientific Name): Buckwheat species / Sandberg Bluegrass Dwarf-shrub Steppe Alliance

Colloquial Name: Buckwheat / Sandberg Bluegrass Dwarf-shrub Steppe

Type Concept: Stands have a sparse to moderately dense, short herbaceous layer (10-60% cover) with a very sparse to moderately dense dwarf-shrub layer (2-40% cover). The herbaceous layer is dominated or codominated by the cool-season, perennial bunchgrass *Poa secunda*. Codominant species may include one or more *Eriogonum* dwarf-shrub species. Associates include perennial graminoids such as *Elymus elymoides* and *Pseudoroegneria spicata* and perennial forbs. Scattered dwarf-shrubs and shrubs such as *Artemisia rigida*, *Ericameria nauseosa* (= *Chrysothamnus nauseosus*), and *Nestotus stenophyllus* (= *Stenotus stenophyllus*) may be present. Moss and lichen cover in undisturbed stands is often high and ranges from 5-60% cover. Adjacent stands include other grasslands dominated by *Festuca idahoensis*, *Pseudoroegneria spicata*, or other perennial grasses, shrublands dominated by *Artemisia tridentata* or woodlands dominated by *Pinus ponderosa*. Grasslands included in this alliance occur in the Columbia Basin of eastern Washington, eastern Oregon, Idaho and into western Wyoming. Stands also likely occur in northeastern California. These grasslands are characteristic of the scablands in the Columbia Basin and portions of the Snake River plain, but extend east into Wyoming. Elevations range from 280-1650 m. Climate is temperate and continental, with mean annual precipitation ranging from 33-60 cm. Precipitation primarily occurs in the winter as snow or rain. Stands are found on flat to undulating ridgetops, plateaus, plains, and benches on steep canyon slopes. Sites are nearly level to moderately sloping (to 15%), but these communities may also occur in soil pockets between rocks on cliffs lining the sides of ravines. They occur on all aspects, but are more common on southern slopes. Soils are shallow with a high percentage of rock fragments and exposed rock (lithic soil). They are moderately to well-drained, sandy to clay loams, non-calcareous, and derived from alluvium, colluvium, residuum or loess. Parent materials include basalt lava.

Classification Comments:**Internal Comments:****Other Comments:**

Similar NVC Types: This alliance is very similar to *Artemisia rigida* Steppe & Shrubland Alliance (A1574) in species composition, but is distinguished by having *Eriogonum* sp. as the dominant shrub.

- A1574 *Artemisia rigida* Steppe & Shrubland Alliance: is very similar but dominated by *Artemisia rigida*.

Diagnostic Characteristics: Sparse to dense herbaceous layer dominated by *Poa secunda* with a sparse to moderately dense layer of *Eriogonum* sp. occurring in the Columbia Basin steppe.

VEGETATION

Physiognomy and Structure: Vegetation in this alliance is characterized by a very sparse to moderately dense dwarf-shrub layer (2-40% cover) and a sparse to moderately dense herbaceous layer (10-60% cover). The herbaceous layer is dominated by perennial bunch grasses less than 0.5 m tall. There is also a sparse to moderate cover of perennial forbs. Scattered shrubs may be present. Annual forbs and grasses are seasonally present. Moss and lichen cover in undisturbed stands is often high and ranges from 5-60% cover.

Floristics: Stands have a sparse to moderately dense, short herbaceous layer (10-60% cover) with a very sparse to moderately dense dwarf-shrub layer (2-40% cover). The herbaceous layer is dominated or codominated by the cool-season, perennial bunchgrass *Poa secunda*. Codominant species may include one or more *Eriogonum* dwarf-shrub species such as *Eriogonum compositum*, *Eriogonum douglasii*, *Eriogonum niveum*, *Eriogonum sphaerocephalum*, *Eriogonum strictum*, and *Eriogonum thymoides*. Scattered dwarf-shrubs and shrubs such as *Artemisia rigida*, *Ericameria nauseosa* (= *Chrysothamnus nauseosus*), and *Nestotus stenophyllus* (= *Stenotus stenophyllus*) may be present. Associates include perennial graminoids such as *Elymus elymoides* and *Pseudoroegneria spicata*; perennial forbs such as *Achillea millefolium*, *Antennaria dimorpha*, *Antennaria luzuloides*, *Balsamorhiza incana*, *Erigeron chrysopsidis*, *Erigeron disparipilus*, *Lomatium cous*, *Lomatium bicolor* var. *leptocarpum* (= *Lomatium leptocarpum*), *Phlox hoodii*, *Sedum lanceolatum*, *Sedum stenopetalum*; and the annual forbs *Collinsia parviflora*, *Epilobium brachycarpum* (= *Epilobium paniculatum*), *Idahoia scapigera*, *Microsteris gracilis*, and *Plantago patagonica*. Moss and lichen cover in undisturbed stands is often high and ranges from 5-60% cover.

ENVIRONMENT & DYNAMICS

Environmental Description: These grasslands are characteristic of the scablands in the Columbia Basin and portions of the Snake River plain, but extend east into Wyoming. Elevations range from 280-1650 m. Climate is temperate continental, with mean annual precipitation ranging from 33-60 cm. Precipitation primarily occurs in the winter as snow or rain. This moisture is stored in the soil profile and utilized during the typically dry summers. Stands are found on flat to undulating ridgetops, plateaus, plains, and benches on steep canyon slopes. Sites are nearly level to moderately sloping (to 15%), but these communities may also occur in soil pockets between rocks on cliffs lining the sides of ravines. They occur on all aspects, but are more common on southern slopes. Soils are shallow (less than 30 cm deep) with a high percentage of rock fragments (approximately 35%) and exposed rock (10-90%) (lithic soil). They are moderately to well-drained, sandy to clay loams, and non-calcareous, with pH of 5.9-7.4. They are derived from alluvium, colluvium, residuum or loess. Parent materials include basalt lava.

Dynamics: Stands in this alliance are generally considered to be late-seral with species composition controlled by the harsh edaphic conditions of the site (Daubenmire 1970, Johnson and Simon 1987). With disturbance comes an increase in erosion pavement and bare ground, and a decrease in moss cover (Daubenmire 1970, Johnson and Simon 1987). These xeric grasslands have shallow rocky soils with limited water-holding capacity. The winter precipitation wets these soils, but they typically dry out completely to bedrock by mid-summer (Daubenmire 1970, 1992, Johnson and Simon 1987). *Poa secunda* is well-adapted to these conditions, initiating growth early in the spring and completing its reproductive cycle early while there is still moisture in the soil (Daubenmire 1970, 1992, Johnson and Simon 1987). If there is late-summer or fall precipitation, *Poa secunda* can respond quickly and green up (Daubenmire 1970). Johnson and Simon (1987) suggest that basalt bedrock present under these dwarf-shrub/grassland stands is fractured enough to support deeper-rooted dwarf-shrubs. In addition to drought tolerance, *Poa secunda* is also tolerant of grazing and trampling by livestock (Daubenmire 1970, Ganskopp 1979). Other disturbances include frost heaving and exotic species invasion. Frost heaving causes local soil disturbance in the winter when these thin, saturated soils freeze and push soil and plants up out of the ground. Exotic plants have invaded many stands especially where disturbed. Common exotics include annual grasses such as *Bromus tectorum*, *Bromus arvensis*, and *Bromus briziformis*, which may be abundant during wet years, and annual forbs such as *Epilobium brachycarpum*, *Erodium cicutarium*, *Lactuca serriola*, *Tragopogon dubius*, and the perennial forb *Hypericum perforatum*. Fire is thought to be unimportant because it is unlikely that the sparse vegetation in these stands could carry a fire.

DISTRIBUTION

Geographic Range: This alliance occurs in the Columbia Basin of eastern Washington, eastern Oregon, Idaho and into western Wyoming. Stands also likely occur in northeastern California.

Nations: US

States/Provinces: CA?, ID, OR, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- >< One-sided Bluegrass Series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS**Associations:**

- CEG001786 *Eriogonum niveum* / *Poa secunda* Dwarf-shrub Grassland
- CEG001788 *Eriogonum strictum* / *Poa secunda* Dwarf-shrub Grassland
- CEG001448 *Eriogonum sphaerocephalum* / *Poa secunda* Dwarf-shrub Grassland
- CEG001785 *Eriogonum douglasii* / *Poa secunda* Dwarf-shrub Grassland
- CEG001784 *Eriogonum compositum* / *Poa secunda* Dwarf-shrub Grassland
- CEG001449 *Eriogonum thymoides* / *Poa secunda* Dwarf-shrub Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Daubenmire 1970, Daubenmire 1992, Faber-Langendoen et al. 2017b, Ganskopp 1979, Johnson and Simon 1987, Sawyer and Keeler-Wolf 1995

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G307. Columbia Plateau Scabland Dwarf-shrubland

A1129. *Salvia dorrii* Dwarf-shrubland Alliance

Type Concept Sentence: This alliance occurs in Oregon in the High Lava Plains, and the southern canyonlands of the Columbia Basin and at isolated spots throughout the Blue Mountains where *Salvia dorrii* is the dominant shrub.

OVERVIEW

Scientific Name: *Salvia dorrii* Dwarf-shrubland Alliance

Common Name (Translated Scientific Name): Purple Sage Dwarf-shrubland Alliance

Colloquial Name: Purple Sage Dwarf-shrubland

Type Concept: In Oregon, this is a somewhat common scabland alliance found from roughly 300-1670 m in elevation. The alliance is often in a mosaic with *Pseudoroegneria spicata* canyon grassland or shrub-steppe communities, but occasionally is found in *Juniperus* woodlands or *Pinus ponderosa* forests. *Salvia dorrii* is the dominant shrub, but cover or abundance information is not available. *Poa secunda* and *Pseudoroegneria spicata* are the dominant grasses, making up most of the herbaceous cover. *Achnatherum hendersonii* (= *Stipa hendersonii*) and *Danthonia unispicata* are occasionally important. Forb species can include *Lewisia rediviva*, *Physaria oregona*, *Trifolium macrocephalum*, *Viola trinervata*, and species of *Arenaria*, *Collomia*, *Erigeron*, and *Lomatium*, all early-blooming species. Many forb species are largely restricted to these environments. It occurs on barren, fairly young basalts or shallow loams over basalt. Sites include ridgetops and steeper sites with rock outcrops. Extreme topo-edaphic drought is the major process influencing these communities.

Classification Comments: This is a poorly documented alliance. The Oregon Natural Heritage Program reports they have plot data collected from a few stands (J. Kagan pers. comm.), and that the alliance occurs on the John Day Fossil Beds National Monument.

CBR alliances

Further inventory and documentation are needed. Information from California must be reviewed for inclusion in this description to determine if occurrences there represent the same alliance.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Small-patch inclusions within matrix forests and woodlands characterized by dwarf-shrublands of *Salvia dorrii* typically with grassy understories occurring on barren, usually fairly young basalts or shallow loams over basalt.

VEGETATION

Physiognomy and Structure: This alliance is composed of low-shrub communities (<0.5 m) or shrub-bunchgrass mosaics, in which the shrubs are dominant or codominant with an understory of very short grasses and forbs. Soil cryptogams can be abundant in some stands, especially where undisturbed.

Floristics: This alliance is poorly documented, and the following information is from Chappell et al. (1997). *Salvia dorrii* is the dominant shrub, but cover or abundance information is not available. *Poa secunda* and *Pseudoroegneria spicata* are the dominant grasses, making up most of the herbaceous cover. *Achnatherum hendersonii* (= *Stipa hendersonii*) and *Danthonia unispicata* are occasionally important. Forb species can include *Lewisia rediviva*, *Physaria oregona*, *Trifolium macrocephalum*, *Viola trinervata*, and species of *Arenaria*, *Collomia*, *Erigeron*, *Lomatium*, and *Arenaria*, all early-blooming species. Many forb species are largely restricted to these environments.

ENVIRONMENT & DYNAMICS

Environmental Description: This is a somewhat common scabland shrubland alliance found from roughly 300-1670 m in elevation. It occurs on barren, usually fairly young basalts or shallow loams over basalt. Sites include ridgetops and steeper sites with rock outcrops. Extreme topo-edaphic drought is the major process influencing these communities.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance occurs in Oregon in the High Lava Plains, and the southern canyonlands of the Columbia Basin and at isolated spots throughout the Blue Mountains. The alliance has also been reported from the northeastern Mojave Desert in southern California. It may also be found in northern California and adjacent areas of Washington, but has not been documented from either area.

Nations: US

States/Provinces: CA?, OR, WA?

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- ? *Salvia dorrii* (Desert purple sage scrub) Alliance (Sawyer et al. 2009) [33.320.00]

LOWER LEVEL UNITS

Associations:

- CEG001453 *Salvia dorrii* / *Pseudoroegneria spicata* Dwarf-shrubland
- CEG002965 *Salvia dorrii* Dwarf-shrubland

AUTHORSHIP

Primary Concept Source: M.S. Reid, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Chappell et al. 1997, Faber-Langendoen et al. 2017b, Kagan pers. comm., Sawyer et al. 2009

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

3.B.1.Ne.2.b. M170 Great Basin-Intermountain Dwarf Sagebrush Steppe & Shrubland

G308. Intermountain Low & Black Sagebrush Steppe & Shrubland

Type Concept Sentence: This broadly defined semi-arid sagebrush dwarf-shrubland and steppe occurs throughout much of the intermountain western U.S. and is characterized by an open to moderately dense shrub or dwarf-shrub layer that is typically dominated by one of the following: *Artemisia arbuscula* ssp. *arbuscula*, *Artemisia arbuscula* ssp. *longicaulis*, *Artemisia arbuscula* ssp. *longiloba*, *Artemisia arbuscula* ssp. *thermopola*, *Artemisia bigelovii*, *Artemisia frigida*, *Artemisia nova*, or *Artemisia tripartita* ssp. *rupicola* depending on environment and range of species.

OVERVIEW

Scientific Name: *Artemisia arbuscula* - *Artemisia bigelovii* - *Artemisia nova* Steppe & Shrubland Group

Common Name (Translated Scientific Name): Little Sagebrush - Bigelow's Sagebrush - Black Sagebrush Steppe & Shrubland Group

Colloquial Name: Little Sagebrush Steppe & Shrubland

Type Concept: This broadly defined semi-arid dwarf-shrubland and steppe occurs throughout much of the intermountain western U.S. The vegetation in this broadly defined shrubland and steppe group includes an open to moderately dense shrub or dwarf-shrub layer with a sparse to dense herbaceous layer. Several different taxa of sagebrush may dominate depending on location and by habitat. *Artemisia nova* is most widespread, occurring throughout most of the region on mid- to low-elevation, gravelly, calcareous soils. *Artemisia arbuscula* ssp. *arbuscula* occurs on low- to high-elevation sites often on shallow, fine-textured soils with a dense clay layer that impedes drainage in spring. *Artemisia arbuscula* ssp. *longiloba* is widespread in the Columbia Basin and Great Basin into southwestern Wyoming and badlands in the western Great Plains. It occurs on shallow, alkaline, calcareous soils derived from shale. *Artemisia bigelovii* occurs throughout much of the Colorado Plateau and extends across northern New Mexico and southeastern Colorado on shallow soils on limestone hills and shale outcrops. Several other more restricted taxa include *Artemisia tripartita* ssp. *rupicola*, *Artemisia arbuscula* ssp. *longicaulis*, *Artemisia arbuscula* ssp. *thermopola*, and *Artemisia frigida*. Other shrubs present to codominant may include *Artemisia tridentata* ssp. *wyomingensis*, *Artemisia tridentata* ssp. *vaseyana*, *Ephedra torreyana*, *Ephedra viridis*, *Grayia spinosa*, or *Purshia tridentata*, depending on habitat. The herbaceous layer, if present, ranges from sparse cushion plants such as *Arenaria hookeri*, *Eriogonum brevicaule*, and *Phlox hoodii* to moderate to dense cover of perennial grasses. Characteristic grasses include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus lanceolatus*, *Festuca idahoensis*, *Hesperostipa comata*, *Pascopyrum smithii*, *Pleuraphis jamesii*, *Poa fendleriana*, *Poa secunda*, and *Pseudoroegneria spicata*. Some stands have significant biological crust formation on the soil surface. Sites are generally xeric and may be wind-blown ridges and benches, gravelly alluvial fans, hilltops, canyons, gravelly draws, and dry flats. Substrates are typically shallow, gravelly or finer-textured alkaline, calcareous soils. Most stands occur from 1000 to 3000 m elevation with some extending to 3800 m in subalpine and alpine habitats of the Sierra Nevada. Substrates are variable, but are typically alluvium derived from limestone, shale, basalt, rhyolite or volcanics.

Classification Comments: Alliances in this group are distinguished largely by the predominant species: *Artemisia nova*, *Artemisia bigelovii*, and the nominal subspecies of *Artemisia arbuscula*, and by the importance of the perennial graminoid layer (>20% cover) in the shrub herbaceous alliances. The *Artemisia arbuscula* subspecies are distinguished by the nominal subspecies taxonomically and by the different environments which they occupy. *Artemisia arbuscula* ssp. *longicaulis* Shrubland Alliance (A2548) occurs in more alkaline and less stony settings than *Artemisia arbuscula* ssp. *arbuscula* Steppe & Shrubland Alliance (A3219). *Artemisia arbuscula* ssp. *thermopola* - *Artemisia papposa* / *Festuca idahoensis* Steppe & Shrubland Alliance (A4122) occurs in more calcareous soils and has a restricted distribution. Beetle and Johnson (1982) report that *Artemisia arbuscula* ssp. *arbuscula* grows in soils with a high volume of gravel (even though soil may be in clay textural class, or contain a clay-rich layer that impedes drainage), and that *Artemisia arbuscula* ssp. *longiloba* grows in clay soils, often alkaline, that contain no gravels.

Similar NVC Types:

Diagnostic Characteristics: This group has an open to moderately dense shrub or dwarf-shrub layer with a sparse to dense herbaceous layer. Several different taxa of sagebrush are diagnostic depending on location and by habitat: *Artemisia nova*, *Artemisia arbuscula* ssp. *arbuscula*, *Artemisia arbuscula* ssp. *longiloba*, *Artemisia arbuscula* ssp. *longicaulis*, *Artemisia bigelovii*, *Artemisia tripartita* ssp. *rupicola*, *Artemisia arbuscula* ssp. *longicaulis*, *Artemisia arbuscula* ssp. *thermopola*, and *Artemisia frigida*. In all cases, these sagebrush taxa tend to occur in shallow, rocky, calcareous or alkaline soils, often fine-textured and sometimes with a claypan impeding drainage. Associated herbaceous taxa are semi-desert grasses and forbs.

VEGETATION

Physiognomy and Structure: The vegetation in this broadly defined shrubland and steppe group includes an open to moderately dense shrub or dwarf-shrub layer dominated by microphyllous evergreen shrubs with a sparse to dense herbaceous layer usually dominated by perennial graminoids (often bunch grasses).

Floristics: This broadly defined shrubland and steppe group includes an open to moderately dense shrub or dwarf-shrub layer with a sparse to dense herbaceous layer. Several different taxa of sagebrush may dominate depending on location and by habitat. *Artemisia nova* is most widespread, occurring throughout most of the region on mid- to low-elevation, gravelly, calcareous soils. *Artemisia arbuscula ssp. arbuscula* occurs on low- to high-elevation sites often on shallow, fine-textured soils with a dense clay layer that impedes drainage in spring. *Artemisia arbuscula ssp. longiloba* is widespread in the Columbia Basin and Great Basin into southwestern Wyoming and badlands in the western Great Plains. It occurs on shallow, alkaline, calcareous soils derived from shale. *Artemisia bigelovii* occurs throughout much of the Colorado Plateau and extends across northern New Mexico and southeastern Colorado on shallow soils on limestone hill and shale outcrops. Several other more restricted taxa may dominate, including *Artemisia tripartita ssp. rupicola* (central Wyoming), *Artemisia arbuscula ssp. longicaulis* (Lahontan Basin of northwestern Nevada, southeastern Oregon, and northeastern California), *Artemisia arbuscula ssp. thermopola* (ridgetops and benches in mountains at 1830 to 2690 m in southern Idaho), and *Artemisia frigida* (described from sites in the Rocky Mountains). Other shrubs present to codominant may include *Artemisia tridentata ssp. wyomingensis*, *Artemisia tridentata ssp. vaseyana*, *Ephedra torreyana*, *Ephedra viridis*, *Grayia spinosa*, or *Purshia tridentata*, depending on habitat. The herbaceous layer is variable. If present, it ranges from sparse cushion plants such as *Arenaria hookeri*, *Astragalus bisulcatus*, *Astragalus jejunus*, *Eriogonum brevicaulis*, *Minuartia nuttallii* (= *Arenaria nuttallii*), *Phlox hoodii*, *Stenotus acaulis*, and *Trifolium gymnocarpon* to moderate to dense cover of perennial grasses. Characteristic grasses may include *Achnatherum hymenoides*, *Achnatherum thurberianum*, *Bouteloua gracilis*, *Elymus elymoides*, *Elymus lanceolatus*, *Festuca idahoensis*, *Hesperostipa comata*, *Leymus salinus*, *Pascopyrum smithii*, *Pleuraphis jamesii*, *Poa fendleriana*, *Poa secunda*, and *Pseudoroegneria spicata*. Some stands have significant biological crust formation on soil surface.

ENVIRONMENT & DYNAMICS

Environmental Description: This broadly defined semi-arid dwarf-shrubland and steppe group occurs throughout much of the intermountain western U.S. Sites are generally xeric and may be on wind-blown, shallow, gravelly or finer-textured alkaline soils. Throughout eastern Oregon, northern Nevada, southern Idaho, western Montana, western Wyoming, and western Colorado, stands typically occur on mountain ridges and flanks and broad terraces, ranging from 1000 to 3000 m in elevation with stands extending to 3800 m elevation in subalpine and alpine habitats of the Sierra Nevada. Substrates are shallow, fine-textured soils, poorly drained clays, shallow-soiled areas, almost always very stony, characterized by recent rhyolite or basalt or are alkaline soils derived from shale (Zamora and Tueller 1973, Baker and Kennedy 1985). In central and southern Wyoming, typical sites are very windy, gently rolling hills and long, gently sloping pediments and fans with shallow, often rocky soils where this group forms the matrix vegetation and large patches on the margins of high-elevation basins. In higher elevation areas, it forms a mosaic with Intermountain Mountain Big Sagebrush Steppe & Shrubland Group (G304) and is restricted to wind-blown ridges. In the Colorado Plateau, Tavaputs Plateau and Uinta Basin, stands occur in canyons, gravelly draws, hilltops, and dry flats at elevations generally below 1800 m. Soils are often rocky, shallow, and alkaline. This group also extends across northern New Mexico and Wyoming into the western Great Plains on limestone hills and shale outcrops.

Dynamics: This broadly defined semi-arid dwarf-shrubland and steppe group occurs throughout much of the intermountain western U.S. Sites are generally xeric and may be on wind-blown, shallow, gravelly or finer-textured alkaline soils. Throughout eastern Oregon, northern Nevada, southern Idaho, western Montana, western Wyoming, and western Colorado, stands typically occur on mountain ridges and flanks and broad terraces, ranging from 1000 to 3000 m in elevation with stands extending to 3800 m elevation in subalpine and alpine habitats of the Sierra Nevada. Substrates are shallow, fine-textured soils, poorly drained clays, shallow-soiled areas, almost always very stony, characterized by recent rhyolite or basalt or are alkaline soils derived from shale (Zamora and Tueller 1973, Baker and Kennedy 1985). In central and southern Wyoming, typical sites are very windy, gently rolling hills and long, gently sloping pediments and fans with shallow, often rocky soils where this group forms the matrix vegetation and large patches on the margins of high-elevation basins. In higher elevation areas, it forms a mosaic with Intermountain Mountain Big Sagebrush Steppe & Shrubland Group (G304) and is restricted to wind-blown ridges. In the Colorado Plateau, Tavaputs Plateau and Uinta Basin, stands occur in canyons, gravelly draws, hilltops, and dry flats at elevations generally below 1800 m. Soils are often rocky, shallow, and alkaline. This group also extends across northern New Mexico and Wyoming into the western Great Plains on limestone hills and shale outcrops.

DISTRIBUTION

Geographic Range: This broadly defined semi-arid dwarf-shrubland and steppe group occurs throughout much of the intermountain western U.S.

Spatial Scale & Pattern [optional]: Large patch

Nations: US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WY

TNC Ecoregions [optional]: 6:C, 8:C, 9:C, 10:C, 11:C, 12:P, 17:P, 18:C, 19:C, 20:C, 21:P, 26:C, 27:C, 28:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313D:CC, 315A:C?, 315B:CC, 315H:CC, 321A:CC, 331A:CC, 331B:CC, 331F:CC, 331G:CC, 331K:CP, 331L:C?, 331N:CP, 341A:CC, 341B:CC, 341C:CC, 341E:CP, 341G:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CP, 342F:CC, 342G:CC, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M242D:CC, M261D:CC, M261G:CC, M313A:CC, M313B:CC, M331A:C?, M331B:CC, M331D:CC, M331E:CC, M331F:CP, M331G:CC, M331H:CC, M331I:CC, M332A:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:??, M341A:CC, M341B:CC, M341C:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate. USNVC Confidence from peer reviewer, not AE. This is a very broad group and further review may suggest splitting into two or three groups.

SYNONYMY

- = Great Basin-Colorado Plateau sagebrush semi-desert (West 1983a)

LOWER LEVEL UNITS

Alliances:

- A3221 *Artemisia arbuscula ssp. longiloba* Steppe & Shrubland Alliance
- A3223 *Artemisia bigelovii* Steppe & Shrubland Alliance
- A3222 *Artemisia nova* Steppe & Shrubland Alliance
- A2548 *Artemisia arbuscula ssp. longicaulis* Shrubland Alliance
- A3219 *Artemisia arbuscula ssp. arbuscula* Steppe & Shrubland Alliance
- A2565 *Artemisia frigida* Dwarf-shrubland Alliance
- A4122 *Artemisia arbuscula ssp. thermopola - Artemisia papposa / Festuca idahoensis* Steppe & Shrubland Alliance

AUTHORSHIP

Primary Concept Source: N.E. West (1983a)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 11/06/2015

Classif Resp Region: West

Internal Author: KAS 3-10, 11-15

REFERENCES

References: Baker and Kennedy 1985, Beetle and Johnson 1982, Brown 1982a, Brown et al. 1979, Dick-Peddie 1993, Faber-Langendoen et al. 2017a, Francis 1986, Jones 1992b, Knight 1994, Knight et al. 1987, Shiflet 1994, West 1983a, West 1983c, Zamora and Tueller 1973

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G308. Intermountain Low & Black Sagebrush Steppe & Shrubland

A3219. *Artemisia arbuscula ssp. arbuscula* Steppe & Shrubland Alliance

Type Concept Sentence: Shrublands dominated by *Artemisia arbuscula ssp. arbuscula* often in association with *Artemisia tridentata*. This widespread alliance is known from cold, dry areas of the Intermountain West, as well as in dry alpine and subalpine habitats of the Sierra Nevada.

OVERVIEW

Scientific Name: *Artemisia arbuscula ssp. arbuscula* Steppe & Shrubland Alliance

Common Name (Translated Scientific Name): Little Sagebrush Steppe & Shrubland Alliance

Colloquial Name: Little Sagebrush Steppe & Shrubland

Type Concept: Structurally, this alliance may be shrub-herbaceous or shrub-dominated. The woody layer consists mainly of the low shrub *Artemisia arbuscula ssp. arbuscula*, although *Artemisia tridentata ssp. vaseyana* or *Artemisia tridentata ssp. wyomingensis* may codominate some stands. Other shrub associates may include *Artemisia nova*, *Chrysothamnus spp.*, *Ephedra viridis*, *Gutierrezia sarothrae*, *Juniperus occidentalis*, *Juniperus osteosperma*, *Purshia tridentata*, and *Tetradymia canescens*. Perennial grasses dominate the understory which may be sparse to very dense. Dominant to common grass species include *Achnatherum thurberianum* (= *Stipa thurberiana*), *Festuca idahoensis*, *Leymus salinus ssp. salmonis*, *Pascopyrum smithii*, *Poa secunda*, *Pseudoroegneria spicata*, and *Elymus elymoides* (in areas in poor condition). *Agoseris glauca*, *Allium spp.*, *Antennaria rosea*, *Balsamorhiza sagittata*, *Castilleja angustifolia*, *Phlox hoodii*, and *Phlox longifolia* are common forb species. This widespread alliance is known from cold, dry areas of

the Intermountain West, as well as in dry alpine and subalpine habitats of the Sierra Nevada. Stands typically occur on shallow, rocky, poorly drained soils on a variety of landforms, from flats and depressions to slopes, ridges or alpine fell-fields. Soils are usually shallow, rocky clays, often with an impenetrable layer at less than 60 cm depth. Poor drainage often leads to perched water tables in the spring, which may control the distribution of the vegetation in this alliance and explain its patchy distribution.

Classification Comments: This widespread alliance is poorly documented in northern Nevada, and additional fieldwork is needed there.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: This alliance occurs throughout the Intermountain West. Diagnostic of this alliance is the *Artemisia arbuscula* ssp. *arbuscula*-dominated low-shrub layer (or codominated with >40% relative shrub cover). Graminoids dominate the understory and cover may be open to very dense.

VEGETATION

Physiognomy and Structure: This alliance is characterized by a sparse to moderate microphyllous evergreen dwarf-shrub canopy (0.1-0.4 m in height). Cespitose graminoids dominate the understory with cover ranging from 10-70% and 0.3-1.0 m tall.

Floristics: Structurally, these communities may be shrub- or shrub-herbaceous-dominated. The woody layer consists mainly of the low shrub *Artemisia arbuscula* ssp. *arbuscula*, although *Artemisia tridentata* ssp. *vaseyana* or *Artemisia tridentata* ssp. *wyomingensis* may codominate some stands. Other shrub associates may include *Artemisia nova*, *Chrysothamnus* spp., *Ephedra viridis*, *Gutierrezia sarothrae*, *Juniperus occidentalis*, *Juniperus osteosperma*, *Purshia tridentata*, and *Tetradymia canescens*. The understory vegetation is characterized by a moderate to dense herbaceous layer dominated by perennial graminoids with sparse to dense cover ranging from 10-70%. Dominant to common grass species include *Achnatherum thurberianum* (= *Stipa thurberiana*), *Danthonia californica*, *Festuca idahoensis*, *Leymus salinus* ssp. *salmonis*, *Pascopyrum smithii*, *Poa secunda*, *Pseudoroegneria spicata*, and *Elymus elymoides* (in areas in poor condition). Other grass species may include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Bromus carinatus*, *Danthonia unispicata*, *Hesperostipa comata* (= *Stipa comata*), *Koeleria macrantha*, and *Leymus ambiguus*. Forbs are generally much less important, but occasionally frequent. Common species include *Achillea millefolium*, *Agoseris glauca*, *Allium* spp., *Antennaria rosea*, *Balsamorhiza sagittata*, *Castilleja angustifolia*, *Lupinus caespitosus*, *Penstemon speciosus*, *Phlox hoodii*, *Phlox longifolia*, *Polygonum* spp., and *Stenotus acaulis* (= *Haplopappus acaulis*).

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance is widespread in the Intermountain West, as well as in dry alpine habitats of the Sierra Nevada between 1500 and 3800 m in elevation. Precipitation ranges from 15-50(150) cm annually, with a large proportion falling as winter snow. Sawyer and Keeler-Wolf (1995) report *Artemisia arbuscula* shrublands to be associated with flats, depressions, slopes, and ridges, and that soils are either very shallow or quite poorly drained. Soils are usually shallow, rocky clays, often with an impenetrable layer at less than 60 cm depth. Beetle and Johnson (1982) report that *Artemisia arbuscula* ssp. *arbuscula* grows in soils with a high volume of gravel (even though soil may be in clay textural class, or contain a clay-rich layer that impedes drainage). Poor drainage often leads to elevated water tables in the spring, which may control the distribution of the vegetation in this alliance. Poor drainage may explain the occurrence of patches of *Artemisia arbuscula* shrublands in *Pinus ponderosa* woodlands or *Artemisia tridentata* shrublands. In alpine settings, the vegetation often occurs in xeric sites where snow cover is blown off or lost to sublimation.

Dynamics: Due to the low-shrub stature of *Artemisia arbuscula*, this dwarf-shrubland alliance is less susceptible to natural fire than taller *Artemisia* spp. shrublands. Grazing appears to have little effect on shrub densities, but tends to decrease the importance of tall bunch grasses and increase the cover of *Chrysothamnus* spp., forbs, and non-native grasses (*Poa bulbosa* and *Poa pratensis*). Heavy livestock grazing may deplete the perennial graminoid layer and convert stands that are shrub-herbaceous in structure to those which are strictly shrub-dominated.

DISTRIBUTION

Geographic Range: The vegetation in this alliance is presently reported from much of the Intermountain West as far west as California and Washington and south to Colorado.

Nations: US

States/Provinces: CA, CO, ID, MT, NM?, NV, OR, UT?, WA, WY

TNC Ecoregions [optional]: 4:C, 5:C, 6:C, 11:C, 12:C, 14:C

USFS Ecoregions (2007): 341D:CC, 341Fc:CCC, 341Ff:CCC, 342B:CC, M261A:CC, M261B:CC, M261D:CC, M261E:CC, M261G:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Great Basin)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Artemisia arbuscula ssp. arbuscula* (Little sagebrush scrub) Alliance (Sawyer et al. 2009) [35.120.00]
- = *Artemisia arbuscula ssp. arbuscula* Shrubland Alliance (Evens et al. 2014)
- = *Artemisia arbuscula ssp. arbuscula* Shrubland Alliance (CNPS 2017) [35.120.00]
- >< Low Sagebrush Series (Sawyer and Keeler-Wolf 1995)
- < SRM Cover Type #406 - Low Sagebrush (Shiflet 1994)
- >< Subalpine Sagebrush Scrub (#35220) (Holland 1986b)
- >< White Mountain Fell-Field (#91140) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEG002983 *Artemisia arbuscula ssp. arbuscula* - *Artemisia tridentata ssp. wyomingensis* / *Festuca idahoensis* Shrubland
- CEG003482 *Artemisia arbuscula ssp. arbuscula* / *Linanthus pungens* Shrubland
- CEG003483 *Artemisia arbuscula ssp. arbuscula* / *Eriogonum microthecum* Shrubland
- CEG001412 *Artemisia arbuscula ssp. arbuscula* / *Pseudoroegneria spicata* Shrub Grassland
- CEG001409 *Artemisia arbuscula ssp. arbuscula* / *Festuca idahoensis* Shrub Grassland
- CEG001518 *Artemisia arbuscula ssp. arbuscula* - *Purshia tridentata* / *Pseudoroegneria spicata* - *Festuca idahoensis* Shrub Grassland
- CEG001411 *Artemisia arbuscula ssp. arbuscula* / *Poa secunda* Shrub Grassland
- CEG002982 *Artemisia arbuscula ssp. arbuscula* - *Artemisia tridentata ssp. vaseyana* / *Festuca idahoensis* Shrubland
- CEG001413 *Artemisia arbuscula ssp. arbuscula* / *Achnatherum thurberianum* Shrub Grassland
- CEG005473 *Artemisia arbuscula ssp. arbuscula* / *Hesperostipa comata* Shrubland
- CEG001410 *Artemisia arbuscula ssp. arbuscula* / *Leymus salinus ssp. salmonis* Shrub Grassland

AUTHORSHIP

Primary Concept Source: D. Sarr, C. Jean, J. Kagan, P. Lyon, E. Peterson, K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Beetle and Johnson 1982, CNPS 2017, Cheng 2004, Evens et al. 2014, Faber-Langendoen et al. 2017b, Holland 1986b, Keeler-Wolf et al. 2003a, Major and Taylor 1977, Murray 1991, Sawyer and Keeler-Wolf 1995, Sawyer and Keeler-Wolf 2007, Sawyer et al. 2009, Shiflet 1994, Smith 1998b, Steinberg 2002a, Stillman 1980, Tisdale 1994b, West 1988, Young et al. 1977, Young et al. 2007b, Zamora and Tueller 1973

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G308. Intermountain Low & Black Sagebrush Steppe & Shrubland

A2548. *Artemisia arbuscula ssp. longicaulis* Shrubland Alliance

Type Concept Sentence: This shrubland alliance is dominated by a low-shrub layer of *Artemisia arbuscula ssp. longicaulis* and is known from cold, dry areas of the Intermountain West, in and around the Lahontan Basin of northwestern Nevada, southeastern Oregon, and northeastern California.

OVERVIEW

Scientific Name: *Artemisia arbuscula ssp. longicaulis* Shrubland Alliance

Common Name (Translated Scientific Name): Lahontan Sagebrush Shrubland Alliance

Colloquial Name: Lahontan Sagebrush Shrubland

Type Concept: The vegetation included in this shrubland alliance is dominated by a low-shrub layer that averages more than 5% cover of *Artemisia arbuscula ssp. longicaulis*. Little is known about this alliance, but shrub associates could presumably include *Artemisia arbuscula ssp. arbuscula*, *Artemisia tridentata ssp. wyomingensis*, *Atriplex confertifolia*, *Chrysothamnus* spp., *Ephedra* spp., *Ericameria* spp., *Grayia spinosa*, *Lycium shockleyi*, *Picrothamnus desertorum*, *Sarcobatus vermiculatus* (= var. *baileyi*), and *Tetradymia* spp. The herbaceous layer is typically sparse, and perennial bunchgrasses may include *Achnatherum hymenoides*, *Achnatherum speciosum* (= *Stipa speciosa*), *Achnatherum thurberianum* (= *Stipa thurberiana*), *Elymus elymoides*, and *Poa secunda*.

Forb cover is likely sparse. This alliance is known from cold, dry areas of the Intermountain West, in and around the Lahontan Basin of northwestern Nevada, southeastern Oregon, and northeastern California. Stands occur on alluvial fans, upland slopes and ridges. Soils are generally shallow and rocky.

Classification Comments: More survey and classification work are needed to fully describe this alliance. The information for this alliance comes entirely from the description of the subspecies (Winward and McArthur 1995) and is very brief. They provide the range of the subspecies, a number of frequent associates, and state that it often occurs in pure stands.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Diagnostic of this alliance is the *Artemisia arbuscula ssp. longicaulis*-dominated shrub layer that has over 5% cover of the nominal species that contributes at least 40% of the total shrub cover.

VEGETATION

Physiognomy and Structure: This alliance is characterized by a sparse to moderately dense microphyllous evergreen dwarf-shrub canopy (0.1-0.4 m in height). Cespitose graminoids dominate the sparse understory.

Floristics: The vegetation included in this alliance is dominated by a low-shrub layer that averages more than 5% cover of *Artemisia arbuscula ssp. longicaulis*. Shrub associates could presumably include *Artemisia arbuscula ssp. arbuscula*, *Artemisia tridentata ssp. wyomingensis*, *Atriplex confertifolia*, *Chrysothamnus* spp., *Ephedra* spp., *Ericameria* spp., *Grayia spinosa*, *Lycium shockleyi*, *Picrothamnus desertorum*, *Sarcobatus vermiculatus* (= var. *baileyi*), and *Tetradymia* spp. The herbaceous layer is likely sparse, and the perennial bunchgrasses may include *Achnatherum hymenoides*, *Achnatherum speciosum* (= *Stipa speciosa*), *Achnatherum thurberianum* (= *Stipa thurberiana*), *Elymus elymoides*, and *Poa secunda*. Forb cover is typically sparse.

ENVIRONMENT & DYNAMICS

Environmental Description: This shrubland alliance is known from cold, dry areas of the Intermountain West. Stands typically occur on alluvial fans, upland slopes and ridges from 1000-2000 m elevation. Precipitation ranges from 17-35 cm annually, with a large proportion falling as winter snow. The range of the subspecies corresponds strongly to the pluvial Lake Lahontan. *Artemisia arbuscula ssp. longicaulis* occurs primarily on Aridisols and Mollisols that are generally shallow and rocky.

Dynamics: Heavy grazing by livestock and other ground disturbance may increase the abundance of introduced annual grasses. Burning may result in conversion to a *Bromus tectorum* annual grassland.

DISTRIBUTION

Geographic Range: The diagnostic taxon for this alliance is known to occur in and around the Lahontan Basin in northwestern Nevada, southeastern Oregon, and northeastern California. The subspecies likely dominates the vegetation, forming this alliance, in all three states.

Nations: US

States/Provinces: CA, NV, OR

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- ? *Artemisia arbuscula ssp. longicaulis* (Lahontan sagebrush scrub) Provisional Alliance (Sawyer et al. 2009) [35.121.00]
- < SRM Cover Type #406 - Low Sagebrush (Shiflet 1994)

LOWER LEVEL UNITS

Associations:

- CEG002986 *Artemisia arbuscula ssp. longicaulis* / *Elymus elymoides* Shrubland
- CEG002984 *Artemisia arbuscula ssp. longicaulis* - *Grayia spinosa* Shrubland

AUTHORSHIP

Primary Concept Source: A.H. Winward and E.D. McArthur (1995)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Faber-Langendoen et al. 2017b, Sawyer et al. 2009, Shiflet 1994, Winward and McArthur 1995

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G308. Intermountain Low & Black Sagebrush Steppe & Shrubland

A3221. *Artemisia arbuscula* ssp. *longiloba* Steppe & Shrubland Alliance

Type Concept Sentence: *Artemisia arbuscula* ssp. *longiloba* is dominant in the shrub canopy and is widespread in the Intermountain West, the southern Rocky Mountains, and in the western Great Plains.

OVERVIEW

Scientific Name: *Artemisia arbuscula* ssp. *longiloba* Steppe & Shrubland Alliance

Common Name (Translated Scientific Name): Alkali Sagebrush Steppe & Shrubland Alliance

Colloquial Name: Alkali Sagebrush Steppe & Shrubland

Type Concept: This shrub-herbaceous alliance occurs in the Intermountain West, into the southern Rocky Mountains and in the western Great Plains. The structure of these stands may be shrub-herbaceous or shrub-dominated. The shrub layer may be sparse to open and dominated by the low shrub *Artemisia arbuscula* ssp. *longiloba*. Shrub associates include *Artemisia nova*, *Artemisia tridentata* ssp. *vaseyana*, *Artemisia tridentata* ssp. *wyomingensis*, *Artemisia tripartita*, *Chrysothamnus viscidiflorus*, *Gutierrezia sarothrae*, and *Purshia tridentata*. Perennial grasses are dominant in the understory and may have sparse to very dense cover where they are more prominent than shrubs. Dominant to common grass species include *Danthonia parryi*, *Elymus lanceolatus*, *Festuca idahoensis*, *Festuca thurberi*, *Pascopyrum smithii*, *Poa secunda*, and *Pseudoroegneria spicata*. Other perennial grasses that may be present include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Elymus elymoides*, *Hesperostipa comata* (= *Stipa comata*), and *Koeleria macrantha*. Forb cover is typically minor. Stands occur on a variety of landforms, from flats and depressions to slopes and ridges. Soils are generally characterized by a heavy clay subsoil occurring within 25 cm of the soil surface, which restricts rooting depth. Soils are also alkaline and calcareous. Diagnostic of this alliance is a moderate (>20% cover) perennial graminoid layer with an *Artemisia arbuscula* ssp. *longiloba*-dominated low-shrub layer that has 10-40% cover. At least 40% of the total shrub cover is *Artemisia arbuscula* ssp. *arbuscula*.

Classification Comments: Stands included in this alliance occur in environments (climate or substrates) that limit the growth of perennial graminoids or may be the result of heavy livestock grazing depleting the perennial graminoid layer of stands of shrub-herbaceous vegetation. The range of this association is currently restricted to Nevada. More survey and classification work are needed to fully describe the range of this alliance.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Diagnostic of this alliance is the *Artemisia arbuscula* ssp. *longiloba*-dominated low-shrub layer (or codominated with >40% relative shrub cover of the nominal species).

VEGETATION

Physiognomy and Structure: This alliance is characterized by a sparse to moderate microphyllous evergreen dwarf-shrub canopy (0.1-0.4 m in height). Cespitose graminoids dominate the understory with cover ranging from 10-70% and 0.3-1.0 m tall.

Floristics: The structure of these stands may be shrub-herbaceous or shrub-dominated. The shrub layer may be sparse to open (10-40% cover) and dominated by the low shrub *Artemisia arbuscula* ssp. *longiloba*. Shrub associates include *Artemisia nova*, *Artemisia tridentata* ssp. *vaseyana*, *Artemisia tridentata* ssp. *wyomingensis*, *Artemisia tripartita*, *Chrysothamnus viscidiflorus*, *Gutierrezia sarothrae*, and *Purshia tridentata*. Perennial grasses are dominant in the understory and may have sparse to very dense cover where they are more prominent than shrubs. Dominant to common grass species include *Danthonia parryi*, *Elymus lanceolatus*, *Festuca idahoensis*, *Festuca thurberi*, *Pascopyrum smithii*, *Poa secunda*, and *Pseudoroegneria spicata*. Other perennial grasses that may be present include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Elymus elymoides*, *Hesperostipa comata* (= *Stipa comata*), and *Koeleria macrantha*. Forb cover is typically minor.

ENVIRONMENT & DYNAMICS

Environmental Description: This shrub-herbaceous alliance occurs in the Intermountain West, into the southern Rocky Mountains and in the western Great Plains from 1600-3200 m (5500-10,600 feet) elevation. Stands occur on a variety of landforms, from flats and depressions to slopes and ridges. Soils are generally characterized by a heavy clay subsoil occurring within 25 cm of the soil surface, which restricts rooting depth. Soils are also alkaline and calcareous. Beetle and Johnson (1982) report that *Artemisia arbuscula ssp. arbuscula* grows in soils with a high volume of gravel (even though soil may be in clay textural class, or contain a clay-rich layer that impedes drainage), and that *Artemisia arbuscula ssp. longiloba* grows in clay soils, often alkaline, that contain no gravels.

Dynamics: Due to the low-shrub stature of *Artemisia arbuscula ssp. longiloba*, this shrubland alliance is less susceptible to natural fire than taller *Artemisia* spp. shrublands. Grazing appears to have little effect on shrub densities, but tends to decrease the importance of tall bunch grasses and increase the cover of *Arenaria congesta* (Johnston 2001). Heavy livestock grazing may deplete the perennial graminoid layer and convert stands that are shrub-herbaceous in structure to those that are strictly shrub-dominated.

DISTRIBUTION

Geographic Range: This alliance is widespread in the western United States, occurring from the Intermountain West, into the southern Rocky Mountains and the western Great Plains.

Nations: US

States/Provinces: CO, ID, MT, NV, OR, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- < SRM Cover Type #406 - Low Sagebrush (Shiflet 1994)

LOWER LEVEL UNITS**Associations:**

- CEGLO01416 *Artemisia arbuscula ssp. longiloba* / *Pseudoroegneria spicata* Shrub Grassland
- CEGLO01415 *Artemisia arbuscula ssp. longiloba* / *Pascopyrum smithii* Shrub Grassland
- CEGLO01414 *Artemisia arbuscula ssp. longiloba* Shrubland
- CEGLO05997 *Artemisia arbuscula ssp. longiloba* / *Poa fendleriana* Shrubland
- CEGLO01522 *Artemisia arbuscula ssp. longiloba* / *Festuca idahoensis* Shrub Grassland
- CEGLO02585 *Artemisia arbuscula ssp. longiloba* / *Elymus lanceolatus* Shrubland
- CEGLO05996 *Artemisia arbuscula ssp. longiloba* / Cushion Plants Shrubland
- CEGLO01523 *Artemisia arbuscula ssp. longiloba* / *Poa secunda* Shrub Grassland

AUTHORSHIP

Primary Concept Source: C. Jean, J. Kagan, P. Lyon, E. Peterson, K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Beetle and Johnson 1982, Faber-Langendoen et al. 2017b, Johnston 2001, Shiflet 1994

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G308. Intermountain Low & Black Sagebrush Steppe & Shrubland

A4122. *Artemisia arbuscula ssp. thermopola* - *Artemisia papposa* / *Festuca idahoensis* Steppe & Shrubland Alliance [Low - Poorly Documented]

Type Concept Sentence:

OVERVIEW

Scientific Name: *Artemisia arbuscula ssp. thermopola* - *Artemisia papposa* / *Festuca idahoensis* Steppe & Shrubland Alliance

Common Name (Translated Scientific Name): Thermopola Little Sagebrush - Owyhee Sage / Idaho Fescue Steppe & Shrubland Alliance

Colloquial Name: Thermopola Little Sagebrush - Owyhee Sage / Idaho Fescue Steppe & Shrubland

Type Concept:

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure:

Floristics:

ENVIRONMENT & DYNAMICS

Environmental Description:

Dynamics:

DISTRIBUTION

Geographic Range:

Nations: US

States/Provinces: ID, NV?, OR, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEG002991 *Artemisia papposa* / *Danthonia californica* - *Festuca idahoensis* Shrubland
- CEG001540 *Artemisia tripartita* ssp. *rupicola* / *Festuca idahoensis* Shrub Grassland
- CEG001519 *Artemisia arbuscula* ssp. *thermopola* / *Festuca idahoensis* Shrub Grassland

AUTHORSHIP

Primary Concept Source: M.S. Reid

Author of Description:

Acknowledgments:

REFERENCES

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G308. Intermountain Low & Black Sagebrush Steppe & Shrubland

A3223. *Artemisia bigelovii* Steppe & Shrubland Alliance

Type Concept Sentence: Shrub and shrub-herbaceous vegetation dominated by *Artemisia bigelovii* occurring in the Tularosa Basin of southern New Mexico and the Colorado Plateau in southwestern Utah and northern Arizona and near canyon rims and along escarpments in southeastern Colorado.

OVERVIEW

Scientific Name: *Artemisia bigelovii* Steppe & Shrubland Alliance

Common Name (Translated Scientific Name): Bigelow's Sagebrush Steppe & Shrubland Alliance

Colloquial Name: Bigelow's Sagebrush Steppe & Shrubland

Type Concept: The structure of this vegetation may be shrub-herbaceous or shrub-dominated. The shrub layer is characterized by a sparse to moderately dense dwarf-shrub layer that is dominated or codominated by *Artemisia bigelovii*. Dwarf-shrub associates from the shortgrass steppe include *Frankenia jamesii*, *Glossopetalon spinescens* var. *meionandrum*, *Krascheninnikovia lanata*, and *Yucca glauca*, which may be present to codominant. On the Colorado Plateau, stands may be codominated by *Ephedra* spp., *Eriogonum corymbosum*, *Parryella filifolia*, or *Purshia stansburiana*. *Gutierrezia sarothrae* and species of *Atriplex* are common in most stands. Scattered *Juniperus* spp. and *Pinus edulis* trees are occasionally present. A sparse to dense graminoid layer is usually present. Dominant grasses include *Aristida purpurea*, *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Bouteloua gracilis*, *Hesperostipa neomexicana* (= *Stipa neomexicana*), *Pleuraphis jamesii* (= *Hilaria jamesii*), *Sporobolus cryptandrus*, or less commonly *Pascopyrum smithii*. On the Colorado Plateau, forbs are generally sparse. However, cushion plants are common on shortgrass steppe slopes. Other forbs, such as *Astragalus missouriensis*, *Heterotheca villosa*, *Melampodium cinereum*, *Picradeniopsis oppositifolia*, *Stanleya pinnata*, and *Zinnia grandiflora*, may be present. Exotic annuals, such as *Bromus arvensis* (= *Bromus japonicus*), *Bromus tectorum*, *Descurainia sophia*, and *Salsola kali*, may be present to common depending on disturbance and the amount of seasonal precipitation. This alliance is reported from the Tularosa Basin of southern New Mexico and the Colorado Plateau in southwestern Utah and northern Arizona and near canyon rims and along escarpments in southeastern Colorado. Sites include gentle to moderately steep shale hillslopes and mesas in Arizona and Utah and escarpment and canyon breaks and shaly plains in the shortgrass steppe west to the foothills near the Colorado Front Range. Soils are typically shallow, well-drained, calcareous loams, clay loams, and clays derived from limestone, sandstone, shale and alluvium. The soil surface has high cover of bare soil and rock.

Classification Comments: The vegetation in some stands included in this alliance may be too sparse to be classified as dwarf-shrubland.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has sparse to moderately dense cover of microphyllous evergreen dwarf-shrubs less than 0.5 m tall. A sparse to dense graminoid layer dominated by perennial medium-tall bunch grasses and short grasses is also present and may be more prominent than the shrubs. Forb cover is generally sparse. Scattered scale-leaved and needle-leaved evergreen trees may be present.

Floristics: The vegetation is characterized by a sparse to moderately dense dwarf-shrub layer that is dominated or codominated by *Artemisia bigelovii*. Dwarf-shrub associates for the shortgrass steppe include *Frankenia jamesii*, *Glossopetalon spinescens* var. *meionandrum*, *Krascheninnikovia lanata*, and *Yucca glauca*, which may be present to codominant. Scattered shrubs such as *Atriplex canescens*, *Cercocarpus montanus*, *Ericameria nauseosa* (= *Chrysothamnus nauseosus*), *Lycium pallidum*, and *Rhus trilobata* are occasionally present. On the Colorado Plateau, stands may be codominated by *Atriplex confertifolia*, *Ephedra* spp., *Eriogonum corymbosum*, *Opuntia polyacantha* var. *polyacantha*, *Cylindropuntia whipplei* (= *Opuntia whipplei*), *Parryella filifolia*, or *Purshia stansburiana*. *Gutierrezia sarothrae* and species of *Atriplex* and *Yucca* are common in most stands. Scattered *Juniperus* spp. and *Pinus edulis* trees are occasionally present. A sparse to dense graminoid layer is usually present and may take prominence over shrubs. Dominant grasses include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Aristida purpurea*, *Bouteloua gracilis*, *Hesperostipa neomexicana* (= *Stipa neomexicana*), *Muhlenbergia torreyi*, *Pascopyrum smithii*, *Pleuraphis jamesii* (= *Hilaria jamesii*), *Poa fendleriana*, *Sporobolus airoides*, and *Sporobolus cryptandrus*. On the Colorado Plateau, forbs are generally sparse. However, on shortgrass steppe slopes, cushion plants such as *Arenaria hookeri*, *Eriogonum lachnogynum*, *Tetranneuris acaulis* (= *Hymenoxys acaulis*), and *Paronychia sessiliflora* are common. Other forbs, such as *Astragalus missouriensis*, *Heterotheca villosa*, *Melampodium cinereum*, *Picradeniopsis oppositifolia*, *Stanleya pinnata*, and *Zinnia grandiflora*, are usually present. Exotic annuals, such as *Bromus arvensis* (= *Bromus japonicus*), *Bromus tectorum*, *Salsola kali*, and *Descurainia sophia*, may be present to common depending on disturbance, and amount and season of precipitation.

ENVIRONMENT & DYNAMICS

Environmental Description: Elevation ranges from 1350-1890 m. Climate is semi-arid with 22-35 cm of mean annual precipitation occurring during the growing season. Sites are nearly flat to moderate and include shale hillslopes and mesas in Arizona and breaks

and shale plains in the shortgrass steppe west to the foothills near the Colorado Front Range. Soils are typically shallow, well-drained, calcareous loams, clay loams, and clays derived from limestone, sandstone, shale and alluvium. The soil surface has high cover of bare soil and rock.

Dynamics: Livestock grazing must be managed carefully to prevent the loss of highly palatable grasses such as *Schizachyrium scoparium*, *Bouteloua curtipendula*, *Hesperostipa neomexicana*, and *Achnatherum hymenoides*. The effects of fire on this vegetation are unknown. However, the vegetation is usually too sparse to carry a fire under most circumstances.

DISTRIBUTION

Geographic Range: Stands included in this shrubland alliance are found in Arizona, western Colorado and Utah on the Colorado Plateau and in southeastern Colorado.

Nations: US

States/Provinces: AZ, CO, NM, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- >< *Artemisia bigelovii*/*Bouteloua gracilis* Plant Community (Shaw et al. 1989)
- >< Limestone Breaks SCS Range Site #58 (Soil Conservation Service n.d.)
- < SRM Cover Type #408 - Other Sagebrush Types (Shiflet 1994)
- >< Sandstone Breaks SCS Range Site #53 (Soil Conservation Service n.d.)
- >< Shaley Plains SCS Range Site (Soil Conservation Service n.d.)

LOWER LEVEL UNITS

Associations:

- CEGLO00276 *Artemisia bigelovii* Shrubland
- CEGLO00990 *Artemisia bigelovii* / *Achnatherum hymenoides* Shrubland
- CEGLO01742 *Artemisia bigelovii* / *Bouteloua gracilis* Dwarf-shrub Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Faber-Langendoen et al. 2017b, Shaw et al. 1989, Shiflet 1994, Soil Conservation Service 1978, Soil Conservation Service n.d.

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G308. Intermountain Low & Black Sagebrush Steppe & Shrubland

A2565. *Artemisia frigida* Dwarf-shrubland Alliance

Type Concept Sentence: This shrubland alliance is dominated by the dwarf-shrub *Artemisia frigida* and is described from the Colorado Plateau and western slope of the southern Rocky Mountains.

OVERVIEW

Scientific Name: *Artemisia frigida* Dwarf-shrubland Alliance

Common Name (Translated Scientific Name): Prairie Sagewort Dwarf-shrubland Alliance

Colloquial Name: Prairie Sagewort Dwarf-shrubland

Type Concept: This shrubland alliance is dominated by the dwarf-shrub *Artemisia frigida*. Total shrub cover ranges from 5-85%. Other common shrubs and dwarf-shrubs include *Artemisia nova*, *Chrysothamnus viscidiflorus*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Tetradymia canescens*, and the cactus *Pediocactus simpsonii*. The understory is dominated by perennial graminoids, including *Achnatherum hymenoides*, *Bouteloua gracilis*, and *Poa secunda*. Other herbaceous species often include low-

growing cushion plants. Other herbaceous associates may include *Festuca brachyphylla*, *Hymenoxys richardsonii*, *Paronychia sessiliflora*, *Penstemon strictus*, *Poa fendleriana*, *Stenotus armerioides*, *Pleiacanthus spinosus* (= *Lygodesmia spinosa*), and *Tetraneuris torreyana*. Cryptogamic cover varies from low to moderate and is occasionally as high as 55%, mostly composed of crustose and foliose lichens. This alliance is described from the Colorado Plateau and western slope of the southern Rocky Mountains. Stands occur on mid to upper slopes and tops of mesas, hills and ridges, but also midslopes of mountains, active slopes and on valley terraces. Site are flat to moderately steep (to 53% slope) on all aspects between 2315 and 2965 m elevation.

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Shrublands of the Colorado Plateau and western slope of the southern Rocky Mountains in which *Artemisia frigida* is dominant and has >50% of the total shrub cover, typically found on exposed, wind-blown sites. The other characteristic species are perennial graminoids.

VEGETATION

Physiognomy and Structure: This alliance is characterized by a sparse to moderate cover of a suffrutescent plant that occurs as both a dwarf-shrub and forb. Cespitose graminoids dominate the understory.

Floristics: Vegetation is dominated by the suffrutescent dwarf-shrub *Artemisia frigida*. Total shrub cover ranges from 5-85%. Other common shrubs and dwarf-shrubs include *Artemisia nova*, *Chrysothamnus viscidiflorus*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Tetradymia canescens*, and the cactus *Pediocactus simpsonii*. The understory is dominated by perennial graminoids, including *Achnatherum hymenoides*, *Bouteloua gracilis*, and *Poa secunda*. Other herbaceous species often include low-growing cushion plants. Other herbaceous associates may include *Festuca brachyphylla*, *Hymenoxys richardsonii*, *Paronychia sessiliflora*, *Penstemon strictus*, *Poa fendleriana*, *Stenotus armerioides*, *Pleiacanthus spinosus* (= *Lygodesmia spinosa*), and *Tetraneuris torreyana*. Cryptogamic cover varies from low to moderate and is occasionally as high as 55%, mostly composed of crustose and foliose lichens.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands occur on mid to upper slopes and tops of mesas, hills and ridges, but also midslopes of mountains, active slopes and on valley terraces. Site are flat to moderately steep (to 53% slope) on all aspects between 2315 and 2965 m elevation. Various amounts of bedrock, large and small rocks, and bare soil compose the majority of the ground surface, with sparse to low cover of litter. Parent materials are frequently volcanic (basalt) rocks that are present as bedrock, boulders and gravel, Mesozoic shale, and Quaternary landslide deposits. Soils are shallow, rapidly drained and range from coarse sand and sandy loam to sandy clay loam and sandy clay.

Dynamics: Dry, windswept conditions appear to be important for this alliance.

DISTRIBUTION

Geographic Range: This shrubland is described from the Colorado Plateau and western slope of the southern Rocky Mountains.

Nations: US

States/Provinces: CO, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEGLO02344 *Artemisia frigida* - (*Bouteloua gracilis*, *Achnatherum hymenoides*, *Poa secunda*) - Lichens Rocky Mesa Dwarf-shrubland

AUTHORSHIP

Primary Concept Source: G. Kittel and K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall**Acknowledgments:****Version Date:** 2014/03/14**REFERENCES****References:** Faber-Langendoen et al. 2017b

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G308. Intermountain Low & Black Sagebrush Steppe & Shrubland

A3222. Artemisia nova Steppe & Shrubland Alliance**Type Concept Sentence:** Associations within this alliance are dominated by *Artemisia nova* and occur at intermediate elevations (1400-2500 m) in the Intermountain West and Rocky Mountains.**OVERVIEW****Scientific Name:** *Artemisia nova* Steppe & Shrubland Alliance**Common Name (Translated Scientific Name):** Black Sagebrush Steppe & Shrubland Alliance**Colloquial Name:** Black Sagebrush Steppe & Shrubland

Type Concept: Structurally, this alliance may occur as shrub-herbaceous or shrub-dominated vegetation. The shrub layer is characterized by the dominance of the dwarf-shrub *Artemisia nova*, which may have sparse to moderate cover of 10-60%. Associated shrub species that occur in stands of this alliance include *Artemisia arbuscula*, *Artemisia cana*, *Artemisia tridentata*, *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Grayia spinosa*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Purshia tridentata*, and *Symphoricarpos oreophilus*. The ground layer is dominated by perennial bunchgrasses which may exceed the height and cover of shrubs, ranging from sparse to dense cover. Recurrent species include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Achnatherum speciosum* (= *Stipa speciosa*), *Achnatherum thurberianum* (= *Stipa thurberiana*), *Elymus elymoides*, *Hesperostipa comata* (= *Stipa comata*), *Koeleria macrantha*, *Poa secunda*, and *Pseudoroegneria spicata*. In southern stands, *Bouteloua gracilis* and *Pleuraphis jamesii* (= *Hilaria jamesii*) may also be important. Common forbs include *Balsamorhiza sagittata*, *Castilleja angustifolia*, *Heterotheca villosa*, *Packera multilobata* (= *Senecio multilobatus*), *Phlox hoodii*, *Senecio integerrimus*, *Sphaeralcea coccinea*, and *Stenotus armerioides*. Associations within this alliance occur at intermediate elevations (1400-2500 m) in the Intermountain West and Rocky Mountains, a region of semi-arid, continental climate regime. Soils are typically young, shallow, coarse-textured, and often derived from calcareous parent materials. *Artemisia nova* associations occur on well-drained slopes and ridges and often grow with other *Artemisia* associations on deeper soils. In the Columbia River Basin, the vegetation in this alliance occupies the driest habitats of all the *Artemisia*-dominated alliances.

Classification Comments:**Internal Comments:****Other Comments:****Similar NVC Types:**

Diagnostic Characteristics: Shrublands of the Intermountain West and Rocky Mountains where *Artemisia nova* has <50% of the total shrub cover. Structurally, this alliance may occur as shrub-herbaceous or shrub-dominated vegetation. The herbaceous layer is graminoid-dominated and may be dominant over shrubs in some stands.

VEGETATION

Physiognomy and Structure: This shrubland alliance is characterized by sparse to moderate cover (10-60%) of a low-statured, microphyllous evergreen shrub, and a sparse to well-developed graminoid layer. The graminoids often exceed the shrubs in height, and ungrazed stands may have the appearance of perennial grasslands (Baker and Kennedy 1985). The shrubs may be pruned by livestock and native ungulate browsing into low, spreading cushion-like shrubs. Prostrate and, occasionally, upright forbs are present, but with very low cover.

Floristics: Associations within this alliance are characterized by the dominance of the dwarf-shrub *Artemisia nova*, which must contribute at least 40% of the total shrub cover in any stand. Structurally, this alliance may occur as shrub-herbaceous or shrub-dominated vegetation. Associated shrub species that occur in stands of this alliance include *Artemisia arbuscula*, *Artemisia cana*, *Artemisia tridentata*, *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, *Grayia spinosa*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Purshia tridentata*, and *Symphoricarpos oreophilus*. The ground layer is dominated by perennial bunchgrasses which may exceed the height and cover of the shrubs, but typically may be sparse to very dense. Recurrent species include *Achnatherum*

hymenoides (= *Oryzopsis hymenoides*), *Achnatherum speciosum* (= *Stipa speciosa*), *Achnatherum thurberianum* (= *Stipa thurberiana*), *Elymus elymoides*, *Festuca idahoensis*, *Hesperostipa comata* (= *Stipa comata*), *Koeleria macrantha*, *Poa secunda*, and *Pseudoroegneria spicata*. In southern stands, *Bouteloua gracilis* and *Pleuraphis jamesii* (= *Hilaria jamesii*) may also be important. Common forbs include *Balsamorhiza sagittata*, *Castilleja angustifolia*, *Heterotheca villosa*, *Packera multilobata* (= *Senecio multilobatus*), *Phlox hoodii*, *Senecio integerrimus*, *Sphaeralcea coccinea*, and *Stenotus armerioides*.

ENVIRONMENT & DYNAMICS

Environmental Description: Associations within this alliance occur at intermediate elevations (1400-2500 m) in the Intermountain West and Rocky Mountains. The climate is semi-arid with 20-30 cm of annual precipitation. The temperature regime is continental, with cold winters, warm summers, a large diurnal temperature range, and a short frost-free season. Soils are typically young, shallow, coarse-textured, and often derived from calcareous parent materials. *Artemisia nova* associations occur on well-drained slopes and ridges and often grow with other *Artemisia* associations on deeper soils. In the Columbia River Basin, the vegetation in this alliance occupies the driest habitats of all the *Artemisia*-dominated alliances. At the edges of intermountain basins, this alliance is usually contiguous with *Atriplex confertifolia* shrublands (Hironaka 1978).

Dynamics: This shrubland alliance is associated with shallow, rocky soils which experience extreme drought in summer. The plants are low and widely spaced, which tends to decrease the risk of fire (Chappell et al. 1997). Barbour and Major (1977) report that *Artemisia nova* is utilized by livestock to a much greater degree than other species of *Artemisia*, resulting in low, pruned plants. *Artemisia nova* dwarf-shrublands grow in more xeric sites than other *Artemisia* shrublands. Blackburn and Tueller (1970) noted rapid invasion of these communities by *Juniperus osteosperma* and *Pinus monophylla* in Nevada, citing overgrazing coupled with fire suppression, and possibly climate change as causative variables.

DISTRIBUTION

Geographic Range: Associations in this alliance occur in the mountains of the Mojave Desert, throughout the Great Basin, and east into western and central Wyoming, Montana, Colorado, Utah, and northwestern New Mexico. It also occurs in the upper Columbia River Basin of southeastern Idaho.

Nations: US

States/Provinces: CA, CO, ID, MT, NM, NV, OR, UT, WY

TNC Ecoregions [optional]: 11:C, 16:C, 17:C

USFS Ecoregions (2007): 322A:CC, 341D:CC, 341Fc:CCC, M262B:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Great Basin)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- = *Artemisia nova* (Black sagebrush scrub) Alliance (Sawyer et al. 2009) [35.130.00]
- = *Artemisia nova* Shrubland Alliance (Evens et al. 2014)
- = *Artemisia nova* Shrubland Alliance (CNPS 2017) [35.130.00]
- >< Big Sagebrush Series (Sawyer and Keeler-Wolf 1995)
- >< Black Sagebrush Series (Sawyer and Keeler-Wolf 1995)
- >< Pebble Plain Community (Holland 1986b)
- > SRM Cover Type #320 - Black Sagebrush-Bluebunch Wheatgrass (Shiflet 1994)
- > SRM Cover Type #321 - Black Sagebrush-Idaho Fescue (Shiflet 1994)
- > SRM Cover Type #322 - Black Sagebrush-Rough Fescue (Shiflet 1994)
- = SRM Cover Type #405 - Black Sagebrush (Shiflet 1994)
- >< Subalpine Sagebrush Scrub (#35220) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEGLO01417 *Artemisia nova* Shrubland
- CEGLO02773 *Artemisia nova* - *Ericameria nana* Shrubland
- CEGLO01425 *Artemisia nova* / *Hesperostipa comata* Shrubland
- CEGLO02698 *Artemisia nova* / *Poa fendleriana* Shrubland
- CEGLO01422 *Artemisia nova* / *Achnatherum hymenoides* Shrubland
- CEGLO01423 *Artemisia nova* / *Poa secunda* Shrubland
- CEGLO01524 *Artemisia nova* / *Festuca idahoensis* Shrub Grassland
- CEGLO01419 *Artemisia nova* - *Gutierrezia sarothrae* / *Bouteloua gracilis* - *Pleuraphis jamesii* Shrubland
- CEGLO01420 *Artemisia nova* / *Pleuraphis jamesii* Shrubland

- CEGLO01424 *Artemisia nova* / *Pseudoroegneria spicata* Shrubland
- CEGLO01421 *Artemisia nova* / *Leymus salinus* Shrub Grassland
- CEGLO01418 *Artemisia nova* / *Elymus elymoides* Shrubland

AUTHORSHIP

Primary Concept Source: D. Sarr, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Baker 1983c, Baker 1983d, Baker and Kennedy 1985, Barbour and Major 1977, Blackburn and Tueller 1970, CNPS 2017, Chappell et al. 1997, Cheatham and Haller 1975, Derby and Wilson 1978, Derby and Wilson 1979, Evens et al. 2014, Faber-Langendoen et al. 2017b, Hironaka 1978, Holland 1986b, Krantz 1988, Krantz 1993, Milton and Purdy 1983, Paysen et al. 1980, Peterson 1984a, Peterson 1984b, Rickard and Beatley 1965, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994, Thomas et al. 2004, Thorne 1976, Tisdale 1994a, Turner 1982c, West 1988, Young et al. 1977, Young et al. 2007b, Zamora and Tueller 1973

M169. Great Basin-Intermountain Tall Sagebrush Steppe & Shrubland

This macrogroup includes the big sagebrush shrubland and shrub-steppe that is a matrix and large-patch type throughout much of the intermountain western U.S. and that is dominated by *Artemisia tridentata*, *Purshia tridentata*, and several local dominants such as *Artemisia cana* and *Artemisia tripartita* ssp. *tripartita*.

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

3.B.1.Ne.3.a. M169 Great Basin-Intermountain Tall Sagebrush Steppe & Shrubland

G303. Intermountain Dry Tall Sagebrush Steppe & Shrubland

Type Concept Sentence: This widely distributed, matrix-forming shrubland group is concentrated in the drier, more southerly portions of the interior western U.S., but extends into more xeric portions of the Columbia Plateau, Rocky Mountains, across Wyoming, then northeast into the northwestern Great Plains. Vegetation is typically dominated by *Artemisia tridentata* ssp. *wyomingensis* and *Artemisia tridentata* ssp. *tridentata*, sometimes codominated by xeric shrubs such as *Atriplex* spp., with a typically sparse to open herbaceous layer dominated by dry-site graminoids.

OVERVIEW

Scientific Name: *Artemisia tridentata* ssp. *wyomingensis* - *Artemisia tridentata* ssp. *tridentata* Steppe & Shrubland Group

Common Name (Translated Scientific Name): Wyoming Big Sagebrush - Basin Big Sagebrush Steppe & Shrubland Group

Colloquial Name: Big Sagebrush - Mixed Shrub Dry Steppe & Shrubland

Type Concept: This widely distributed, matrix-forming shrubland group is concentrated in the drier, more southerly portions of the interior western U.S., especially in the Great Basin and Colorado Plateau, but extends into more xeric portions of the Columbia Plateau, Wyoming steppe, Rocky Mountains, and northeast into the northwestern Great Plains. Stands are dominated by *Artemisia tridentata* ssp. *wyomingensis* and *Artemisia tridentata* ssp. *tridentata* and, in some cases, codominated by xeric shrubs such as *Atriplex canescens*, *Atriplex confertifolia*, *Ephedra nevadensis*, *Ephedra viridis*, *Ericameria nauseosa*, *Grayia spinosa*, or *Sarcobatus vermiculatus*. Other common shrubs include *Amelanchier utahensis*, *Artemisia frigida*, *Atriplex gardneri*, *Chrysothamnus* spp., *Ericameria* spp., *Peraphyllum ramosissimum*, *Purshia tridentata*, and *Tetradymia* spp. If present, the herbaceous layer ranges from sparse and patchy to moderately dense and is typically dominated by dry-site graminoids with low cover of forbs. Characteristic graminoids include *Achnatherum hymenoides*, *Achnatherum lettermanii* (= *Stipa lettermanii*), *Achnatherum pinetorum*, *Achnatherum thurberianum*, *Bouteloua gracilis*, *Bromus tectorum*, *Carex filifolia*, *Distichlis spicata*, *Elymus albicans*, *Elymus elymoides*, *Hesperostipa comata* (= *Stipa comata*), *Leymus ambiguus*, *Leymus salinus*, *Pleuraphis jamesii*, *Poa fendleriana*, *Poa secunda*, *Pseudoroegneria spicata*, *Sporobolus airoides*, and *Sporobolus cryptandrus*. A sparse layer of cold-deciduous needle-leaved or scale-leaved evergreen trees may occasionally be emergent over the shrubs. This group occurs on flat to steeply sloping upland slopes on alluvial fans and terraces, toeslopes, lower and middle slopes, draws, badlands, and foothills. Stands are found at elevations as low as 500 m in the northwestern Great Plains to 2500 m in the Rocky Mountains and Colorado Plateau. Sites with little slope tend to have deep soils, while those with steeper slopes have shallow to moderately deep soils. Climate is mostly semi-arid but ranges from semi-arid in the western Great Basin to subhumid in the northern Great Plains and Rocky Mountains with much of the precipitation falling primarily as snow. The amount and reliability of growing-season moisture increase eastward and with increasing elevation.

Classification Comments: This group tends to occur in drier biophysical settings than the two similar tall sagebrush groups (G302, G304). Hence, it tends to have a less abundant herbaceous component, with the predominant grasses being more adapted to drier

conditions. In addition, the co-occurring shrub taxa will include more desert species as well as cacti. This is a slid group in concept, but the specific associations included in it need to be reviewed and will require some adjustment.

Similar NVC Types:

- G302 Intermountain Mesic Tall Sagebrush Steppe & Shrubland
- G304 Intermountain Mountain Big Sagebrush Steppe & Shrubland

Diagnostic Characteristics: Stands are dominated by *Artemisia tridentata* ssp. *wyomingensis* or *Artemisia tridentata* ssp. *tridentata* and, in some cases, codominated by dry-site shrubs such as *Atriplex canescens*, *Ephedra nevadensis*, *Ephedra viridis*, *Ericameria nauseosa*, or *Sarcobatus vermiculatus*. If present, the herbaceous component layer ranges from sparse and patchy to moderately dense and is typically dominated by dry-site graminoids with low cover of forbs. Characteristic graminoids include *Achnatherum hymenoides*, *Achnatherum lettermanii*, *Achnatherum pinetorum*, *Achnatherum thurberianum*, *Bouteloua gracilis*, *Bromus tectorum*, *Carex filifolia*, *Distichlis spicata*, *Elymus albicans*, *Elymus elymoides*, *Hesperostipa comata*, *Leymus ambiguus*, *Leymus salinus*, *Pleuraphis jamesii*, *Poa fendleriana*, *Poa secunda*, *Pseudoroegneria spicata*, *Sporobolus airoides*, and *Sporobolus cryptandrus*. Associated species tend to include more semi-desert taxa with core distribution in the Great Basin and Colorado Plateau regions. Warm-season grasses are common in the southern and eastern portions of its range.

VEGETATION

Physiognomy and Structure: This deciduous scrub and grassland group is structurally characterized by open to dense sagebrush with associated shrubs interspersed and/or a moderately dense understory of perennial grasses.

Floristics: Stands are dominated by *Artemisia tridentata* ssp. *wyomingensis* and *Artemisia tridentata* ssp. *tridentata* and, in some cases, codominated by *Atriplex canescens*, *Atriplex confertifolia*, *Ephedra nevadensis*, *Ephedra viridis*, *Ericameria nauseosa*, *Grayia spinosa*, or *Sarcobatus vermiculatus*. Other common shrubs include *Artemisia frigida*, *Atriplex gardneri*, *Chrysothamnus* spp., *Ericameria* spp., *Krascheninnikovia lanata*, *Peraphyllum ramosissimum*, *Prunus virginiana*, *Purshia tridentata*, *Symphoricarpos longiflorus*, and *Tetradymia* spp. A sparse layer of cold-deciduous needle-leaved or scale-leaved evergreen trees may occasionally be emergent over the shrubs. The herbaceous layer may be sparse to strongly dominated by graminoids, including *Achnatherum hymenoides*, *Achnatherum lettermanii* (= *Stipa lettermanii*), *Achnatherum pinetorum*, *Achnatherum thurberianum*, *Bouteloua gracilis*, *Bromus tectorum*, *Carex filifolia*, *Elymus albicans*, *Elymus elymoides*, *Elymus lanceolatus*, *Festuca idahoensis*, *Hesperostipa comata* (= *Stipa comata*), *Leymus ambiguus*, *Pleuraphis jamesii*, *Poa fendleriana*, *Poa secunda*, *Pseudoroegneria spicata*, *Sporobolus airoides*, and *Sporobolus cryptandrus*. Trees found across the range include *Cercocarpus ledifolius*, *Juniperus monosperma*, *Juniperus occidentalis*, *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus edulis*, *Pinus flexilis*, *Pinus jeffreyi*, *Pinus monophylla*, *Pinus ponderosa*, *Populus tremuloides*, *Quercus gambelii*, *Quercus garryana*, and *Yucca brevifolia*.

ENVIRONMENT & DYNAMICS

Environmental Description: This shrubland group is widely distributed in the western U.S., at elevations as low as 500 m in the northwestern Great Plains to 2500 m in the Rocky Mountains and Colorado Plateau. This group occurs on flat to steeply sloping upland slopes on alluvial fans and terraces, toeslopes, lower and middle slopes, draws, badlands, and foothills. *Climate:* Climate ranges from arid in the western Great Basin to subhumid in the northern plains and Rocky Mountains with much of the precipitation falling primarily as snow. The amount and reliability of growing-season moisture increase eastward and with increasing elevation. *Soil/substrate/hydrology:* Sites with little slope tend to have deep soils while those with steeper slopes have shallow to moderately deep soils. Soil texture is loamy sand, loam, sandy loam, or clay loam (Hansen and Hoffman 1988), and there is often a significant amount of coarse fragments in the soil profile.

Dynamics: The natural fire regime of this group likely maintains patchy distribution of shrubs, so the general aspect of the vegetation is that of a grassland. Shrubs may increase following heavy grazing and/or with fire suppression, particularly in moist portions of the northern Columbia Plateau where it forms a landscape mosaic pattern with shallow-soil scabland shrublands. Response to grazing can be variable depending on the type of grazer and the season in which grazing occurs. *Hesperostipa comata* can increase in abundance in response to either grazing or fire. Microphytic crust is very important in this group.

DISTRIBUTION

Geographic Range: This widely distributed, matrix-forming shrubland group is concentrated in the drier, more southerly portions of the interior western U.S., especially in the Great Basin and Colorado Plateau, but extends into more xeric portions of the Columbia Plateau, Wyoming steppe, Rocky Mountains, and northeast into the northwestern Great Plains.

Spatial Scale & Pattern [optional]: Matrix, Large patch

Nations: CA, US

States/Provinces: BC, CA, CO, ID, MT, ND, NV, OR, SD?, UT, WY

TNC Ecoregions [optional]: 4:C, 6:C, 8:C, 9:C, 10:C, 11:C, 12:C, 18:C, 19:C, 20:C, 26:C, 27:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 322A:CC, 331A:CP, 331D:CC, 331F:CC, 331G:CC, 331H:CC, 331J:C?, 341A:CC, 341B:CC, 341C:CC, 342A:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CC, M242C:CC, M261G:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333D:CC, M334A:CC, M341A:CC, M341B:CC, M341C:CC

Omerik Ecoregions:

Federal Lands [optional]: NPS (Arches, Bighorn Canyon, Black Canyon of the Gunnison?, Bryce Canyon, Canyon de Chelly, Canyonlands, Capitol Reef, Colorado, Curecanti, Death Valley, Dinosaur, Fossil Butte, Glen Canyon, Golden Spike, Grand Canyon, Hovenweep, John Day Fossil Beds, Mesa Verde, Natural Bridges, Theodore Roosevelt, Zion); USFS (Arapaho-Roosevelt, Custer, Medicine Bow, Shoshone, Thunder Basin); USFWS (Ouray)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate. USNVC Confidence from peer reviewer, not AE.

SYNONYMY

- >< Basin Big Sagebrush (401) (Shiflet 1994)
- = Great Basin-Colorado Plateau sagebrush semi-desert (West 1983a)
- >< Wyoming Big Sagebrush (403) (Shiflet 1994)

LOWER LEVEL UNITS

Alliances:

- A3194 *Artemisia tridentata* ssp. *tridentata* - *Artemisia tridentata* ssp. *xericensis* Dry Steppe & Shrubland Alliance
- A3198 *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance
- A3184 *Artemisia tridentata* ssp. *wyomingensis* Dry Steppe & Shrubland Alliance

AUTHORSHIP

Primary Concept Source: N.E. West (1983a)

Author of Description: M.E. Hall and K.A. Schulz

Acknowledgments:

Version Date: 11/06/2015

Classif Resp Region: West

Internal Author: MEH/KAS 3-10, mod. GK 8-15, mod. KAS 11-15

REFERENCES

References: Baker and Kennedy 1985, Barbour and Billings 1988, Barbour and Major 1988, Blackburn and Tueller 1970, Brown 1982a, Brown et al. 1979, Chappell et al. 1997, Daubenmire 1970, Ecosystems Working Group 1998, Faber-Langendoen et al. 2017a, Hansen and Hoffman 1988, Hironaka et al. 1983, Holland and Keil 1995, Knight 1994, Mueggler and Stewart 1980, Shiflet 1994, West 1983a, West 1983c

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G303. Intermountain Dry Tall Sagebrush Steppe & Shrubland

A3198. *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance

Type Concept Sentence: Stands in this alliance have a mixed shrub canopy codominated by *Artemisia tridentata* with dry-site shrub species such as *Atriplex canescens*, *Atriplex confertifolia*, *Ephedra aspera*, *Ephedra viridis*, *Ephedra nevadensis*, *Grayia spinosa*, *Sarcobatus vermiculatus*, or *Tetradymia canescens* present to codominant. The sparse to moderately dense herbaceous layer is dominated by perennial graminoids with lower cover of sometimes diverse forbs characteristic of semi-arid upland sites.

OVERVIEW

Scientific Name: *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance

Common Name (Translated Scientific Name): Big Sagebrush - Mixed Shrub Dry Steppe & Shrubland Alliance

Colloquial Name: Big Sagebrush - Mixed Shrub Dry Steppe & Shrubland

Type Concept: Stands in this alliance have a mixed shrub canopy codominated by *Artemisia tridentata* with dry-site shrub species such as *Atriplex canescens*, *Atriplex confertifolia*, *Ephedra aspera* (= *Ephedra fasciculata*), *Ephedra viridis*, *Ephedra nevadensis*, *Grayia spinosa*, *Sarcobatus vermiculatus*, or *Tetradymia canescens* present to codominant. The sparse to moderately dense herbaceous layer is dominated by perennial graminoids with lower cover of sometimes diverse forbs characteristic of semi-arid upland sites. Characteristic dry-site understory species include *Achnatherum hymenoides*, *Achnatherum speciosum*, *Bouteloua gracilis*, *Bromus tectorum*, *Elymus elymoides*, *Elymus lanceolatus*, *Hesperostipa comata* (= *Stipa comata*), *Leymus cinereus*, *Opuntia polyacantha*, *Phlox hoodii*, *Pleuraphis jamesii*, *Poa fendleriana*, *Poa secunda*, *Sphaeralcea coccinea*, and *Sporobolus cryptandrus*. This dry-site shrubland alliance is distributed throughout the central and southern interior western U.S., especially in the Great Basin and Colorado Plateau regions. Stands occur on flat to steeply sloping upland sites, on a wide variety of landform positions such as alluvial

fans and plains, plateaus, mesas and foothills. Soil texture is loamy sand, loam, sandy loam, or clay loam, and there is often a significant amount of coarse fragments in the soil profile.

Classification Comments: This is a weak artificial alliance. It would be better to further develop this alliance using more biogeographic or environmental (stabilized dunes) information, but the analysis is not done. Big sagebrush subspecies include *Artemisia tridentata ssp. tridentata*, *Artemisia tridentata ssp. xericensis*, and *Artemisia tridentata ssp. wyomingensis*.

Internal Comments:

Other Comments:

Similar NVC Types:

- A3194 *Artemisia tridentata ssp. tridentata* - *Artemisia tridentata ssp. xericensis* Dry Steppe & Shrubland Alliance: is not codominated by non-sagebrush shrubs.

Diagnostic Characteristics: Stands in this dry shrubland alliance have a mixed shrub canopy codominated by *Artemisia tridentata* with dry-site shrub species such as *Atriplex canescens*, *Atriplex confertifolia*, *Ephedra aspera*, *Ephedra viridis*, *Ephedra nevadensis*, *Grayia spinosa*, *Peraphyllum ramosissimum*, *Purshia tridentata*, *Sarcobatus vermiculatus*, or *Tetradymia canescens*. Characteristic dry shrubland understory species include *Achnatherum hymenoides*, *Achnatherum speciosum*, *Bouteloua gracilis*, *Elymus elymoides*, *Elymus lanceolatus*, *Hesperostipa comata*, *Leymus cinereus*, *Phlox hoodii*, *Pleuraphis jamesii*, *Poa fendleriana*, *Poa secunda*, *Sphaeralcea coccinea*, and *Sporobolus cryptandrus*.

VEGETATION

Physiognomy and Structure: The vegetation in this alliance is characterized by a moderate to dense (25-70%) cover of microphyllous evergreen shrubs, usually 0.5-1 m in height. Cespitose graminoids are usually prominent, often matching the shrubs in height and cover. Forb species may be frequent, but usually contribute little canopy cover. With increasing summer rain in the eastern portion of the range, there is a corresponding increase in the abundance of sod-forming grasses as compared to bunchgrasses. There may be significant cover on the ground surface by mosses and lichens, or a cryptogamic soil crust.

Floristics: Stands in this alliance have a mixed shrub canopy codominated by *Artemisia tridentata* with dry-site shrub species such as *Atriplex canescens*, *Atriplex confertifolia*, *Ephedra aspera* (= *Ephedra fasciculata*), *Ephedra viridis*, *Ephedra nevadensis*, *Grayia spinosa*, *Sarcobatus vermiculatus*, or *Tetradymia canescens* present to codominant. The sparse to moderately dense herbaceous layer is dominated by perennial graminoids with lower cover of sometimes diverse forbs characteristic of semi-arid upland sites. Characteristic dry-site understory species include *Achnatherum hymenoides*, *Achnatherum speciosum*, *Bouteloua gracilis*, *Bromus tectorum*, *Elymus elymoides*, *Elymus lanceolatus*, *Hesperostipa comata* (= *Stipa comata*), *Leymus cinereus*, *Opuntia polyacantha*, *Phlox hoodii*, *Pleuraphis jamesii*, *Poa fendleriana*, *Poa secunda*, *Sphaeralcea coccinea*, and *Sporobolus cryptandrus*.

ENVIRONMENT & DYNAMICS

Environmental Description: This dry-site shrubland alliance is distributed throughout the central and southern interior western U.S., especially in the Great Basin and Colorado Plateau regions. Climate is semi-arid with the amount and reliability of growing-season moisture increasing eastward and with increasing elevation. Stands occur on flat to steeply sloping upland sites, on a wide variety of landform positions. These include alluvial fans and terraces, toeslopes, lower and middle slopes, draws, badly eroded badland slopes, and foothills. Sites with little slope tend to have deep soils, while those with steeper slopes have shallow to moderately deep soils. Sloping sites tend to have southerly aspects. Soil texture is loamy sand, loam, sandy loam, or clay loam, and there is often a significant amount of coarse fragments in the soil profile.

Dynamics: Complex ecological interactions between fire regimes, grazing history, and climate patterns result in equally complex patterns of species structure and composition in *Artemisia tridentata*. These present corresponding difficulties in the classification of these shrublands, which have been compounded by the influence of human settlement and agricultural patterns. What follows is a summary of some of the influences of altered fire regimes and grazing history on *Artemisia tridentata* shrublands and shrub-herbaceous vegetation.

Artemisia tridentata ssp. wyomingensis shrublands may represent either drier or more disturbed examples of the *Artemisia tridentata ssp. wyomingensis* shrubland and shrub-herbaceous alliances. Shrub densities typically increase with overgrazing of the bunchgrass component or with increasing summer drought (West 1983c). There is considerable debate over whether present shrub-dominated stands are actually degraded "steppe" (e.g., shrub-herbaceous physiognomy), and if the stands will return to steppe with changes in grazing and fire management. *Artemisia tridentata* is inhibited by fire, and excessive grazing may decrease fire frequency due to consumption of herbaceous forage, resulting in increased shrub density. Conversely, invasion by non-native annual grasses (e.g., *Bromus tectorum* or *Bromus arvensis*) may increase fire frequency sufficiently to eliminate the shrubs from the stands (Hironaka et al. 1983). With a change in fire frequency, species composition will be altered as well (West 1983c). With a high fire frequency (every 2-5 years), perennial grasses and shrubs are eliminated and non-native annual grasses dominate. At fire-return

intervals of 10-30 years, short-lived resprouting shrubs such as *Chrysothamnus* or *Tetradymia* spp. dominate. At fire intervals of 30-70 years, a mixture of perennial bunchgrasses and shrubs is maintained. Finally, in the complete absence of fire, deep-rooted shrubs such as *Artemisia tridentata* become the theoretical dominants.

DISTRIBUTION

Geographic Range: This broadly distributed alliance is found in the western United States on dry steppes with core distribution in the Great Basin and Colorado Plateau regions.

Nations: US

States/Provinces: AZ, CA, CO, ID, MT, NV, OR, UT, WY

TNC Ecoregions [optional]: 4:C, 5:C, 11:C, 12:C, 13:C, 15:C, 16:C, 17:C

USFS Ecoregions (2007): 262A:CC, 322A:CC, 341D:CC, 341F:CC, 342B:CC, M261A:CC, M261D:CC, M261E:CC, M261G:CC, M262A:CC, M262B:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Great Basin, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Artemisia tridentata* (Big sagebrush) Alliance (Sawyer et al. 2009) [35.110.00]
- = *Artemisia tridentata* Shrubland Alliance (Evens et al. 2014)
- = *Artemisia tridentata* Shrubland Alliance (CNPS 2017) [35.110.00]
- >< Big Sagebrush Scrub (#35210) (Holland 1986b)
- < Big Sagebrush Series (Sawyer and Keeler-Wolf 1995)
- >< Great Basin Mixed Scrub (#35100) (Holland 1986b)
- >< Sagebrush Steppe (#35300) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEG001040 *Artemisia tridentata* ssp. *wyomingensis* - *Atriplex confertifolia* Shrubland
- CEG000993 *Artemisia tridentata* - *Atriplex confertifolia* Shrubland
- CEG001054 *Purshia tridentata* - *Artemisia tridentata* ssp. *tridentata* Shrubland
- CEG001004 *Artemisia tridentata* ssp. *tridentata* - *Grayia spinosa* Shrubland
- CEPP005793 *Artemisia tridentata* - *Ericameria teretifolia* Shrubland
- CEG001355 *Artemisia tridentata* - *Atriplex canescens* - *Sarcobatus vermiculatus* / (*Achnatherum hymenoides*) Shrubland
- CEG005430 *Peraphyllum ramosissimum* - *Artemisia tridentata* Shrubland
- CEG001002 *Artemisia tridentata* - *Ephedra nevadensis* Shrubland
- CEG001056 *Purshia tridentata* - *Ericameria nauseosa* Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Blackburn 1967, Blackburn et al. 1968a, Blackburn et al. 1968b, Blackburn et al. 1969a, Blackburn et al. 1969b, Blackburn et al. 1969c, Blackburn et al. 1969d, Blackburn et al. 1971, Brown 1971, CNPS 2017, Cheng 2004, Evens et al. 2014, Faber-Langendoen et al. 2017b, Ferren and Davis 1991, Francis 1983, Gordon and White 1994, Hanes 1976, Hironaka et al. 1983, Holland 1986b, Johnson 2000b, Keeler-Wolf et al. 2003a, Klein and Evens 2006, Paysen et al. 1980, Peterson 1984a, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Thomas et al. 2004, Tirmenstein 1999c, West 1983c, Wolfram and Martin 1965, Young et al. 1977, Young et al. 2007b

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G303. Intermountain Dry Tall Sagebrush Steppe & Shrubland

A3194. *Artemisia tridentata* ssp. *tridentata* - *Artemisia tridentata* ssp. *xericensis* Dry Steppe & Shrubland Alliance

Type Concept Sentence: Stands in this semi-arid shrubland alliance have a shrub canopy dominated by *Artemisia tridentata* ssp. *tridentata* or *Artemisia tridentata* ssp. *xericensis*. Other shrubs have low cover, except species that increase with disturbance such as *Gutierrezia sarothrae*, *Chrysothamnus viscidiflorus*, and *Ericameria nauseosa*. The understory, if present, is characterized by dry-site grass species.

OVERVIEW

Scientific Name: *Artemisia tridentata* ssp. *tridentata* - *Artemisia tridentata* ssp. *xericensis* Dry Steppe & Shrubland Alliance

Common Name (Translated Scientific Name): Basin Big Sagebrush - Foothill Big Sagebrush Dry Steppe & Shrubland Alliance

Colloquial Name: Basin Big Sagebrush - Foothill Big Sagebrush Dry Steppe & Shrubland

Type Concept: This semi-arid alliance occurs throughout much of the Intermountain West, especially in the Great Basin and Colorado Plateau. Stands in have a mixed shrub canopy dominated by *Artemisia tridentata* ssp. *tridentata* or *Artemisia tridentata* ssp. *xericensis*. Other shrubs have low cover, except species that increase with disturbance such as *Gutierrezia sarothrae*, *Chrysothamnus viscidiflorus*, and *Ericameria nauseosa*. Characteristic dry shrubland understory species include *Achnatherum hymenoides*, *Achnatherum lettermanii*, *Bouteloua gracilis*, *Distichlis spicata*, *Pascopyrum smithii*, *Pleuraphis jamesii*, *Poa secunda*, *Sporobolus airoides*, and *Sporobolus cryptandrus*. The non-native, invasive annual grass *Bromus tectorum* may be present and dominant in disturbed stands. Sites supporting this alliance include sloping fans, footslopes, rolling hills, swales, draws, and deep, well-drained alluvial bottomlands. Soils are deep, fine- to medium-textured alluvial soils with some source of subirrigation during the summer season, but moderately deep upland soils with ample moisture storage also support these shrublands. Some stands occur on deep, sandy soils, or soils that are highly calcareous.

Classification Comments: Associations with undetermined subspecies of *Artemisia tridentata* from former *Artemisia tridentata* Shrubland Alliance (A.829) were reviewed and placed into either *Artemisia tridentata* ssp. *wyomingensis* Dry Steppe & Shrubland Alliance (A3184) or *Artemisia tridentata* ssp. *tridentata* - *Artemisia tridentata* ssp. *xericensis* Dry Steppe & Shrubland Alliance (A3194). More review would increase confidence of placement. *Artemisia tridentata* / *Ericameria nauseosa* Shrubland (CEGL000998) is currently a broadly defined association that may need to be split into an *Artemisia tridentata* ssp. *wyomingensis* / *Ericameria nauseosa* shrubland association and an *Artemisia tridentata* ssp. *tridentata* / *Ericameria nauseosa* shrubland association after more data are available.

Internal Comments:

Other Comments:

Similar NVC Types:

- A3198 *Artemisia tridentata* - Mixed Shrub Dry Steppe & Shrubland Alliance: is codominated by non-sagebrush shrubs.

Diagnostic Characteristics: Stands in this semi-arid shrubland alliance are dominated by *Artemisia tridentata* ssp. *tridentata* or *Artemisia tridentata* ssp. *xericensis*. Characteristic herbaceous species include *Achnatherum hymenoides*, *Achnatherum lettermanii*, *Bouteloua gracilis*, *Distichlis spicata*, *Pascopyrum smithii*, *Pleuraphis jamesii*, *Poa secunda*, *Sporobolus airoides*, and *Sporobolus cryptandrus*.

VEGETATION

Physiognomy and Structure: The shrublands in this alliance are characterized by a open to dense (10-75%) cover of microphyllous evergreen shrubs, usually 1-2 m in height. Cespitose graminoids are scattered in the shrub matrix and can occasionally match the shrubs in height. A sparse, emergent layer of scale-leaved or needle-leaved evergreen trees may also be present, but in many areas no trees are present. Forb species may be frequent, but are usually of low cover. With increasing summer rain in the southeastern edge of the range, there is an increase in the importance of sod-forming grasses in comparison to bunchgrasses. In many areas, undisturbed stands in this alliance will have a cryptogamic soil crust composed of a mix of lichens, tiny mosses, and bacteria.

Floristics: Stands in this semi-arid shrubland alliance have a mixed shrub canopy dominated by *Artemisia tridentata* ssp. *tridentata* or *Artemisia tridentata* ssp. *xericensis*. Other shrubs have low cover, except species that increase with disturbance such as *Gutierrezia sarothrae*, *Chrysothamnus viscidiflorus*, and *Ericameria nauseosa*. Characteristic dry shrubland understory species include *Achnatherum hymenoides*, *Achnatherum lettermanii*, *Bouteloua gracilis*, *Distichlis spicata*, *Pascopyrum smithii*, *Pleuraphis jamesii*, *Poa secunda*, *Sporobolus airoides*, and *Sporobolus cryptandrus*. The non-native, invasive annual grass *Bromus tectorum* may be present and dominant in disturbed stand. Forbs are generally of low importance and are highly variable across the range, but may be diverse in some stands. Common forbs include species of *Astragalus*, *Oenothera*, *Eriogonum*, and *Erigeron*.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance occurs throughout the Intermountain West from the western Great Basin to the Columbia Basin and Colorado Plateau at elevations ranging from 240 m in the Columbia Basin up to 2500 m. The climate where this alliance occurs is semi-arid with annual precipitation ranging from 18-40 cm and high inter-annual variation. Much of the precipitation falls as snow, and growing-season drought is characteristic. Temperatures are continental with large annual and diurnal variation. In drier regions, these shrublands are usually associated with perennial or ephemeral stream drainages with water tables less than 3 m from the soil surface. Sites supporting this alliance include sloping fans, footslopes, rolling hills, swales, draws, and deep, well-drained alluvial bottomlands. Soils are deep, fine- to medium-textured alluvial soils with some source of subirrigation during the summer season, but moderately deep upland soils with ample moisture storage also support these shrublands. Some stands occur on deep, sandy soils, or soils that are highly calcareous (Hironaka et al. 1983). Although this alliance may grade into sites with alkaline soils at the edge of internally drained basins, *Artemisia tridentata* is a non-halophyte and requires low salinity for optimum growth. The importance of perennial bunchgrasses, the most typical herbaceous associates, is favored with greater spring and summer rain, which increases northward and eastward. Because of the deep alluvial soils, stands have been converted to agriculture in much of the range of the alliance. Adjacent vegetation is highly variable, but some common adjacent communities include *Juniperus occidentalis*-, *Pinus ponderosa*-, and *Cercocarpus ledifolius*-dominated woodlands, as well as shrublands dominated by *Artemisia tridentata* ssp. *vaseyana*.

Dynamics: Complex ecological interactions between fire regimes, grazing history, and climate patterns result in equally complex patterns of species structure and composition in *Artemisia tridentata* stands. These present corresponding difficulties in the classification of these shrublands, which have been compounded by the influence of human settlement and agricultural patterns. What follows is a summary of some of the influences of altered fire regimes and grazing history on *Artemisia tridentata* shrublands and shrub-herbaceous vegetation.

Artemisia tridentata is inhibited by fire, and excessive grazing may decrease fire frequency due to consumption of herbaceous forage, resulting in increased shrub density. Conversely, invasion by non-native annual grasses (e.g., *Bromus tectorum*) may increase fire frequency sufficiently to eliminate the shrubs from the stands (Daubenmire 1970). With a change in fire frequency, species composition will be altered as well (West 1983c). With a high fire frequency (every 2-5 years), perennial grasses and shrubs are eliminated and non-native annual grasses dominate. At fire-return intervals of 10-30 years, short-lived resprouting shrubs such as *Chrysothamnus* or *Tetradymia* spp. dominate. At fire intervals of 30-70 years, a mixture of perennial bunchgrasses and shrubs is maintained. Finally, in the complete absence of fire, deep-rooted shrubs such as *Artemisia tridentata* become the dominant shrubs.

This alliance is often found in seasonal or intermittent stream drainages. Currently, it can often be found on the benches of perennial streams which have become restricted to a downcut channel, although these are generally in poor condition with a *Bromus tectorum* understory. It is likely that these habitats are a result of livestock grazing impacts.

DISTRIBUTION

Geographic Range: This broadly distributed alliance is found in the western United States on dry steppes with core distribution in the Great Basin and Colorado Plateau regions.

Nations: US

States/Provinces: AZ, CA, CO, ID, NM, NV, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- > *Artemisia tridentata* / *Sporobolus cryptandrus* - *Oryzopsis hymenoides* Plant Community (Francis 1986)
- >< Big Sagebrush Scrub (#35210) (Holland 1986b)
- >< Big Sagebrush Series (Sawyer and Keeler-Wolf 1995)
- < SRM Cover Type #401 - Basin Big Sagebrush (Shiflet 1994)
- >< Western Shrub: 38: Great Basin Sagebrush (*Artemisia*) (Küchler 1964)

LOWER LEVEL UNITS

Associations:

- CEG001545 *Artemisia tridentata* / *Sporobolus cryptandrus* - *Achnatherum hymenoides* Shrub Grassland
- CEG000999 *Artemisia tridentata* / *Chrysothamnus viscidiflorus* / (*Poa secunda*) Shrubland
- CEG001000 *Artemisia tridentata* ssp. *tridentata* / *Distichlis spicata* Shrubland
- CEG001008 *Artemisia tridentata* ssp. *tridentata* / *Poa secunda* Shrubland

- CEGLO00996 *Artemisia tridentata* / *Bouteloua gracilis* - *Pleuraphis jamesii* Shrubland
- CEGLO01006 *Artemisia tridentata* / *Achnatherum hymenoides* Shrubland
- CEGLO00995 *Artemisia tridentata* / *Bouteloua gracilis* Shrubland
- CEGLO00997 *Artemisia tridentata* / *Bouteloua gracilis* - *Pascopyrum smithii* Shrubland
- CEGLO01011 *Artemisia tridentata* / *Achnatherum lettermanii* Shrubland
- CEGLO00998 *Artemisia tridentata* / *Ericameria nauseosa* Shrubland
- CEGLO01013 *Artemisia tridentata* Upperzone Community Shrubland
- CEGLO00991 *Artemisia tridentata* Shrubland
- CEGLO02200 *Artemisia tridentata* ssp. *tridentata* / *Sporobolus airoides* Shrubland
- CEGLO03826 *Artemisia tridentata* ssp. *tridentata* / *Sporobolus cryptandrus* Shrubland
- CEGLO01015 *Artemisia tridentata* ssp. *tridentata* / *Pleuraphis jamesii* Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Baker 1982b, Baker 1983b, Baker 1984a, Barbour and Major 1988, Barrows et al. 1977, Blackburn 1967, Blackburn et al. 1968a, Blackburn et al. 1968c, Blackburn et al. 1969a, Blackburn et al. 1969b, Blackburn et al. 1969c, Blackburn et al. 1969d, Blackburn et al. 1971, Branson et al. 1976, Britton et al. 1981, Caicco and Wellner 1983f, Caicco and Wellner 1983k, Chappell et al. 1997, Daubenmire 1970, DeVelice and Lesica 1993, Donart et al. 1978b, Eddleman and Jaindl 1994, Faber-Langendoen et al. 1996, Faber-Langendoen et al. 2017b, Fenemore 1970, Francis 1983, Francis 1986, Francis and Aldon 1983, Franklin and Dyrness 1973, Hansen et al. 1984, Harper and Jaynes 1986, Heinze et al. 1962, Hess 1981, Hironaka 1978, Hironaka et al. 1983, Holecheck and Stephenson 1983, Holland 1986b, Jameson et al. 1962, Jensen et al. 1988a, Johnson and Payne 1968, Johnson and Simon 1987, Jorgensen 1979, Keammerer 1977, Kittel et al. 1994, Kittel et al. 1999a, Kurzius 1981, Küchler 1964, Leary and Peterson 1984, Lesica and DeVelice 1992, Loope 1969, McArthur and Welch 1986, McLean 1970, Mooney 1985, Moretti 1979, Moretti and Brotherson 1982, Mueggler and Stewart 1980, Northcutt 1978, ORNHP unpubl. data, Poulton 1955, Ralston 1969, Reid et al. 1994, Rickard and Beatley 1965, Robertson 1971, Savage 1968, Sawyer and Keeler-Wolf 1995, Sheehy and Winward 1981, Shiflet 1994, Strong 1980, Tiedemann et al. 1987, Tisdale 1986, Tisdale and Hironaka 1981, Tueller and Blackburn 1974, Tueller et al. 1966, Tweit and Houston 1980, USFS 1992, Warren et al. 1982, West 1983a, West 1983c

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G303. Intermountain Dry Tall Sagebrush Steppe & Shrubland

A3184. *Artemisia tridentata* ssp. *wyomingensis* Dry Steppe & Shrubland Alliance

Type Concept Sentence: This semi-arid shrubland alliance is found in the western United States on dry steppes with core distribution in the Great Basin, Colorado Plateau and Wyoming and is characterized by an open to moderately dense shrub canopy dominated by *Artemisia tridentata* ssp. *wyomingensis*. Other shrubs have low cover, except species that increase with disturbance such as *Gutierrezia sarothrae*, *Chrysothamnus viscidiflorus*, and *Ericameria nauseosa*. This understory is a sparse to moderately dense herbaceous layer characterized by dry-site perennial graminoids such as *Achnatherum hymenoides*, *Bouteloua gracilis*, *Carex filifolia*, *Distichlis spicata*, *Elymus elymoides*, *Hesperostipa comata*, *Pleuraphis jamesii*, and *Poa fendleriana*.

OVERVIEW

Scientific Name: *Artemisia tridentata* ssp. *wyomingensis* Dry Steppe & Shrubland Alliance

Common Name (Translated Scientific Name): Wyoming Big Sagebrush Dry Steppe & Shrubland Alliance

Colloquial Name: Wyoming Big Sagebrush Dry Steppe & Shrubland

Type Concept: This broadly distributed semi-arid shrubland alliance is found in the western United States on dry sites with core distribution in the Great Basin, Colorado Plateau and Wyoming. Stands have open to moderately dense shrub canopy dominated by *Artemisia tridentata* ssp. *wyomingensis*. *Artemisia tridentata* ssp. *tridentata* may be present in some stands. Other shrubs have low cover, except species that increase with disturbance such as *Gutierrezia sarothrae*, *Chrysothamnus viscidiflorus*, and *Ericameria nauseosa*. This understory is a sparse to moderately dense herbaceous layer characterized by dry-site graminoids such as *Achnatherum hymenoides*, *Achnatherum pinetorum*, *Achnatherum thurberianum*, *Bouteloua gracilis*, *Carex filifolia*, *Distichlis spicata*, *Elymus albicans*, *Elymus elymoides*, *Elymus lanceolatus*, *Hesperostipa comata*, *Leymus ambiguus*, *Leymus salinus*, *Pleuraphis jamesii*, and *Poa fendleriana*. The non-native, invasive species *Agropyron cristatum*, *Bromus tectorum*, and *Psathyrostachys juncea* may be present and dominant in disturbed stands. This alliance occurs on flat to steeply sloping sites with southerly aspects. Sites with little

slope tend to have deep soils, while those with steeper slopes have shallow to moderately deep soils. Soil texture is loamy sand, loam, sandy loam, or clay loam.

Classification Comments: Associations with undetermined subspecies of *Artemisia tridentata* from former *Artemisia tridentata* Shrubland Alliance (A.829) were reviewed and placed into either *Artemisia tridentata* ssp. *wyomingensis* Dry Steppe & Shrubland Alliance (A3184) or *Artemisia tridentata* ssp. *tridentata* - *Artemisia tridentata* ssp. *xericensis* Dry Steppe & Shrubland Alliance (A3194). More review would increase confidence of placement.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Stands in this dry-site alliance are dominated by *Artemisia tridentata* ssp. *wyomingensis*. Characteristic herbaceous species include *Achnatherum hymenoides*, *Achnatherum pinetorum*, *Achnatherum thurberianum*, *Bouteloua gracilis*, *Carex filifolia*, *Distichlis spicata*, *Elymus albicans*, *Elymus elymoides*, *Elymus lanceolatus*, *Hesperostipa comata*, *Leymus ambiguus*, *Leymus salinus*, *Pleuraphis jamesii*, and *Poa fendleriana*.

VEGETATION

Physiognomy and Structure: The vegetation in this alliance is characterized by a moderate to dense (25-70%) cover of microphyllous evergreen shrubs, usually 0.5-1 m in height. Cespitose graminoids are usually prominent, often matching the shrubs in height and cover. Forb species may be frequent, but usually contribute little canopy cover. With increasing summer rain in the eastern portion of the range, there is a corresponding increase in the abundance of sod-forming grasses as compared to bunchgrasses. There may be significant cover on the ground surface by mosses and lichens, or a cryptogamic soil crust.

Floristics: Stands in this dry-site shrublands alliance have an open to moderately dense shrub canopy dominated by *Artemisia tridentata* ssp. *wyomingensis*. *Artemisia tridentata* ssp. *tridentata* may be present in some stands. Other shrubs have low cover, except species that increase with disturbance such as *Gutierrezia sarothrae*, *Chrysothamnus viscidiflorus*, and *Ericameria nauseosa*. Characteristic dry shrubland understory species include *Achnatherum hymenoides*, *Achnatherum pinetorum*, *Achnatherum thurberianum*, *Bouteloua gracilis*, *Carex filifolia*, *Distichlis spicata*, *Elymus albicans*, *Elymus elymoides*, *Elymus lanceolatus*, *Hesperostipa comata*, *Leymus ambiguus*, *Leymus salinus*, *Pleuraphis jamesii*, and *Poa fendleriana*. The non-native, invasive species *Agropyron cristatum*, *Bromus tectorum*, and *Psathyrostachys juncea* may be present and dominant in disturbed stands. Forbs form a minor and highly variable portion of this vegetation. Recurrent species include *Achillea millefolium*, *Balsamorhiza sagittata*, *Camelina microcarpa*, *Erigeron* spp., *Opuntia* spp., *Phlox* spp., and *Sphaeralcea coccinea*. Mosses and lichens, such as *Selaginella densa* and *Tortula ruralis*, may occur on bare ground, and in Washington and Idaho stands may cover up to 50% of the ground surface. Diagnostic of this dry-site shrubland alliance is the *Artemisia tridentata* ssp. *wyomingensis*-dominated shrub layer typically lacking a significant perennial graminoid layer (<20% cover).

ENVIRONMENT & DYNAMICS

Environmental Description: This broadly distributed alliance is found in the western United States on dry steppes with core distribution in the Great Basin, Colorado Plateau and Wyoming. Climate ranges from semi-arid in the western Great Basin and Colorado Plateau to subhumid in the northern plains. The amount and reliability of growing-season moisture increase eastward and with increasing elevation. These shrublands occur from less than 1000 m elevation in the Columbia Basin and northern Great Plains to over 2500 m in the Rocky Mountains and Great Basin ranges. The alliance occurs on flat to steeply sloping upland sites, on a wide variety of landform positions. These include alluvial fans and terraces, toeslopes, lower and middle slopes, draws, badly eroded badland slopes, and foothills. Sites with little slope tend to have deep soils, while those with steeper slopes have shallow to moderately deep soils (USFS 1992). Sloping sites tend to have southerly aspects. Soil texture is loamy sand, loam, sandy loam, or clay loam (Hansen and Hoffman 1988), and there is often a significant amount of coarse fragments in the soil profile. Hironaka et al. (1983) reported that most of their *Artemisia tridentata* ssp. *wyomingensis* habitat types occurred on calcareous soils, often with some form of a cemented duripan or silica-hardpan at about 1 m in depth.

In eastern Idaho and western Wyoming, *Artemisia tridentata* ssp. *wyomingensis* occupies somewhat dry, low-elevation sites, while *Artemisia tridentata* ssp. *tridentata* or *Artemisia cana* occupy deep alluvial soils of drainage bottoms at low elevation, and *Artemisia tridentata* ssp. *vaseyana* occupies cooler, moister upland sites at higher elevation. In addition to *Artemisia tridentata* and *Artemisia cana*, other associated vegetation types include *Atriplex confertifolia*, *Ericameria* spp., or *Chrysothamnus* spp. shrublands, *Populus tremuloides*, *Pinus ponderosa*, *Pinus contorta*, *Abies grandis*, or *Pseudotsuga menziesii* forests, *Pinus* - *Juniperus* woodlands, or mesic herbaceous communities.

Dynamics: Complex ecological interactions between fire regimes, grazing history, and climate patterns result in equally complex patterns of species structure and composition in *Artemisia tridentata*. These present corresponding difficulties in the classification of

these shrublands, which have been compounded by the influence of human settlement and agricultural patterns. What follows is a summary of some of the influences of altered fire regimes, and grazing history on *Artemisia tridentata* shrublands and shrub-herbaceous vegetation.

Artemisia tridentata ssp. *wyomingensis* shrublands may represent either drier or more disturbed examples of the *Artemisia tridentata* ssp. *wyomingensis* shrubland and shrub herbaceous alliances. Shrub densities typically increase with overgrazing of the bunchgrass component or with increasing summer drought (West 1983c). There is considerable debate over whether present shrub-dominated stands are actually degraded "steppe" (e.g., shrub-herbaceous physiognomy), and if the stands will return to steppe with changes in grazing and fire management. *Artemisia tridentata* is inhibited by fire, and excessive grazing may decrease fire frequency due to consumption of herbaceous forage, resulting in increased shrub density. Conversely, invasion by non-native annual grasses (e.g., *Bromus tectorum* or *Bromus arvensis*) may increase fire frequency sufficiently to eliminate the shrubs from the stands (Hironaka et al. 1983). With a change in fire frequency, species composition will be altered as well (West 1983c). With a high fire frequency (every 2-5 years), perennial grasses and shrubs are eliminated and non-native annual grasses dominate. At fire-return intervals of 10-30 years, short-lived resprouting shrubs such as *Chrysothamnus* or *Tetradymia* spp. dominate. At fire intervals of 30-70 years, a mixture of perennial bunchgrasses and shrubs is maintained. Finally, in the complete absence of fire, deep-rooted shrubs such as *Artemisia tridentata* become the theoretical dominants.

DISTRIBUTION

Geographic Range: This broadly distributed alliance is found in the western United States on dry steppes with core distribution in the Great Basin, Colorado Plateau and Wyoming.

Nations: US

States/Provinces: AZ, CA, CO, ID, MT, ND, NM, NV, OR, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- >< Big Sagebrush Scrub (#35210) (Holland 1986b)
- >< Big Sagebrush Series (Sawyer and Keeler-Wolf 1995)
- >< SRM Cover Type #314 - Big Sagebrush-Bluebunch Wheatgrass (Shiflet 1994)
- < SRM Cover Type #403 - Wyoming Big Sagebrush (Shiflet 1994)
- < SRM Cover Type #612 - Sagebrush - Grass (Shiflet 1994)
- >< Western Shrub and Grasslands Combinations: 55: Sagebrush-Steppe (*Artemisia-Agropyron*) (Küchler 1964)
- >< Western Shrub: 38: Great Basin Sagebrush (*Artemisia*) (Küchler 1964)

LOWER LEVEL UNITS

Associations:

- CEG001534 *Artemisia tridentata* ssp. *wyomingensis* / Mixed Grasses Shrub Grassland
- CEG002761 *Artemisia tridentata* ssp. *wyomingensis* / *Hesperostipa comata* Colorado Plateau Shrubland
- CEG001041 *Artemisia tridentata* ssp. *wyomingensis* / *Bouteloua gracilis* Shrubland
- CEG001001 *Artemisia tridentata* / *Elymus elymoides* Shrubland
- CEG001005 *Artemisia tridentata* / *Pleuraphis jamesii* Shrubland
- CEG001042 *Artemisia tridentata* ssp. *wyomingensis* / *Carex filifolia* Shrubland
- CEG002810 *Artemisia tridentata* ssp. *wyomingensis* / *Achnatherum pinetorum* Shrubland
- CEG001045 *Artemisia tridentata* ssp. *wyomingensis* / *Leymus ambiguus* Shrubland
- CEG001046 *Artemisia tridentata* ssp. *wyomingensis* / *Achnatherum hymenoides* Shrubland
- CEG001052 *Artemisia tridentata* ssp. *wyomingensis* / *Achnatherum thurberianum* Shrubland
- CEG002084 *Artemisia tridentata* ssp. *wyomingensis* / *Pleuraphis jamesii* Shrubland
- CEG002768 *Artemisia tridentata* ssp. *wyomingensis* / Sparse Understory Shrubland
- CEG002775 *Artemisia tridentata* ssp. *wyomingensis* / *Poa fendleriana* Shrubland
- CEG002813 *Artemisia tridentata* ssp. *wyomingensis* / *Leymus salinus* Shrubland
- CEG001043 *Artemisia tridentata* ssp. *wyomingensis* / *Elymus elymoides* Shrubland
- CEG001044 *Artemisia tridentata* ssp. *wyomingensis* / *Elymus albicans* Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by D. Sarr.

Version Date: 2014/12/18

REFERENCES

References: Baker 1982b, Baker 1983c, Baker and Kennedy 1985, Bear Creek Uranium Mine Application n.d., Bighorn Coal Mine n.d., Blackburn 1967, Blackburn et al. 1968a, Blackburn et al. 1968b, Blackburn et al. 1968c, Blackburn et al. 1969a, Blackburn et al. 1969b, Blackburn et al. 1969c, Blackburn et al. 1969d, Blackburn et al. 1971, Britton et al. 1981, Brotherson and Brotherson 1981, Brown 1971, Caicco and Wellner 1983f, Caicco and Wellner 1983i, Caicco and Wellner 1983j, Caicco and Wellner 1983k, Caicco and Wellner 1983l, Chappell et al. 1997, Comer 1999, Cotter-Ferguson Project n.d., Daubenmire 1970, Day and Wright 1985, DeVelice and Lesica 1993, DeVelice et al. 1991, Doescher et al. 1986, Driese et al. 1997, Earth Resource Technology n.d., Eddleman and Jaindl 1994, Ellis and Hackney 1981, Faber-Langendoen et al. 1996, Faber-Langendoen et al. 2017b, Fenemore 1970, Ferchau 1973, Fisser 1964, Fisser 1970, Francis 1983, Francis 1986, Franklin and Dyrness 1973, Giese 1975, Gross 1955, Hall 1973, Hansen and Hoffman 1988, Hansen et al. 1984, Harper and Jaynes 1986, Heinze et al. 1962, Hess 1981, Hess and Wasser 1982, Hironaka 1978, Hironaka et al. 1983, Holecheck and Stephenson 1983, Holland 1986b, Jameson et al. 1962, Jensen et al. 1988a, Johnson and Payne 1968, Johnson and Simon 1987, Johnston 1987, Jorgensen 1979, Keammerer 1987, Knight 1994, Knight et al. 1987, Komarkova 1986, Kurzius 1981, K uchler 1964, Leary and Peterson 1984, Lesica and DeVelice 1992, Leucite Hills Mine Application n.d., Lewis 1975a, Loope 1969, Lucky McMine Application n.d., Lundberg 1977, Marr et al. 1979, McArthur and Welch 1986, McLean 1970, Moretti 1979, Moretti and Brotherson 1982, Mueggler and Stewart 1980, Nichols 1964a, Nichols 1964b, Northwest Resources Co. 1981, ORNHP unpubl. data, Poulton 1955, Ralston 1969, Rickard and Beatley 1965, Robertson 1971, Savage 1968, Sawyer and Keeler-Wolf 1995, Seminoe I Mine Application n.d., Sheehy and Winward 1981, Shiflet 1994, Skull Point Mine Application n.d., Skull Point Mine Permit Renewal n.d., Smith n.d.b, Steger 1970, Stoecker-Keammerer Consultants n.d.a, Strong 1980, Sweetwater Uranium Project 1978, Sweetwater Uranium Project n.d., Terwilliger et al. 1979a, Thorne Ecological Institute 1973a, Thorne Ecological Institute 1973b, Tiedemann et al. 1987, Tisdale 1947, Tisdale and Hironaka 1981, Tueller and Blackburn 1974, Tueller et al. 1966, Tweit and Houston 1980, USFS 1992, Van Pelt 1978, Warren et al. 1982, West 1983c, West et al. 1984, Winward 1970

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

3.B.1.Ne.3.b. M169 Great Basin-Intermountain Tall Sagebrush Steppe & Shrubland

G302. Intermountain Mesic Tall Sagebrush Steppe & Shrubland

Type Concept Sentence: This widespread matrix-forming sagebrush steppe and shrubland group occurs throughout the interior western U.S., Wyoming and the northwestern Great Plains and is characterized by an open to sparse shrub layer of *Artemisia tridentata* (*ssp. tridentata*, *ssp. xericensis*) or *Artemisia tripartita ssp. tripartita* with an often dense herbaceous layer dominated by perennial bunchgrasses such as *Achnatherum occidentale*, *Festuca campestris*, *Festuca idahoensis*, *Leymus cinereus*, *Poa secunda*, and *Pseudoroegneria spicata*.

OVERVIEW

Scientific Name: *Artemisia tridentata* - *Artemisia tripartita* - *Purshia tridentata* Big Sagebrush Steppe & Shrubland Group

Common Name (Translated Scientific Name): Basin Big Sagebrush - Threetip Sagebrush - Antelope Bitterbrush Big Sagebrush Steppe & Shrubland Group

Colloquial Name: Basin Big Sagebrush - Foothill Big Sagebrush Mesic Steppe & Shrubland

Type Concept: This widespread matrix-forming sagebrush steppe group occurs throughout much of the western U.S. in the Great Basin, Columbia Plateau, northwestern Great Plains, eastern Sierra Nevada, Wyoming Basins, Rocky Mountains, and Colorado Plateau between elevations of 1200 and 2400 m. Stands are characterized by open to sparse shrublands dominated by *Artemisia tridentata* (*ssp. tridentata*, *ssp. xericensis*) or *Artemisia tripartita ssp. tripartita* which tend to occupy more mesic sites with well-developed soil, and *Purshia tridentata* which tends to occupy drier, rockier soils and positions, as well as sandy dune areas. Some *Artemisia tridentata ssp. wyomingensis* associations are included here, where they occur in biophysical settings conducive to an abundant herbaceous layer, and more mesic-indicator species. Herbaceous layers are often dense and dominated by perennial bunchgrasses, especially as *Festuca idahoensis* and *Pseudoroegneria spicata*. Other common graminoids include *Achnatherum hymenoides*, *Achnatherum occidentale*, *Carex pensylvanica*, *Festuca campestris*, *Hesperostipa comata*, *Leymus cinereus*, *Pascopyrum smithii*, and *Poa secunda*. In some cases scattered trees may form an emergent layer of individual trees; species include *Cercocarpus ledifolius*, *Juniperus occidentalis*, *Juniperus osteosperma*, *Juniperus scopulorum*, or *Pinus ponderosa*. Many perennial forb species are important in these shrublands, and microphytic crust is very important in this group. This group may occur on stream terraces, point bars, valley floors, alluvial fans, floodplains, washes, gullies, stabilized dunes, swales, and rocky slopes. Soils vary from deep and well-developed to shallow, rocky and poorly developed sandy loams, loamy sands, sand, silt loams, and clay loams derived from alluvium, loess, shale, and sandstone.

Classification Comments: This group is a solid concept at its core, although the associations considered "mesic tall sagebrush" probably need adjustment. These communities tend to occur in the northern Great Basin and Northern Rockies, or on somewhat more mesic settings than the dry tall sagebrush group. Slightly higher precipitation and less evapotranspiration stress combined with deeper soils allow for the significant bunchgrass and perennial forb component of the shrublands in this group.

Similar NVC Types:

- G303 Intermountain Dry Tall Sagebrush Steppe & Shrubland
- G304 Intermountain Mountain Big Sagebrush Steppe & Shrubland

Diagnostic Characteristics: Stands are characterized by open to sparse shrublands dominated by *Artemisia tridentata* (*ssp. tridentata*, *ssp. xericensis*) or *Artemisia tripartita ssp. tripartita* which tend to occupy more mesic sites with well-developed soil, and *Purshia tridentata* which tends to occupy drier, rockier soils and positions, as well as sandy dune areas. Herbaceous layers are often dense and dominated by perennial bunchgrasses and a significant perennial graminoid layer is diagnostic of this group. Common graminoids include *Achnatherum hymenoides*, *Achnatherum occidentale*, *Achnatherum thurberianum*, *Carex pensylvanica*, *Elymus lanceolatus*, *Festuca campestris*, *Festuca idahoensis*, *Hesperostipa comata*, *Koeleria macrantha*, *Leymus cinereus*, *Pascopyrum smithii*, *Poa secunda*, and *Pseudoroegneria spicata*.

VEGETATION

Physiognomy and Structure: These are microphyllous evergreen or deciduous scrublands, with a significant component of perennial grasses. The group is structurally characterized by open to dense sagebrush or bitterbrush with associated shrubs interspersed and/or a dense understory of perennial bunch grasses.

Floristics: This shrub and shrub herbaceous group is characterized by communities dominated by *Artemisia tridentata ssp. tridentata*, *Artemisia tridentata ssp. xericensis*, *Artemisia tridentata ssp. wyomingensis*, *Artemisia tripartita ssp. tripartita*, and *Purshia tridentata*. Other associated shrubs and dwarf-shrubs may include *Arctostaphylos uva-ursi*, *Artemisia frigida*, *Chrysothamnus viscidiflorus*, *Ericameria* spp., *Peraphyllum ramosissimum*, *Philadelphus lewisii*, *Prunus virginiana*, *Ribes cereum*, *Symphoricarpos longiflorus*, and *Symphoricarpos rotundifolius*. Herbaceous layers are often dense and dominated by perennial bunchgrasses. Common graminoids include *Achnatherum hymenoides*, *Achnatherum nelsonii*, *Achnatherum occidentale*, *Achnatherum thurberianum*, *Carex pensylvanica*, *Elymus lanceolatus*, *Festuca campestris*, *Festuca idahoensis*, *Hesperostipa comata*, *Koeleria macrantha*, *Leymus cinereus*, *Muhlenbergia montana*, *Pascopyrum smithii*, *Poa secunda*, and *Pseudoroegneria spicata*. Forbs are often diverse and have moderate to low cover. Species may include *Balsamorhiza sagittata*, *Eriogonum umbellatum*, or *Penstemon deustus*. In some cases scattered trees may form an emergent layer of individual trees; species include *Cercocarpus ledifolius*, *Juniperus occidentalis*, *Juniperus osteosperma*, *Juniperus scopulorum*, or *Pinus ponderosa*.

ENVIRONMENT & DYNAMICS

Environmental Description: This widespread matrix-forming group occurs throughout much of the western U.S. between elevations of 600 m in the northern extents to 2500 m in southern range limits. This group may occur on stream terraces, point bars, valley floors, alluvial fans, floodplains, washes, gullies, stabilized dunes, mesic uplands, swales, and rocky slopes. Slopes are variable from gentle to very steep. *Climate:* The climate where this group occurs is semi-arid with annual precipitation ranging from 18-40 cm and high inter-annual variation. Much of the precipitation falls as snow, and growing-season drought is characteristic. Temperatures are continental with large annual and diurnal variations. *Soil/substrate/hydrology:* Soils vary from deep and well-developed to rocky and poorly developed sandy loams, loamy sands, sand, silt loams, and clay loams derived from alluvium, loess, shale, and sandstone. In drier regions, these shrublands are usually associated with perennial or ephemeral stream drainages with water tables less than 3 m from the soil surface.

Dynamics: The natural fire regime of this group likely maintains a patchy distribution of shrubs so that the general aspect of the vegetation is a grassland. Shrubs may increase following heavy grazing and/or with fire suppression, particularly in moist portions in the northern Columbia Plateau where it forms a landscape mosaic pattern with shallow-soil scabland shrublands. Response to grazing can be variable depending on the type of grazer and the season in which grazing occurs. *Hesperostipa comata* can increase in abundance in response to either grazing or fire. In central and eastern Montana (and possibly elsewhere), complexes of prairie dog towns are common in this group. Microphytic crust is very important in this group.

DISTRIBUTION

Geographic Range: This widespread matrix-forming sagebrush steppe group occurs throughout much of the western U.S. in the Columbia Plateau, Great Basin, eastern Sierra Nevada, Colorado Plateau, Wyoming Basins, Rocky Mountains, and northwestern Great Plains.

Spatial Scale & Pattern [optional]: Matrix, Large patch

Nations: CA, US

States/Provinces: BC, CA, CO, ID, MT, ND, NV, OR, SD?, UT, WA, WY

TNC Ecoregions [optional]: 4:P, 6:C, 8:C, 9:C, 10:C, 11:C, 18:C, 19:C, 20:C, 26:C, 68:C

USFS Ecoregions (2007): 313A:CC, 331D:CC, 331G:CC, 341A:CC, 341B:CC, 342A:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:C?, 342I:CC, M242C:CC, M261G:CC, M331A:CC, M331D:CC, M331E:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:C?, M332D:CC, M332E:CC, M332F:CC, M332G:CC

Omerik Ecoregions:

Federal Lands [optional]: NPS (Arches, Curecanti, Dinosaur, Fossil Butte, Golden Spike, Grand Teton?, John Day Fossil Beds, Mesa Verde, Natural Bridges, Zion); USFS (Arapaho-Roosevelt, Bridger-Teton, Shoshone); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low. USNVC Confidence from peer reviewer, not AE.

SYNONYMY

- = Western Intermountain sagebrush steppe (West 1983c)

LOWER LEVEL UNITS

Alliances:

- A3179 *Purshia tridentata* - *Artemisia tridentata* Mesic Steppe & Shrubland Alliance
- A3183 *Artemisia tridentata* ssp. *tridentata* - *Artemisia tridentata* ssp. *xericensis* Mesic Steppe & Shrubland Alliance
- A1528 *Artemisia tripartita* ssp. *tripartita* - *Artemisia tridentata* Mesic Steppe & Shrubland Alliance
- A3182 *Artemisia tridentata* ssp. *wyomingensis* Mesic Steppe & Shrubland Alliance

AUTHORSHIP

Primary Concept Source: N.E. West (1983c)

Author of Description: M.E. Hall and K.A. Schulz

Acknowledgments:

Version Date: 11/06/2015

Classif Resp Region: West

Internal Author: MEH/KAS 3-10, mod. KAS 11-15

REFERENCES

References: Barbour and Billings 1988, Barbour and Major 1977, Barbour and Major 1988, Brown 1982a, Brown et al. 1979, Daubenmire 1970, Faber-Langendoen et al. 2017a, Hironaka et al. 1983, Holland and Keil 1995, Knight 1994, Mueggler and Stewart 1980, Shiflet 1994, West 1983a, West 1983c

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G302. Intermountain Mesic Tall Sagebrush Steppe & Shrubland

A3183. *Artemisia tridentata* ssp. *tridentata* - *Artemisia tridentata* ssp. *xericensis* Mesic Steppe & Shrubland Alliance

Type Concept Sentence: This mesic shrubland and steppe alliance occurs throughout the Intermountain West on sloping fans, footslopes, rolling hills, and especially deep, well-drained alluvial bottomlands with vegetation characterized by an open to moderately dense (10-70% cover) shrub layer of *Artemisia tridentata* ssp. *tridentata* or *Artemisia tridentata* ssp. *xericensis* and a sparse to dense herbaceous layer dominated by perennial bunchgrasses, especially *Elymus lanceolatus*, *Festuca idahoensis*, *Hesperostipa comata*, *Leymus cinereus*, *Pascopyrum smithii*, and *Pseudoroegneria spicata*.

OVERVIEW

Scientific Name: *Artemisia tridentata* ssp. *tridentata* - *Artemisia tridentata* ssp. *xericensis* Mesic Steppe & Shrubland Alliance

Common Name (Translated Scientific Name): Basin Big Sagebrush - Foothill Big Sagebrush Mesic Steppe & Shrubland Alliance

Colloquial Name: Basin Big Sagebrush - Foothill Big Sagebrush Mesic Steppe & Shrubland

Type Concept: This mesic shrubland and steppe alliance occur throughout the Intermountain West from the western Great Basin to the northern Rocky Mountains, the Columbian Basin and Colorado Plateau. The vegetation included in this alliance is characterized by a somewhat sparse to moderately dense (10-70% cover) shrub layer of *Artemisia tridentata* ssp. *tridentata* or *Artemisia tridentata* ssp. *xericensis*. Shrub associates include *Ericameria nauseosa* (= *Chrysothamnus nauseosus*) or *Chrysothamnus viscidiflorus* which increase with disturbance. Other shrubs occasionally present include *Atriplex* spp., *Gutierrezia sarothrae*, and *Symphoricarpos longiflorus*. Occasionally individual trees are present in some stands. The sparse to dense herbaceous layer is dominated by bunchgrasses that occupy patches in the shrub matrix. The most widespread species is *Pseudoroegneria spicata*, which occurs from the Columbia Basin to the Northern Rockies. Other locally dominant or important species include *Elymus elymoides*, *Elymus lanceolatus*, *Festuca idahoensis*, *Hesperostipa comata* (= *Stipa comata*), *Koeleria macrantha*, *Leymus cinereus*, *Muhlenbergia*

richardsonis, *Pascopyrum smithii*, *Pleuraphis jamesii* (= *Hilaria jamesii*), and *Poa secunda*. Forbs are generally of low importance and are highly variable across the range. Mosses and lichens are important ground cover in some stands. This mesic shrubland and steppe alliance occurs on sloping fans, footslopes, rolling hills, and especially deep, well-drained alluvial bottomlands.

Classification Comments: This mesic shrubland and steppe alliance occurs as large patch/matrix stands in relatively mesic northern latitudes. However, in semi-arid landscapes in more southern latitudes, it frequently occurs in smaller patch stands restricted to relatively mesic sites, such as swales and basins, that receive additional moisture from surrounding slopes, and at higher elevations.

The subspecies of *Artemisia tridentata* occurring in some associations included in this alliance are not determined, inconsistent or may be mixed. As the subspecies in stands in this alliance are determined, some associations can be moved or split and placed into these other alliances. Further study is needed to re-apportion communities within this alliance or justify the current classification. Mueggler and Stewart (1980) describe two *Artemisia tridentata* habitat types, one with *Festuca campestris* diagnostic and the other with *Festuca idahoensis*. The first one includes both *ssp. vaseyana* and *ssp. wyomingensis* depending on elevation. They cite an *Artemisia tridentata ssp. tridentata* / *Festuca idahoensis* Habitat Type from eastern Washington (Daubenmire 1970). Dick-Peddie (1993) described several vegetation types that may be classified in this alliance from four shrub-grass series in New Mexico. More complete descriptions of both alliances are needed to distinguish them.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: This mesic shrubland and steppe alliance is characterized by a somewhat sparse to moderately dense (10-70% cover) shrub layer of *Artemisia tridentata ssp. tridentata* or *Artemisia tridentata ssp. xericensis*. The open to moderately dense herbaceous layer is dominated by bunchgrasses. Characteristic species are *Elymus lanceolatus*, *Festuca idahoensis*, *Hesperostipa comata*, *Leymus cinereus*, *Pascopyrum smithii*, *Poa secunda*, and *Pseudoroegneria spicata*.

VEGETATION

Physiognomy and Structure: The vegetation is characterized by a sparse cover of microphyllous evergreen shrubs, usually 1-2 m in height. Shrub cover can be variable, but on average is less than 25% for steppe sites and 10-70% cover for shrubland sites. Perennial cespitose graminoids form a matrix surrounding the shrubs in steppe, occasionally matching them in height, or form a sparse to moderately dense graminoid layer in shrublands. Forb species may be frequent, but are usually of low canopy cover. The ground surface is covered with mosses and lichens in good condition stands, except for fluvial sites.

Floristics: The vegetation included in this alliance is characterized by a somewhat sparse to moderately dense (10-70% cover) shrub layer of *Artemisia tridentata ssp. tridentata* or *Artemisia tridentata ssp. xericensis*. Shrub associates include *Ericameria nauseosa* (= *Chrysothamnus nauseosus*) or *Chrysothamnus viscidiflorus* which increase with disturbance. Other shrubs occasionally present include *Atriplex* spp., *Gutierrezia sarothrae*, and *Symphoricarpos longiflorus*. Occasionally individual trees are present in some stands. The open to dense herbaceous layer is dominated by bunchgrasses that occupy patches in the shrub matrix. The most widespread species is *Pseudoroegneria spicata*, which occurs from the Columbia Basin to the Northern Rockies. Other locally dominant or important species include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Elymus elymoides*, *Elymus lanceolatus*, *Festuca idahoensis*, *Hesperostipa comata* (= *Stipa comata*), *Koeleria macrantha*, *Leymus cinereus*, *Muhlenbergia richardsonis*, *Pascopyrum smithii*, *Pleuraphis jamesii* (= *Hilaria jamesii*), and *Poa secunda*. Forbs are generally of low importance and are highly variable across the range. Mosses and lichens are important ground cover in some stands. Diagnostic of this alliance is the *Artemisia tridentata ssp. tridentata*- or *Artemisia tridentata ssp. xericensis*-dominated shrub layer. The graminoid layer typically has >20% cover perennial graminoids or has over 40% total cover of shrubs.

ENVIRONMENT & DYNAMICS

Environmental Description: This mesic shrubland and steppe alliance occurs throughout the Intermountain West from the western Great Basin to the Colorado Plateau, northern Rocky Mountains and northwestern Great Plains. Elevation is mostly 1200-2500 m, but extends down to 240 m in the Columbia Basin. Mean annual precipitation ranges from 20-50 cm. Precipitation primarily occurs in the winter as snow or rain in the western portion of its range; however, spring and summer precipitation becomes important in the eastern portion of its range. This moisture is stored in the soil profile and utilized during the typically dry summers. Sites supporting this alliance include sloping fans, footslopes, rolling hills, and deep, well-drained alluvial bottomlands and swales. Soils are deep, fine- to medium-textured alluvial soils with some source of subirrigation during the summer season, but moderately deep upland soils with ample moisture storage also support these shrublands. Some stands occur on deep, sandy soils, or soils that are highly calcareous.

Dynamics: Complex ecological interactions between fire regimes, grazing history, and climate patterns result in equally complex patterns of species structure and composition in *Artemisia tridentata*. These present corresponding difficulties in the classification of

these shrublands, which have been compounded by the influence of human settlement and agricultural patterns. What follows is a summary of some of the influences of altered fire regimes and grazing history on *Artemisia tridentata* shrublands and shrub-herbaceous vegetation that can result in the conversion of stands of this alliance into stands of exotic annual grassland. Exotic plants have invaded many stands, especially where disturbed (Daubenmire 1970). Common exotics may include annual grasses such as *Bromus tectorum*, *Bromus arvensis*, and *Bromus briziformis* which may be abundant during wet years; and annual forbs such as *Epilobium brachycarpum*, *Erodium cicutarium*, *Lactuca serriola*, *Tragopogon dubius*, and the perennial forb *Hypericum perforatum*. The winter precipitation recharges soil moisture, and the typically dry summers favor shrubs and deep-rooted grasses (West 1983c, 1988). The exotic annual grass *Bromus tectorum* competes favorably with these cool-season, perennial bunchgrasses in these stands by germinating in the fall, establishing a root system during the winter, then utilizing and depleting soil moisture early in the spring while the bunchgrasses are still mostly dormant (West 1983c).

Artemisia tridentata (*ssp. tridentata*, *ssp. xericensis*) shrub-herbaceous communities may represent either moister or less disturbed examples of the *Artemisia tridentata* (*ssp. tridentata*, *ssp. xericensis*) shrubland complex. Shrub densities typically increase with overgrazing of the bunchgrass component or with increasing summer drought (West 1983c). *Artemisia tridentata* is inhibited by fire, and excessive grazing may decrease fire frequency due to consumption of herbaceous forage, resulting in increased shrub density. Conversely, invasion by non-native annual grasses (e.g., *Bromus tectorum*) may increase fire frequency sufficiently to eliminate the shrubs from the stands (Daubenmire 1970). With a change in fire frequency, species composition will be altered as well (West 1983c). With a high fire frequency (every 2-5 years), perennial grasses and shrubs are eliminated and non-native annual grasses dominate. At fire-return intervals of 10-30 years, short-lived resprouting shrubs, such as *Chrysothamnus* or *Tetradymia* spp. dominate. At fire intervals of 30-70 years, a mixture of perennial bunchgrasses and shrubs is maintained. Finally, in the complete absence of fire, deep-rooted shrubs such as *Artemisia tridentata* become the dominant shrubs.

DISTRIBUTION

Geographic Range: This shrubland and steppe alliance occurs throughout the Intermountain West from the western Great Basin to the Colorado Plateau, northern Rocky Mountains and northwestern Great Plains.

Nations: CA, US

States/Provinces: BC?, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Artemisia tridentata ssp. tridentata* / *Festuca idahoensis* habitat type (Daubenmire 1970)
- >< *Artemisia tridentata ssp. tridentata* and *ssp. wyomingensis* Shrub Steppe (Chappell et al. 1997)
- > *Artemisia tridentata*-*Agropyron spicatum* habitat type (Daubenmire 1970)
- > *Artemisia tridentata*/*Agropyron spicatum* Habitat Type (Hironaka et al. 1983)
- < *Artemisia tridentata* Series (Mueggler and Stewart 1980)
- >< Big Sagebrush Scrub (#35210) (Holland 1986b)
- < Big Sagebrush Series (Sawyer and Keeler-Wolf 1995)
- < Great Basin Sagebrush (*Artemisia*), #32 (Küchler 1964)
- > SRM Cover Type #314 - Big Sagebrush-Bluebunch Wheatgrass (Shiflet 1994)
- < Sagebrush Steppe (*Artemisia*-*Agropyron*) (Küchler 1964)

LOWER LEVEL UNITS

Associations:

- CEG001530 *Artemisia tridentata* / *Festuca idahoensis* Shrub Grassland
- CEG001017 *Artemisia tridentata ssp. tridentata* / *Pascopyrum smithii* - (*Elymus lanceolatus*) Shrubland
- CEG001019 *Artemisia tridentata* (*ssp. tridentata*, *ssp. xericensis*) / *Pseudoroegneria spicata* - *Poa secunda* Shrub Grassland
- CEG001016 *Artemisia tridentata ssp. tridentata* / *Leymus cinereus* Shrubland
- CEG001012 *Artemisia tridentata* / *Symphoricarpos longiflorus* Shrubland
- CEG001014 *Artemisia tridentata ssp. tridentata* / *Festuca idahoensis* Shrubland
- CEG002966 *Artemisia tridentata ssp. tridentata* / *Hesperostipa comata* Shrubland
- CEG001458 *Artemisia tridentata* / *Leymus cinereus* Shrub Grassland
- CEG001018 *Artemisia tridentata* (*ssp. tridentata*, *ssp. xericensis*) / *Pseudoroegneria spicata* Shrub Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Blackburn et al. 1968a, Blackburn et al. 1968c, Blackhawk Coal Company 1981, Brotherson and Brotherson 1979, Caicco and Wellner 1983k, Chappell et al. 1997, Dastrup 1963, Daubenmire 1970, Daubenmire 1992, Dick-Peddie 1993, Faber-Langendoen et al. 1996, Faber-Langendoen et al. 2017b, Graham 1937, Hall 1973, Hansen 1985, Hansen et al. 1984, Hironaka 1978, Hironaka et al. 1983, Hirsch 1985, Holland 1986b, Jensen et al. 1988a, K uchler 1964, Mariah Associates 1981, McArthur and Welch 1986, McLean 1970, Mooney 1985, Mueggler and Stewart 1980, ORNHP unpubl. data, Poulton 1955, Ralston 1969, Sawyer and Keeler-Wolf 1995, Shiflet 1994, Thilenius et al. 1995, Tisdale 1947, Tweit and Houston 1980, USFS 1992, Van Pelt 1978, West 1983c, West 1988

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G302. Intermountain Mesic Tall Sagebrush Steppe & Shrubland

A3182. *Artemisia tridentata* ssp. *wyomingensis* Mesic Steppe & Shrubland Alliance

Type Concept Sentence: This mesic shrubland and steppe alliance is found in the western United States and southwestern Canada and is characterized by an open to dense (10-70% cover) shrub layer that is dominated (or codominated with at least 40% relative cover in mixed stands) by *Artemisia tridentata* ssp. *wyomingensis*. Common associates include *Atriplex confertifolia*, *Artemisia frigida*, *Krascheninnikovia lanata*, *Purshia tridentata*, and *Symphoricarpos longiflorus*.

OVERVIEW

Scientific Name: *Artemisia tridentata* ssp. *wyomingensis* Mesic Steppe & Shrubland Alliance

Common Name (Translated Scientific Name): Wyoming Big Sagebrush Mesic Steppe & Shrubland Alliance

Colloquial Name: Wyoming Big Sagebrush Mesic Steppe & Shrubland

Type Concept: This mesic shrubland and steppe alliance is found in the western United States and southwestern Canada and is characterized by an open to dense (10-70% cover) shrub layer that is dominated (or codominated with at least 40% relative cover in mixed stands) by *Artemisia tridentata* ssp. *wyomingensis*. Common associates include *Atriplex confertifolia*, *Artemisia frigida*, *Krascheninnikovia lanata*, *Purshia tridentata*, and *Symphoricarpos longiflorus*. The herbaceous stratum can be diverse and have open to dense cover, but perennial graminoids typically total >20% cover. Characteristic dominant species are *Balsamorhiza sagittata*, *Hesperostipa comata*, *Pascopyrum smithii*, *Poa secunda*, and *Pseudoroegneria spicata*. Stands occur on flat to steeply sloping upland sites. Sites with little slope tend to have deep soils, while those with steeper slopes have shallow to moderately deep soils. Soil texture is loam, sandy loam, or clay loam with coarse fragments common in the soil profile.

Classification Comments: This mesic shrubland and steppe alliance occurs as large patch/matrix stands in relatively mesic northern latitudes. However, in semi-arid landscapes in more southern latitudes, it frequently occurs in smaller patch stands restricted to relatively mesic sites, such as swales and basins, that receive additional moisture from surrounding slopes and at higher elevations.

Associations with undetermined subspecies of *Artemisia tridentata* from old alliances *Artemisia tridentata* Shrubland Alliance (A.829) and *Artemisia tridentata* Shrub Herbaceous Alliance (A.1521) were reviewed and placed into either *Artemisia tridentata* ssp. *wyomingensis* Mesic Steppe & Shrubland Alliance (A3182) or *Artemisia tridentata* ssp. *tridentata* - *Artemisia tridentata* ssp. *xericensis* Mesic Steppe & Shrubland Alliance (A3183). More review would increase confidence of placement. *Artemisia tridentata* ssp. *wyomingensis* - *Peraphyllum ramosissimum* / *Festuca idahoensis* Shrubland (CEGL001048) was placed in this alliance (A3182) instead of *Artemisia tridentata* - Mixed Shrub Dry Shrubland Alliance (A3198) because it is a relatively mesic shrubland, and the current concept of the association only requires *Peraphyllum ramosissimum* be present to codominant (1-20% cover), so it is not a reliable *Artemisia tridentata* - mixed shrub stand. Currently, this alliance includes stands in North Dakota In the northwestern Great Plains.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: This mesic steppe and shrubland alliance has an open to moderately dense conspicuous shrub layer dominated by diagnostic shrub *Artemisia tridentata* ssp. *wyomingensis*. Associated shrubs include *Atriplex confertifolia*, *Artemisia frigida*, *Purshia tridentata*, and *Krascheninnikovia lanata*. The herbaceous layer ranges from open to moderate cover, but perennial graminoids typically total >20% cover. Characteristic dominant species are *Balsamorhiza sagittata*, *Hesperostipa comata*, *Pascopyrum smithii*, *Poa secunda*, and *Pseudoroegneria spicata*.

VEGETATION

Physiognomy and Structure: This alliance is characterized by an open to dense (10-70%) cover of microphyllous evergreen shrubs, usually 0.3-1 m in height, although in Washington the shrubs may be up to 2 m tall. Cespitose graminoids are usually dominant, often matching, and sometimes exceeding, the shrubs in height or cover. Forb species may be frequent, but are usually of low canopy cover. With increasing summer rain in the eastern portion of the range, there is a corresponding increase in the proportion of sod-forming grasses as compared to bunchgrasses. Undisturbed stands in Washington and Oregon may have a nearly continuous cryptogamic soil crust of mosses and lichens.

Floristics: Shrubs are conspicuous in this alliance, but herbaceous species usually have equal or greater cover. The vegetation included in this alliance is characterized by an open to moderately dense (10-70% cover) shrub layer that is dominated (or codominated with at least 40% relative cover in mixed stands) by *Artemisia tridentata ssp. wyomingensis*. Common associated shrubs are *Artemisia frigida*, *Chrysothamnus* spp., *Ericameria* spp., *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Peraphyllum ramosissimum*, and *Symphoricarpos longiflorus*. The herbaceous stratum can be diverse and have open to moderate cover, but perennial graminoids typically total <20% cover. The most widespread and common species are *Pseudoroegneria spicata*, which occurs from the Columbia Basin to the Northern Rockies, and *Pascopyrum smithii*, which is more common in the northwestern Great Plains. Other locally abundant grass associates include *Achnatherum thurberianum* (= *Stipa thurberiana*) (in the western portion of the range), *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Bouteloua curtipendula*, *Bouteloua gracilis*, *Carex filifolia*, *Elymus lanceolatus*, *Hesperostipa comata* (= *Stipa comata*), *Koeleria macrantha*, *Leymus ambiguus*, and *Poa secunda*. Forbs form a minor and highly variable portion of this vegetation. Recurrent species include *Achillea millefolium*, *Balsamorhiza sagittata*, *Camelina microcarpa*, *Erigeron* spp., *Opuntia* spp., *Phlox* spp., and *Sphaeralcea coccinea*. Mosses and lichens, such as *Selaginella densa* and *Tortula ruralis*, may occur on bare ground. Where there is supplemental moisture or where the vegetation grades into forest, emergent needle-leaved evergreen or cold-deciduous trees may be scattered through these shrub-steppe communities. Recurrent tree associates include *Juniperus occidentalis*, *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus contorta*, *Pinus edulis*, *Pinus flexilis*, *Pinus ponderosa*, and *Populus tremuloides*.

ENVIRONMENT & DYNAMICS

Environmental Description: This mesic steppe and shrubland alliance is found in the western United States and southwestern Canada from the Columbia River Basin south and east across the Great Basin to the northern Rocky Mountains and northwestern Great Plains. Climates range from semi-arid in the western Great Basin to subhumid in the Rocky Mountains and northern plains. The amount and reliability of growing-season moisture increase eastward and with increasing elevation. The associations in this alliance occur in somewhat wetter areas of the range of *Artemisia tridentata ssp. wyomingensis*, generally with over 25 cm annual precipitation or with a significant proportion falling in the growing season. These communities occur at elevations of less than 1000 m in the Columbia Basin and northern Great Plains to over 2500 m in the Rocky Mountains and Great Basin ranges. The alliance occurs on flat to steeply sloping upland sites. Sites with little slope tend to have deep soils, while those with steeper slopes have shallow to moderately deep soils (USFS 1992). Soil texture is loam, sandy loam, or clay loam (Hansen and Hoffman 1988), which allows ample shallow rainfall storage and percolation of snowmelt. Coarse fragments are common in the soil profile. Hironaka et al. (1983) reported that most of their *Artemisia tridentata ssp. wyomingensis* habitat types occurred on calcareous soils, often with some form of a cemented duripan or silica-hardpan at about 1 m in depth.

In eastern Idaho and western Wyoming, *Artemisia tridentata ssp. wyomingensis* occupies somewhat dry, low-elevation sites, while *Artemisia tridentata ssp. tridentata* or *Artemisia cana* occupy deep alluvial soils of drainage bottoms at low elevation, and *Artemisia tridentata ssp. vaseyana* occupies cooler, moister upland sites at higher elevation. In addition to *Artemisia tridentata* and *Artemisia cana*, other associated vegetation types include *Atriplex confertifolia*, *Ericameria* spp., or *Chrysothamnus* spp. shrublands, *Abies grandis*, *Pinus contorta*, *Pinus ponderosa*, *Populus tremuloides*, or *Pseudotsuga menziesii* forests, *Pinus* - *Juniperus* woodlands, or mesic herbaceous communities.

Dynamics: Stands in this alliance represent the moister communities of the *Artemisia tridentata ssp. wyomingensis*-dominated communities in Great Basin-Intermountain Tall Sagebrush Steppe & Shrubland Macrogroup (M169). Shrub densities typically increase with overgrazing of the bunchgrass component or with increasing summer drought (West 1983c). *Artemisia tridentata* is inhibited by fire, and excessive grazing may decrease fire frequency due to consumption of herbaceous forage, resulting in increased shrub density. Conversely, invasion by non-native annual grasses (e.g., *Bromus tectorum*, *Bromus arvensis*) may increase fire frequency sufficiently to eliminate the shrubs from the stands (Daubenmire 1970). With a change in fire frequency, species composition will be altered as well (West 1983c). With a high fire frequency (every 2-5 years), perennial grasses and shrubs are eliminated and non-native annual grasses dominate. At fire-return intervals of 10-30 years, short-lived resprouting shrubs such as *Chrysothamnus* or *Tetradymia* spp. dominate. At fire intervals of 30-70 years, a mixture of perennial bunchgrasses and shrubs is maintained. Finally, in the complete absence of fire, deep-rooted shrubs such as *Artemisia tridentata* become the theoretical dominants.

DISTRIBUTION

Geographic Range: This mesic alliance occurs from northeastern California and eastern Oregon across the Great Basin, Utah and habitats of the Rocky Mountains to the northern Great Plains of Montana, Wyoming, and into western North and South Dakota. Associations are also reported from the intermountain parks of Colorado, and from British Columbia, Canada. The alliance has not been reported from either Arizona or New Mexico but may occur there.

Nations: CA, US

States/Provinces: AZ?, BC?, CA, CO, ID, MT, ND, NM?, NV, OR, SD, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- >< Big Sagebrush Series (Sawyer and Keeler-Wolf 1995)
- >< SRM Cover Type #314 - Big Sagebrush-Bluebunch Wheatgrass (Shiflet 1994)
- >< SRM Cover Type #315 - Big Sagebrush-Idaho Fescue (Shiflet 1994)
- = SRM Cover Type #403 - Wyoming Big Sagebrush (Shiflet 1994)
- < SRM Cover Type #612 - Sagebrush - Grass (Shiflet 1994)
- >< Western Shrub and Grasslands Combinations: 55: Sagebrush-Steppe (*Artemisia-Agropyron*) (Küchler 1964)
- >< Western Shrub: 38: Great Basin Sagebrush (*Artemisia*) (Küchler 1964)

LOWER LEVEL UNITS**Associations:**

- CEG001535 *Artemisia tridentata ssp. wyomingensis* / *Pseudoroegneria spicata* Shrub Grassland
- CEG001050 *Artemisia tridentata ssp. wyomingensis* - *Purshia tridentata* / *Pseudoroegneria spicata* Shrubland
- CEG001051 *Artemisia tridentata ssp. wyomingensis* / *Hesperostipa comata* Shrubland
- CEG005479 *Artemisia tripartita ssp. tripartita* / *Achnatherum thurberianum* Shrubland
- CEG000994 *Artemisia tridentata ssp. wyomingensis* / *Balsamorhiza sagittata* Shrubland
- CEG001009 *Artemisia tridentata ssp. wyomingensis* / *Pseudoroegneria spicata* Shrubland
- CEG001048 *Artemisia tridentata ssp. wyomingensis* - *Peraphyllum ramosissimum* / *Festuca idahoensis* Shrubland
- CEG005478 *Artemisia tridentata ssp. wyomingensis* / *Festuca idahoensis* Shrubland
- CEG001049 *Artemisia tridentata ssp. wyomingensis* / *Poa secunda* Shrubland
- CEG001047 *Artemisia tridentata ssp. wyomingensis* / *Pascopyrum smithii* Shrub Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by D. Sarr.

Version Date: 2014/12/18

REFERENCES

References: Baker 1982b, Baker 1983c, Baker and Kennedy 1985, Bear Creek Uranium Mine Application n.d., Bighorn Coal Mine n.d., Blackburn 1967, Blackburn et al. 1968a, Blackburn et al. 1968b, Blackburn et al. 1969a, Blackburn et al. 1969b, Blackburn et al. 1969c, Blackburn et al. 1969d, Blackburn et al. 1971, Brotherson and Brotherson 1981, Brown 1971, Caicco and Wellner 1983i, Caicco and Wellner 1983j, Caicco and Wellner 1983k, Caicco and Wellner 1983l, Chappell et al. 1997, Comer 1999, Cotter-Ferguson Project n.d., Daubenmire 1970, Day and Wright 1985, DeVelice and Lesica 1993, DeVelice et al. 1991, Doescher et al. 1986, Driese et al. 1997, Earth Resource Technology n.d., Ellis and Hackney 1981, Faber-Langendoen et al. 1996, Faber-Langendoen et al. 2017b, Ferchau 1973, Fisser 1964, Fisser 1970, Francis 1983, Giese 1975, Gross 1955, Hall 1973, Hansen and Hoffman 1988, Heinze et al. 1962, Hess 1981, Hess and Wasser 1982, Hironaka 1978, Hironaka et al. 1983, Jensen et al. 1988a, Johnson and Simon 1987, Johnston 1987, Keammerer 1987, Knight 1994, Knight et al. 1987, Komarkova 1986, Küchler 1964, Leucite Hills Mine Application n.d., Lewis 1975a, Lucky McMine Application n.d., Lundberg 1977, Marr et al. 1979, McArthur and Welch 1986, McLean 1970, Moretti 1979, Moretti and Brotherson 1982, Mueggler and Stewart 1980, Nichols 1964a, Nichols 1964b, Northwest Resources Co. 1981, ORNHP unpubl. data, Poulton 1955, Sawyer and Keeler-Wolf 1995, Seminoe I Mine Application n.d., Shiflet 1994, Skull Point Mine Application n.d., Skull Point Mine Permit Renewal n.d., Smith n.d.b, Steger 1970, Stoecker-Keammerer Consultants n.d.a, Strong 1980, Sweetwater Uranium Project 1978, Sweetwater Uranium Project n.d., Terwilliger et al. 1979a, Thorne Ecological Institute 1973a, Thorne Ecological Institute 1973b, Tiedemann et al. 1987, Tisdale 1947, Tweit and Houston 1980, USFS 1992, Van Pelt 1978, West 1983c, West et al. 1984, Winward 1970

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G302. Intermountain Mesic Tall Sagebrush Steppe & Shrubland

A1528. *Artemisia tripartita* ssp. *tripartita* - *Artemisia tridentata* Mesic Steppe & Shrubland Alliance

Type Concept Sentence: This mesic alliance is distributed from the Columbia Basin east to the northern Rocky Mountains and is characterized by an open to moderately dense shrub layer dominated or codominated by *Artemisia tripartita* with 10-25% cover and with herbaceous species having equal or greater coverage than shrubs.

OVERVIEW

Scientific Name: *Artemisia tripartita* ssp. *tripartita* - *Artemisia tridentata* Mesic Steppe & Shrubland Alliance

Common Name (Translated Scientific Name): Threetip Sagebrush - Big Sagebrush Mesic Steppe & Shrubland Alliance

Colloquial Name: Threetip Sagebrush - Big Sagebrush Mesic Steppe & Shrubland

Type Concept: This mesic shrubland and steppe alliance is distributed from the Columbia Basin east to the northern Rocky Mountains and is characterized by an open to moderately dense shrub layer dominated or codominated by *Artemisia tripartita* with 10-25% cover and with herbaceous species having equal or greater coverage than shrubs. Common shrub associates include *Artemisia frigida*, *Artemisia tridentata* ssp. *tridentata*, *Artemisia tridentata* ssp. *vaseyana*, *Chrysothamnus viscidiflorus*, *Krascheninnikovia lanata*, *Purshia tridentata*, or *Tetradymia canescens*. The herbaceous stratum is typically dominated by graminoids and of moderate to moderately high cover (20-70%). *Pseudoroegneria spicata* and *Festuca idahoensis* are the most common associates. Other locally abundant graminoid species include *Bouteloua curtipendula*, *Bouteloua gracilis*, *Carex filifolia*, *Festuca campestris*, *Hesperostipa comata* (= *Stipa comata*), and *Koeleria macrantha*. Forbs form a minor and highly variable portion of this vegetation. Recurrent species include *Achillea millefolium*, *Balsamorhiza sagittata*, *Camelina microcarpa*, *Erigeron* spp., *Opuntia* spp., *Phlox* spp., and *Sphaeralcea coccinea*. Climate ranges from semi-arid in intermountain basins to subhumid in higher elevations of the Rocky Mountains. Stands occur on flat to steeply sloping upland sites. Soil texture is loam, sandy loam, or clay loam, but is highly variable.

Classification Comments: This mesic shrubland and steppe alliance occurs as large patch/matrix stands in relatively mesic northern latitudes. However, in semi-arid landscapes in more southern latitudes, it frequently occurs in smaller patch stands restricted to relatively mesic sites, such as swales and basins, that receive additional moisture from surrounding slopes and at higher elevations.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Vegetation in this mesic shrubland and steppe is characterized by an open, conspicuous shrub layer with herbaceous species having equal or greater coverage with diagnostic species *Artemisia tripartita* dominant to codominant with 10-25% cover. Other characteristic shrubs include *Artemisia frigida*, *Artemisia tridentata* ssp. *tridentata*, *Artemisia tridentata* ssp. *vaseyana*, *Chrysothamnus viscidiflorus*, *Krascheninnikovia lanata*, *Purshia tridentata*, or *Tetradymia canescens*. The herbaceous layer is dominated by graminoids with moderate to moderately high cover (25-70%). Characteristic and often dominant grasses are *Festuca campestris*, *Festuca idahoensis*, *Hesperostipa comata*, *Leymus cinereus*, and *Pseudoroegneria spicata*.

VEGETATION

Physiognomy and Structure: This alliance is characterized by an open to moderately dense (10-25%) cover of microphyllous evergreen shrubs, usually 0.3-1 m in height. Cespitose graminoids are usually prominent, and exceed the shrubs in height and/or cover. Forb species may be frequent or not, but are usually of low canopy cover.

Floristics: This mesic shrubland and steppe alliance is characterized by an open to moderately dense shrub layer dominated or codominated by *Artemisia tripartita* with 10-25% cover and with herbaceous species having equal or greater coverage than shrubs. Common shrub associates include *Artemisia frigida*, *Artemisia tridentata* ssp. *tridentata*, *Artemisia tridentata* ssp. *vaseyana*, *Chrysothamnus viscidiflorus*, *Krascheninnikovia lanata*, *Purshia tridentata*, or *Tetradymia canescens*. The herbaceous stratum is typically dominated by graminoids of moderate to moderately high cover (20-70%). *Pseudoroegneria spicata* and *Festuca idahoensis* are the most common associates. Other locally abundant graminoid species include *Bouteloua curtipendula*, *Bouteloua gracilis*, *Carex filifolia*, *Festuca campestris*, *Hesperostipa comata* (= *Stipa comata*), and *Koeleria macrantha*. Forbs form a minor and highly variable portion of this vegetation. Recurrent species include *Achillea millefolium*, *Balsamorhiza sagittata*, *Camelina microcarpa*, *Erigeron* spp., *Opuntia* spp., *Phlox* spp., and *Sphaeralcea coccinea*.

ENVIRONMENT & DYNAMICS

Environmental Description: This mesic shrubland and steppe alliance is distributed from the Columbia Basin east to the northern Rocky Mountains. Climate ranges from semi-arid in intermountain basins to subhumid in higher elevations of the Rocky Mountains. The amount and reliability of growing-season moisture increase eastward and with increasing altitude, generally averaging 25-35 cm annually. These communities occur from elevations of less than 1000 m in the Columbia Basin to over 2500 m in the Rocky Mountains. The alliance occurs on flat to steeply sloping upland sites. Sites with little slope tend to have deeper soils, while those with steeper slopes have shallow to moderately deep soils. Soil texture is loam, sandy loam, or clay loam, but is highly variable (Hironaka et al. 1983). *Artemisia cana*- or *Artemisia tridentata ssp. wyomingensis*-dominated communities often occupy lower elevations, and *Artemisia tridentata ssp. vaseyana*-dominated communities occupy cooler, moister upland sites at higher elevation. Other adjacent vegetation types across the range of this alliance include *Atriplex confertifolia*, *Chrysothamnus* spp., or *Artemisia nova* shrublands, *Populus tremuloides*, *Pinus ponderosa*, *Pinus contorta*, *Abies grandis*, or *Pseudotsuga menziesii* forests, *Pinus - Juniperus* woodlands, shortgrass and mixed-grass prairie, or mesic montane meadow communities.

Dynamics: *Artemisia tripartita* is able to resprout following fire, and dominance by the shrub is favored in overgrazed ranges (Hironaka et al. 1983). Populations may have variation in this ability (Hironaka et al. 1983). *Artemisia tripartita ssp. tripartita* occurs from the Continental Divide of Wyoming to the Columbia Basin of Washington. This subspecies has an erect growth form and may reach 2 m in height. *Artemisia tripartita ssp. rupicola* occurs east of the Continental Divide in Wyoming and forms low, layered shrubs less than 0.3 m in height (Fisser 1962). Growth trials of the two subspecies under similar conditions have shown that these morphological characteristics are genetic rather than environmentally controlled (Fisser 1962).

DISTRIBUTION

Geographic Range: This alliance occurs from eastern Washington and British Columbia, across the upper Columbia Basin to various habitats in the Rocky Mountains of Montana, Wyoming, and Colorado.

Nations: CA, US

States/Provinces: BC, CO, ID, MT, OR, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = SRM Cover Type #404 - Threetip Sagebrush (Shiflet 1994)

LOWER LEVEL UNITS

Associations:

- CEGLO01538 *Artemisia tripartita ssp. tripartita* / *Pseudoroegneria spicata* Shrub Grassland
- CEGLO05482 *Artemisia tripartita ssp. tripartita* / *Pascopyrum smithii* Shrubland
- CEGLO02994 *Artemisia tripartita ssp. tripartita* / *Leymus cinereus* Shrub Grassland
- CEGLO01536 *Artemisia tripartita ssp. tripartita* / *Festuca idahoensis* Shrub Grassland
- CEGLO05483 *Artemisia tripartita ssp. tripartita* / *Poa secunda* Shrubland
- CEGLO01537 *Artemisia tripartita ssp. tripartita* / *Festuca campestris* Shrub Grassland
- CEGLO01539 *Artemisia tripartita ssp. tripartita* / *Hesperostipa comata* Shrub Grassland
- CEGLO05481 *Artemisia tripartita ssp. tripartita* / *Koeleria macrantha* Shrubland

AUTHORSHIP

Primary Concept Source: D. Sarr and M.S. Reid, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by D. Sarr and M.S. Reid.

Version Date: 2014/12/18

REFERENCES

References: Caicco and Wellner 1983h, Caicco and Wellner 1983i, Caicco and Wellner 1983j, Chappell et al. 1997, Daubenmire 1970, Faber-Langendoen et al. 2017b, Fisser 1962, Hess 1981, Hironaka et al. 1983, Johnston 1987, McLean 1970, Mueggler and Stewart 1980, Shiflet 1994, Tweit and Houston 1980, WNHP unpubl. data

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G302. Intermountain Mesic Tall Sagebrush Steppe & Shrubland

A3179. *Purshia tridentata* - *Artemisia tridentata* Mesic Steppe & Shrubland Alliance

Type Concept Sentence: This mesic alliance occurs throughout the Intermountain West and is characterized by an open to moderately dense short-shrub layer dominated or codominated by *Purshia tridentata* with *Artemisia tridentata* and sometimes *Prunus virginiana* present to codominant. The understory is sparse to dense and typically dominated by perennial bunchgrasses such as *Achnatherum hymenoides*, *Achnatherum nelsonii*, *Achnatherum occidentale*, *Festuca campestris*, *Festuca idahoensis*, *Hesperostipa comata*, *Leymus cinereus*, *Poa secunda*, and *Pseudoroegneria spicata*.

OVERVIEW

Scientific Name: *Purshia tridentata* - *Artemisia tridentata* Mesic Steppe & Shrubland Alliance

Common Name (Translated Scientific Name): Antelope Bitterbrush - Big Sagebrush Mesic Steppe & Shrubland Alliance

Colloquial Name: Antelope Bitterbrush - Big Sagebrush Mesic Steppe & Shrubland

Type Concept: This mesic shrubland and steppe alliance occurs throughout the Intermountain West and occurs over a broad range of landforms and microhabitats. Stands are characterized by an open to moderately dense short-shrub layer dominated or codominated by *Purshia tridentata* with *Artemisia tridentata* and sometimes *Prunus virginiana* present to codominant. Other important shrubs include *Ericameria nauseosa* (= *Chrysothamnus nauseosus*), *Eriogonum heracleoides*, *Ribes cereum*, and *Symphoricarpos oreophilus*. The understory is sparse to dense and typically dominated by perennial bunchgrasses such as *Achnatherum hymenoides*, *Achnatherum nelsonii*, *Achnatherum occidentale*, *Festuca campestris*, *Festuca idahoensis*, *Hesperostipa comata*, *Leymus cinereus*, *Poa secunda*, and *Pseudoroegneria spicata*. Some stands may have a well-developed forb component composed of *Arabis holboellii*, *Achillea millefolium*, *Balsamorhiza sagittata*, *Brodiaea* spp., *Eriogonum ovalifolium*, *Eriogonum umbellatum*, *Lithospermum ruderale*, and *Pteryxia terebinthina* (= *Cymopterus terebinthinus*). Mosses and lichens are important in some stands. Scattered trees may form an emergent layer of individual trees. Stands occur on flats to moderate slopes in foothills, on slopes of lakebeds with ash or pumice soils, and on drier sites within lower forest zones as shrub-steppe inclusions in forest. In Idaho, the alliance is reported from stabilized dunes. In general, it is an upland type associated with coarse, well-drained soils without high salinity or pH. Adjacent vegetation is typically *Artemisia* steppe, *Pseudoroegneria* - *Poa* - *Festuca* grasslands, or *Pinus flexilis* woodlands.

Classification Comments: This mesic shrubland and steppe alliance occurs as large patch/matrix stands in relatively mesic northern latitudes. However, in semi-arid landscapes in more southern latitudes, it frequently occurs in smaller patch stands restricted to relatively mesic sites, such as swales and basins, that receive additional moisture from surrounding slopes and at higher elevations.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Stands in this mesic shrubland and steppe alliance are dominated or codominated by *Purshia tridentata* with *Artemisia tridentata* and sometimes *Prunus virginiana* present to codominant. Characteristic herbaceous species are *Achnatherum hymenoides*, *Achnatherum nelsonii*, *Achnatherum occidentale*, *Carex pensylvanica*, *Eriogonum umbellatum*, *Festuca campestris*, *Festuca idahoensis*, *Hesperostipa comata*, *Leymus cinereus*, *Poa secunda*, and *Pseudoroegneria spicata*.

VEGETATION

Physiognomy and Structure: This alliance has a moderately dense to open (20-60% cover) microphyllous evergreen (or late cold-deciduous) shrublands with the dominant shrubs varying from 0.5-3 m in height. Maximum shrub height generally decreases with latitude and altitude, reaching a minimum in subalpine stands. A second tier of microphyllous evergreen or cold-deciduous shrubs may be present. Cespitose graminoids are typical herbaceous associates and may strongly dominate the ground layer. Some regional variants may have a substantial forb component as well. Lichens and mosses may cover the ground surface in good condition stands.

Floristics: This mesic shrubland and steppe alliance is characterized by an open to moderately dense short-shrub layer dominated or codominated by *Purshia tridentata* with *Artemisia tridentata* and sometimes *Prunus virginiana* present to codominant. Other important or occasional shrubs include *Artemisia frigida*, *Ceanothus velutinus*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa* (= *Chrysothamnus nauseosus*), *Eriogonum heracleoides*, *Ribes cereum*, and *Symphoricarpos oreophilus*. Scattered trees may form an emergent layer of individual trees; species include *Cercocarpus ledifolius*, *Juniperus occidentalis*, *Juniperus osteosperma*, *Juniperus scopulorum*, *Pinus ponderosa*, *Pinus jeffreyi*, *Pinus ponderosa* var. *washoensis* (= *Pinus washoensis*), *Quercus garryana*, or *Yucca brevifolia*. The understory is sparse to dense and typically dominated by perennial bunchgrasses such as *Achnatherum hymenoides*, *Achnatherum nelsonii*, *Achnatherum occidentale*, *Elymus lanceolatus*, *Festuca campestris*, *Festuca idahoensis*, *Hesperostipa comata*, *Koeleria macrantha*, *Leymus cinereus*, *Poa secunda*, and *Pseudoroegneria spicata*. Other graminoids include *Carex geyeri*, *Carex pensylvanica*, and *Muhlenbergia montana*. Some stands may have a well-developed forb component composed of *Arabis holboellii*,

Achillea millefolium, *Balsamorhiza sagittata*, *Brodiaea* spp., *Eriogonum ovalifolium*, *Eriogonum umbellatum*, *Lithospermum ruderales*, and *Pteryxia terebinthina* (= *Cymopterus terebinthinus*). Mosses and lichens are important in some stands. Diagnostic of this alliance is the dominance of *Purshia tridentata* in a shrub layer that is greater than 25% on average.

ENVIRONMENT & DYNAMICS

Environmental Description: This mesic shrubland and steppe alliance occurs throughout the Intermountain West over a broad range of landforms and microhabitats at elevations from 500-3000 m. Stands are often found on the margins of *Pinus ponderosa* woodlands or forests, forming the transition into sagebrush vegetation. Most of the region is arid to semi-arid with annual precipitation ranging from 15-75 cm. The entire range is under a continental temperature regime of cold winters, cool to warm summers and large diurnal variation. In the western portions of the alliance's range, summers are dry. Growing-season precipitation increases eastward and is the greatest in the Rocky Mountains. They also occur on flats to moderate slopes in foothills, on slopes of lakebeds with ash or pumice soils, and on drier sites within lower forest zones as shrub-steppe inclusions in forest. In Idaho, the alliance is reported from stabilized dunes (Chadwick and Dalke 1965). In Colorado, the alliance is found on exposed, steep (45-60% slope) mountain slopes with southerly aspects on the eastern slopes of the Front Range (Hess 1981). These sites are typically too xeric to support extensions of the surrounding coniferous forests. Parent materials are colluvial and residual metamorphic rocks which have developed into soils classified as Entisols. These soils are poorly developed and rocky, with loamy and sandy textures, and shallow A horizons over rocky C horizons. The soil surface is also moderately rocky. In general, it is an upland type associated with coarse, well-drained soils without high salinity or pH. Adjacent vegetation is typically *Artemisia* steppe, *Pseudoroegneria* - *Poa* - *Festuca* grasslands, or *Pinus flexilis* woodlands.

Dynamics: *Purshia tridentata* displays considerable plasticity in growth across its range. The variation in height and form of different populations appears to be related to ecotypic variation (Mozingo 1987). Although mycorrhizae are considered important in establishment and growth of individual plants, *Purshia tridentata* is one of the first species to colonize barren volcanic substrates following eruption. The species is valuable as winter browse for native ungulates and livestock and is used extensively. Moderate livestock utilization (<60% of the year's current growth) has been reported to stimulate twig growth the following spring (Mueggler and Stewart 1980). Sawyer and Keeler-Wolf (1995) report that stands of *Purshia tridentata* can reach 125 years of age on deep, well-drained sites, but more commonly become decadent at 30 years, and die at 40-50 years of age. Stands appear to result from either a disturbance event (such as fire), or from rare years when many seedlings survive. This results in even-aged stands (Sawyer and Keeler-Wolf 1995).

DISTRIBUTION

Geographic Range: This alliance is found in many western U.S. states and Canada, from California north and east into Oregon, Washington, Idaho, Colorado and British Columbia. The core of its range is the Columbia Basin and Columbia Plateau, Owyhee Uplands, Snake River Plain, and the Colorado Rockies. *Purshia tridentata* is one of the most widespread shrubs in the western United States.

Nations: CA, US

States/Provinces: BC, CA, ID, MT, NV, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- > *Purshia tridentata* (Bitter brush scrub) Alliance (Sawyer et al. 2009) [35.200.00]
- >< Bitterbrush Series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS

Associations:

- CEG001494 *Purshia tridentata* / *Festuca campestris* Shrub Grassland
- CEPP006746 *Purshia glandulosa* - *Artemisia tridentata* Shrubland
- CEG001497 *Purshia tridentata* / *Pseudoroegneria spicata* - *Leymus cinereus* Shrub Grassland
- CEG002674 *Purshia tridentata* / *Festuca idahoensis* Shrub Grassland
- CEG001058 *Purshia tridentata* / *Achnatherum hymenoides* Shrubland
- CEG001498 *Purshia tridentata* / *Hesperostipa comata* Shrub Grassland
- CEG001059 *Purshia tridentata* / *Poa secunda* Shrubland
- CEG001060 *Purshia tridentata* / *Prunus virginiana* Shrubland
- CEG003124 *Purshia tridentata* Shrubland [Placeholder]

- CEGLO01495 *Purshia tridentata* / *Pseudoroegneria spicata* Shrub Grassland
- CEGLO03477 *Purshia tridentata* - *Artemisia tridentata* / *Eriogonum umbellatum* Shrubland
- CEGLO03478 *Purshia tridentata* - *Artemisia tridentata* / *Achnatherum hymenoides* Shrubland
- CEGLO05610 *Purshia tridentata* - *Ericameria nana* / *Penstemon deustus* Shrubland
- CEGLO03479 *Purshia tridentata* - *Artemisia tridentata* / *Achnatherum nelsonii* Shrubland
- CEGLO03480 *Purshia tridentata* - *Artemisia tridentata* - *Symphoricarpos rotundifolius* Shrubland
- CEGLO03481 *Purshia tridentata* - *Artemisia tridentata* - *Tetradymia canescens* Shrubland
- CEGLO01492 *Purshia tridentata* / *Carex pensylvanica* - *Achnatherum occidentale* Shrub Grassland
- CEGLO05612 *Purshia tridentata* / *Achnatherum thurberianum* Shrubland
- CEGLO05613 *Purshia tridentata* / *Leymus cinereus* Shrub Grassland
- CEPP006747 *Purshia glandulosa* Shrubland
- CEGLO05611 *Purshia tridentata* - *Philadelphus lewisii* / *Poa secunda* Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by D. Sarr.

Version Date: 2014/12/18

REFERENCES

References: Buttery 1955, Caicco and Wellner 1983e, Chadwick and Dalke 1965, Chappell et al. 1997, Copeland 1978, Daubenmire 1970, Daubenmire 1975, Day 1985, Day and Wright 1985, Evens et al. 2014, Faber-Langendoen et al. 2017b, Franklin and Dyrness 1973, Hall 1973, Hess 1981, Hess and Wasser 1982, Hironaka et al. 1983, Johnson and Clausnitzer 1992, Johnson and Simon 1987, Johnston 1987, Lewis 1975a, Marr et al. 1980, Moseley 1987c, Mozingo 1987, Mueggler and Stewart 1980, Poulton 1955, Reid et al. 1994, Roughton 1966, Roughton 1972, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Tisdale 1947, Tweit and Houston 1980, Volland 1976, WNHP unpubl. data, Wasser and Hess 1982

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

3.B.1.Ne.3.c. M169 Great Basin-Intermountain Tall Sagebrush Steppe & Shrubland

G304. Intermountain Mountain Big Sagebrush Steppe & Shrubland

Type Concept Sentence: This sagebrush shrubland and shrub-steppe group is found at montane and subalpine elevations across the western U.S. where the open to dense shrub layer is composed primarily of *Artemisia tridentata* ssp. *vaseyana*, *Artemisia cana* ssp. *bolanderi*, *Artemisia cana* ssp. *viscidula*, and related taxa such as *Artemisia tridentata* ssp. *spiciformis* and *Artemisia rothrockii* with *Symphoricarpos* spp. often codominant and there is usually an abundant perennial herbaceous layer (over 25% cover).

OVERVIEW

Scientific Name: *Artemisia tridentata* ssp. *spiciformis* - *Artemisia tridentata* ssp. *vaseyana* - *Artemisia cana* ssp. *viscidula* Steppe & Shrubland Group

Common Name (Translated Scientific Name): Spiked Big Sagebrush - Mountain Big Sagebrush - Mountain Silver Sagebrush Steppe & Shrubland Group

Colloquial Name: Silver Sagebrush Steppe & Shrubland

Type Concept: This group includes sagebrush communities occurring at foothills (in Wyoming) to montane and subalpine elevations across the western U.S. from 1000 m in eastern Oregon and Washington to over 3000 m in the Southern Rockies. In Montana, it occurs on mountain "islands" in the north-central portion of the state and possibly along the Boulder River south of Absarokee and at higher elevations. In British Columbia, it occurs between 450 and 1650 m in the southern Fraser Plateau and the Thompson and Okanagan basins. Across its range of distribution, this is a compositionally diverse group. It is composed primarily of *Artemisia tridentata* ssp. *vaseyana*, and related taxon *Artemisia tridentata* ssp. *spiciformis* often with *Symphoricarpos* spp. present to codominant. Also included, but less common, are stands dominated by *Artemisia cana* ssp. *bolanderi*, *Artemisia cana* ssp. *viscidula*, and *Artemisia rothrockii* (a California endemic). Additionally there are mixed shrub stands codominated by *Amelanchier* spp., *Chamaebatiaria millefolium*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Peraphyllum ramosissimum*, *Purshia tridentata*, and *Ribes cereum*. *Artemisia tridentata* ssp. *wyomingensis* may be present to codominant if the stand is clearly montane as indicated by montane indicator species such as *Artemisia tridentata* ssp. *vaseyana*, *Danthonia intermedia*, *Festuca thurberi*, or *Leucopoa kingii*.

Most stands have an abundant perennial herbaceous layer (over 25% cover, and in many cases over 50% cover), but this group also includes *Artemisia tridentata* ssp. *vaseyana* shrublands that lack a significant herbaceous layer. Other common graminoids include *Achnatherum lettermanii*, *Achnatherum occidentale*, *Achnatherum pinetorum*, *Bromus carinatus*, *Calamagrostis rubescens*, *Carex geyeri*, *Elymus trachycaulus*, *Festuca arizonica*, *Festuca campestris*, *Festuca idahoensis*, *Hesperostipa comata*,

Leucopoa kingii, *Muhlenbergia montana*, *Pascopyrum smithii*, *Poa fendleriana*, *Poa secunda*, and *Pseudoroegneria spicata*. In many areas, wildfires can maintain an open herbaceous-rich steppe condition, although at most sites, shrub cover can be unusually high for a steppe system (>40%), with the moisture providing equally high grass and forb cover.

Classification Comments: *Artemisia cana* is often found in mesic to wet swales and toeslopes. Some *Artemisia cana* ssp. *viscidula* communities are included in this group, when they are not composed of more obligate wetland taxa, such as *Juncus*, wetland Carices, and such.

Similar NVC Types:

- G303 Intermountain Dry Tall Sagebrush Steppe & Shrubland
- G302 Intermountain Mesic Tall Sagebrush Steppe & Shrubland

Diagnostic Characteristics: This montane and subalpine sagebrush shrubland and shrub-steppe group is dominated by diagnostic shrub species *Artemisia tridentata* ssp. *vaseyana*, *Artemisia cana* ssp. *bolanderi*, *Artemisia cana* ssp. *viscidula*, and related taxa such as *Artemisia tridentata* ssp. *spiciformis* and *Artemisia rothrockii* (a California endemic). *Symphoricarpos* spp. are often codominant, but other shrubs may be present, forming a mixed canopy. There is usually an abundant perennial herbaceous layer (over 25% cover). Characteristic montane and subalpine herbaceous species include *Achnatherum lettermanii*, *Achnatherum occidentale*, *Achnatherum pinetorum*, *Bromus carinatus*, *Calamagrostis rubescens*, *Carex geyeri*, *Carex exserta*, *Danthonia intermedia*, *Danthonia parryi*, *Elymus trachycaulus*, *Festuca arizonica*, *Festuca campestris*, *Festuca idahoensis*, *Festuca thurberi*, *Leucopoa kingii*, and *Muhlenbergia montana*.

VEGETATION

Physiognomy and Structure: Microphyllous-leaved evergreen and broad-leaved, cold-deciduous shrub-steppe group with open to dense cover of sagebrush species and an abundant perennial herbaceous layer of graminoid and forb species.

Floristics: Vegetation types within this group are usually less than 1.5 m tall and dominated by *Artemisia tridentata* ssp. *vaseyana*, *Artemisia tridentata* ssp. *spiciformis*, or *Artemisia cana* ssp. *viscidula*, often with *Symphoricarpos* spp. present to codominant. Also included, but less common, are stands dominated by *Artemisia cana* ssp. *bolanderi*, *Artemisia cana* ssp. *viscidula*, and *Artemisia rothrockii* (a California endemic). Additionally, there are mixed shrub stands codominated by *Amelanchier* spp., *Chamaebatiaria millefolium*, *Peraphyllum ramosissimum*, and *Purshia tridentata*. A variety of other shrubs can be found in some occurrences, but these are seldom dominant. They include *Amelanchier alnifolia*, *Artemisia arbuscula*, *Ceanothus velutinus*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Ribes cereum*, and *Rosa woodsii*. *Artemisia tridentata* ssp. *wyomingensis* may be present to codominant if the stand is clearly montane to subalpine as indicated by montane indicator species such as *Artemisia tridentata* ssp. *vaseyana*, *Danthonia intermedia*, *Festuca thurberi*, or *Leucopoa kingii*. The shrub canopy cover ranges from 10 to 80%. The herbaceous layer is usually well-represented (over 25% cover, and in many cases over 50% cover), but bare ground may be common in particularly arid or disturbed occurrences. Additional characteristic graminoids may include *Achnatherum lettermanii*, *Achnatherum occidentale*, *Achnatherum pinetorum*, *Bromus carinatus*, *Calamagrostis rubescens*, *Carex geyeri*, *Carex exserta*, *Danthonia parryi*, *Elymus trachycaulus*, *Festuca arizonica*, *Festuca campestris*, *Festuca idahoensis*, *Hesperostipa comata*, *Muhlenbergia montana*, *Pascopyrum smithii*, *Poa fendleriana*, *Poa secunda*, and *Pseudoroegneria spicata*. Forbs are often numerous and an important indicator of health. Common forbs include *Achillea millefolium*, *Antennaria rosea*, *Artemisia ludoviciana*, *Balsamorhiza sagittata*, *Eriogonum umbellatum*, *Fragaria virginiana*, *Hymenoxys hoopesii* (= *Helenium hoopesii*), and several species of *Astragalus*, *Castilleja*, *Erigeron*, *Geum*, *Lupinus*, *Penstemon*, *Phlox*, and *Potentilla*.

ENVIRONMENT & DYNAMICS

Environmental Description: This group occurs in many of the western United States, usually at middle elevations (1000-2500 m). The climate regime is cool, semi-arid to subhumid, with yearly precipitation ranging from 25 to 90 cm/year. Much of this precipitation falls as snow. Temperatures are continental with large annual and diurnal variation. In general, this group shows an affinity for mild topography, fine soils, and some source of subsurface moisture. Soils generally are moderately deep to deep, well-drained, and of loam, sandy loam, clay loam, or gravelly loam textural classes; soils often have a substantial volume of coarse fragments, and are derived from a variety of parent materials. This group primarily occurs on deep-soiled to stony flats, ridges, nearly flat ridgetops, and mountain slopes. All aspects are represented, but the higher elevation occurrences may be restricted to south- or west-facing slopes.

Dynamics: Healthy sagebrush shrublands are very productive, are often grazed by domestic livestock, and are strongly preferred during the growing season (Padgett et al. 1989). Prolonged livestock use can cause a decrease in the abundance of native bunch grasses and increase in the cover of shrubs and non-native grass species such as *Poa pratensis*. *Artemisia cana* resprouts vigorously following spring fire, and prescribed burning may increase shrub cover. Conversely, fire in the fall may decrease shrub abundance (Hansen et al. 1995). *Artemisia tridentata* is generally killed by fires and may take over ten years to form occurrences of some 20%

cover or more. The condition of most sagebrush steppe has been degraded due to fire suppression and heavy livestock grazing. It is unclear how long restoration will take to restore degraded occurrences.

DISTRIBUTION

Geographic Range: This group is found at montane and subalpine elevations across the western U.S. from 1000 m in eastern Oregon and Washington to over 3000 m in the Southern Rockies. In British Columbia, it occurs in the southern Fraser Plateau and the Thompson and Okanagan basins. This group also occurs in central Montana in the Rocky Mountain island ranges

Spatial Scale & Pattern [optional]: Matrix

Nations: CA, US

States/Provinces: AZ?, BC, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]: 6:C, 7:C, 8:C, 9:C, 12:C, 18:C, 19:C, 20:C, 26:C, 68:C

USFS Ecoregions (2007): 313A:CC, 313B:CP, 315A:CC, 315H:CC, 321A:??, 322A:CC, 331B:C?, 331F:CC, 331G:CC, 331J:CC, 331M:C?, 331N:CP, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342A:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CC, 342J:CC, M242C:CC, M242D:CC, M261A:CC, M261D:CC, M261E:CC, M261F:C?, M261G:CC, M313A:CP, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M341A:CC, M341B:CC, M341C:CC, M341D:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate. USNVC Confidence from peer reviewer, not AE.

SYNONYMY

- = Mountain Big Sagebrush (402) (Shiflet 1994)
- = Western Intermountain sagebrush steppe (West 1983c)

LOWER LEVEL UNITS

Alliances:

- A3208 *Artemisia tridentata ssp. vaseyana* - Mixed Steppe & Shrubland Alliance
- A1098 *Artemisia rothrockii* Shrubland Alliance
- A3200 *Artemisia cana ssp. bolanderi* - *Artemisia cana ssp. viscidula* Steppe & Shrubland Alliance
- A3207 *Artemisia tridentata ssp. spiciformis* - *Artemisia tridentata ssp. vaseyana* Steppe & Shrubland Alliance

AUTHORSHIP

Primary Concept Source: N.E. West (1983c)

Author of Description: M.E. Hall and K.A. Schulz

Acknowledgments:

Version Date: 11/06/2015

Classif Resp Region: West

Internal Author: MEH 2-10, mod. KAS 11-15

REFERENCES

References: Faber-Langendoen et al. 2017a, Hansen et al. 1995, Hironaka et al. 1983, Johnston 2001, Mueggler and Stewart 1980, Padgett et al. 1989, Shiflet 1994, West 1983c

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G304. Intermountain Mountain Big Sagebrush Steppe & Shrubland

A3200. *Artemisia cana ssp. bolanderi* - *Artemisia cana ssp. viscidula* Steppe & Shrubland Alliance

Type Concept Sentence: This alliance occurs throughout the northern half of the Intermountain West and is characterized by an open to closed, medium-tall shrub canopy of *Artemisia cana ssp. viscidula* or *Artemisia cana ssp. bolanderi* with dry graminoids in the understory. Stands occur in relatively moist environments, including mesic alkaline or saline basins, but not wetland or riparian sites.

OVERVIEW

Scientific Name: *Artemisia cana ssp. bolanderi* - *Artemisia cana ssp. viscidula* Steppe & Shrubland Alliance

Common Name (Translated Scientific Name): Bolander's Silver Sagebrush - Mountain Silver Sagebrush Steppe & Shrubland Alliance

Colloquial Name: Silver Sagebrush Steppe & Shrubland

Type Concept: This shrubland and steppe alliance occurs throughout the northern half of the Intermountain West. The shrub layer ranges from 0.5-1.5 m tall, and shrub canopy cover ranges from 10-60%. In most stands, *Artemisia cana ssp. viscidula* or *Artemisia cana ssp. bolanderi* is the only dominant shrub, although other shrubs such as *Purshia tridentata* can be present. The understory is variable, ranging from a sparse to dense herbaceous layer that is typically dominated by dry to mesic, perennial graminoids with 20% cover. Species include *Elymus elymoides*, *Festuca thurberi*, *Poa cusickii*, *Poa fendleriana*, *Poa pratensis*, and *Poa secunda* (= *Poa nevadensis*). Wetland indicators such as species of *Eleocharis*, *Deschampsia*, *Juncus*, or *Salix* are absent or restricted to local microsites. This alliance occupies seasonally moist sites in broad meadows. Although it occurs in relatively moist environments and may be marginally riparian, including alkaline or saline basins, it is not a true riparian or wetland type. Soils are mostly well-developed with thick mollic epipedons and lack indicators of seasonally high water tables. Soil texture is variable and includes clayey, clayey skeletal, coarse-loamy and loamy skeletal. Depth to water table is over 75 to 100+ cm.

Classification Comments: There may be alliance range/taxonomic problems with the subspecies of *Artemisia cana*. For example, according to Kartesz (1999), *ssp. bolanderi* is not reported to occur in Oregon, but is reported to occur there by the Oregon Natural Heritage Program. Thus the distribution of this alliance is subject to change as updated information becomes available. Although there may be taxonomic issues with the subspecies, there are two other *Artemisia cana* alliances: (1) *Artemisia cana* Wet Shrubland Alliance (A2557) in Rocky Mountain-Great Basin Lowland-Foothill Riparian Shrubland Group (G526) that is dominated by the same two subspecies of *Artemisia cana* (*ssp. bolanderi*, *ssp. viscidula*), but is riparian, and (2) *Artemisia cana ssp. cana* Wet Shrubland Alliance (A3586) in Great Plains Riparian Wet Meadow & Shrubland Group (G337) that is dominated by *Artemisia cana ssp. cana* and occurs in riparian habitats (not upland) in the Great Plains. The subspecies will remain for now as more taxonomic and classification review is done.

Manning and Padgett (1995) include *Artemisia cana / Festuca ovina* c.t. (Padgett et al. 1989) and *Artemisia cana / Festuca idahoensis* c.t. (Youngblood et al. 1985) in the *Artemisia cana*/Dry Graminoid c.t. These community types are currently included in *Artemisia cana* Wet Shrubland Alliance (A2557) in Rocky Mountain-Great Basin Lowland-Foothill Riparian Shrubland Group (G526) so additional review is warranted.

Internal Comments: KAS 12-14: Mike Jennings in the alliance review recommended that "references to the subspecies, for example but not limited to the title, should be minimized. The two subspecies (*ssp. bolanderi* and *viscidula*) are the only two subspecies of the species. While *ssp. viscidula* is more of the Great Basin/Rocky Mtn region and *ssp. Bolanderi* is more of the Sierra/Cascades region, the compositions of the underlying associations are distinct regardless of the dominant subspecies. Relying on subspecific taxonomic differences as diagnostics at the alliance level is not good practice (though there are cases where this is unavoidable, like *A. tridentata* types). The name and description of this alliance should be revised accordingly. This is not to say that the biogeography of the dominant species should not be acknowledged and discussed in the comments section and elsewhere as appropriate, but the description as written reflects too much of a kluge" I decided to leave as is for now because the subspecies is important to distinguish between A3586. "Mesic-Riparian" was added to names of similar riparian *Artemisia cana* alliances: *Artemisia cana* Shrubland Alliance (A2557) in the Rocky Mountain & Great Basin Lowland & Foothill Riparian Shrubland (G526) group and *Artemisia cana ssp. cana* Shrub Herbaceous Alliance (A3586) in the Great Plains Shrub & Herb Riparian (G337) group to distinguish between this non-riparian *Artemisia cana* alliance.

Other Comments:

Similar NVC Types:

- A2557 *Artemisia cana* Wet Shrubland Alliance: is dominated by the same two subspecies of *Artemisia cana* (*ssp. bolanderi*, *ssp. viscidula*), but occurs in riparian situation not upland.
- A3586 *Artemisia cana ssp. cana* Wet Shrubland Alliance: is dominated by *Artemisia cana ssp. cana* and occurs in riparian situation (not upland) in the Great Plains.

Diagnostic Characteristics: Stands in this mesic alliance are characterized by an open to closed, medium-tall shrub canopy of *Artemisia cana ssp. viscidula* or *Artemisia cana ssp. bolanderi*. *Purshia tridentata* may be present to codominant. The shrub layer ranges from 0.5-1.5 m tall, and shrub canopy cover ranges from 10-60%. In most stands, herbaceous cover can be abundant to very sparse, but perennial graminoids generally total less than 20% cover. Characteristic herbaceous species include *Festuca idahoensis*, *Festuca thurberi*, *Poa secunda*, *Poa cusickii*, and *Poa fendleriana ssp. fendleriana*. Wetland indicators such as species of *Eleocharis*, *Deschampsia*, *Juncus*, and *Salix* are absent.

VEGETATION

Physiognomy and Structure: These are mesic shrubland and steppe communities characterized by moderately to widely spaced microphyllous evergreen shrubs. Widely spaced, often robust bunchgrasses usually dominate the understory, although rhizomatous species occasionally occur. The graminoids may exceed the shrubs in height and total cover. Prostrate and, occasionally, upright forbs may be present.

Floristics: The shrub layer ranges from 0.5-1.5 m tall, and shrub canopy cover ranges from 10-60%. In most stands, *Artemisia cana* ssp. *viscidula* or *Artemisia cana* ssp. *bolanderi* is the only dominant shrub, although other shrubs such as *Purshia tridentata*, *Rosa woodsii*, or *Symphoricarpos oreophilus* can be present. The understory is variable, ranging from a sparse to dense herbaceous layer that is typically dominated by dry to mesic, perennial graminoids with 20% cover. Species include *Bromus anomalus*, *Bromus porteri*, *Carex douglasii*, *Carex geyeri*, *Danthonia intermedia*, *Elymus elymoides*, *Elymus trachycaulus*, *Festuca idahoensis*, *Festuca thurberi*, *Poa cusickii*, *Poa fendleriana*, *Poa pratensis* (exotic), and *Poa secunda* (= *Poa nevadensis*) (Hess 1981, Francis 1983, Johnston 1987, Tiedemann et al. 1987, Manning and Padgett 1995). Forb associates include *Achillea millefolium*, *Eriogonum umbellatum*, *Geranium richardsonii*, *Potentilla gracilis*, and *Wyethia amplexicaulis*. Obligate and facultative wetland indicators such as species of *Eleocharis*, *Deschampsia*, *Juncus*, or *Salix* are generally absent or restricted to local microsites. One exception is the wide-ranging *Juncus arcticus*, a facultative wetland plant (usually occurs in wetlands, but may occur in non-wetlands) is often present but not dominant.

ENVIRONMENT & DYNAMICS

Environmental Description: This shrubland and steppe alliance occurs throughout the northern half of the Intermountain West in high mountain valleys, on broad flats and gently sloping to undulating alluvial outwash fans usually at middle elevations (1000-2500 m) and occasionally high elevations (to 3000 m) (Hess 1981, Francis 1983, Johnston 1987, Tiedemann et al. 1987, Manning and Padgett 1995). Climate is temperate. Precipitation varies across the range, from less than 25 cm in semi-arid basins of the western Great Basin, to over 90 cm in moister meadow habitats of the Sierra Nevada and central Rocky Mountains. Stands occupy seasonally moist sites in broad meadows that are flooded during snowmelt, but dry out by mid-late summer. Although it occurs in relatively moist environments and may be marginally riparian, including alkaline or saline basins, it is not a true riparian or wetland type. Substrates are mostly well-developed soils with thick mollic epipedons that lack indicators of seasonally high water tables. Soil texture is variable and includes clayey, clayey skeletal, coarse-loamy and loamy skeletal (Manning and Padgett 1995). Depth to water table is over 75 to 100+ cm.

Dynamics: *Artemisia cana* ssp. *viscidula* and *Artemisia cana* ssp. *bolanderi* both resprout vigorously after fire, and prescribed burning may increase shrub cover. Conversely, fire in the fall may decrease shrub abundance (Hansen et al. 1995). These highly productive sites often attract heavy livestock use. Livestock grazing may shift the understory composition to increased abundance of early-seral species such as *Achillea millefolium*, *Potentilla gracilis*, or *Taraxacum officinale* and result in reduced abundance of native bunchgrass species such as *Festuca thurberi*, *Poa cusickii*, *Poa fendleriana*, or *Poa secunda*.

DISTRIBUTION

Geographic Range: This alliance is found west of the Continental Divide from the Rocky Mountains across the Great Basin to the Sierra Nevada and Cascade Range. Associations dominated by *Artemisia cana* ssp. *viscidula* occur mostly along streams or in areas with heavy snowpack. Associations dominated by *Artemisia cana* ssp. *bolanderi* occur mainly in the Sierra Nevada and Cascade Range, commonly in internally drained basins with poor drainage and/or alkaline conditions.

Nations: US

States/Provinces: CA, CO, ID, MT, NV?, OR, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- < *Artemisia cana* / *Festuca thurberi* Plant Association (Johnston 1987)
- < *Artemisia cana* (Silver sagebrush scrub) Alliance (Sawyer et al. 2009) [35.150.00]
- > *Artemisia cana* / Dry Graminoid Community Type (Manning and Padgett 1995)
- < SRM Cover Type #408 - Other Sagebrush Types (Shiflet 1994)

LOWER LEVEL UNITS

Associations:

- CEGLO01549 *Artemisia cana* (ssp. *bolanderi*, ssp. *viscidula*) - *Artemisia tridentata* ssp. *vaseyana* / *Poa cusickii* Shrub Grassland
- CEGLO01071 *Artemisia cana* ssp. *viscidula* / *Festuca thurberi* Shrubland
- CEGLO01073 *Artemisia cana* ssp. *viscidula* / *Purshia tridentata* Shrubland
- CEGLO01551 *Artemisia cana* (ssp. *bolanderi*, ssp. *viscidula*) / *Poa fendleriana* ssp. *fendleriana* Shrub Grassland

AUTHORSHIP

Primary Concept Source: M.E. Manning and W.G. Padgett (1995)

Author of Description: K.A. Schulz

Acknowledgments:**Version Date:** 2014/12/18**REFERENCES**

References: Bramble-Brodahl 1978, Chappell et al. 1997, Comer et al. 1999, Cunningham 1971, Daubenmire 1970, Dealy 1971, Faber-Langendoen et al. 1996, Faber-Langendoen et al. 2017b, Francis 1983, Franklin and Dyrness 1973, Hansen et al. 1995, Hess 1981, Hironaka et al. 1983, Jankovsky-Jones et al. 2001, Johnston 1987, Kartesz 1999, Kovalchik 1987, Manning and Padgett 1995, Mueggler and Stewart 1980, Mutz and Graham 1982, Mutz and Queiroz 1983, ORNHP unpubl. data, Padgett 1982, Padgett et al. 1988b, Padgett et al. 1989, Reid et al. 1994, Sarr 1995, Sawyer et al. 2009, Schlatterer 1972, Shiflet 1994, Soil Conservation Service 1978, Tiedemann et al. 1987, Tuhy 1981, Tuhy and Jensen 1982, Turner 1969, USFS 1992, Winward 1980b, Youngblood et al. 1985a

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G304. Intermountain Mountain Big Sagebrush Steppe & Shrubland

A1098. Artemisia rothrockii Shrubland Alliance

Type Concept Sentence: This dwarf-shrubland is heavily dominated by *Artemisia rothrockii*. The only shrubs which co-occur are *Symphoricarpos rotundifolius*, *Ribes montigenum*, and *Holodiscus discolor*. Graminoids dominate the open herbaceous layer. Stands occur on slopes and ridges in the subalpine regions of California.

OVERVIEW**Scientific Name:** *Artemisia rothrockii* Shrubland Alliance**Common Name (Translated Scientific Name):** Rothrock's Sagebrush Shrubland Alliance**Colloquial Name:** Rothrock's Sagebrush Shrubland

Type Concept: This dwarf-shrubland is heavily dominated by *Artemisia rothrockii*. The only shrubs which co-occur in this association are *Symphoricarpos rotundifolius*, *Ribes montigenum*, and *Holodiscus discolor*. Emergent conifers, such as *Pinus balfouriana*, *Pinus contorta* var. *murrayana*, and *Pinus albicaulis*, may be present. Graminoids dominate the open herbaceous layer, and species composition may be highly variable among stands. *Carex filifolia*, *Danthonia intermedia*, and/or *Poa wheeleri* are the most common graminoid associates. Forbs only total a small amount of cover, typified by the diagnostic forb *Monardella odoratissima*. Other forbs which are often present at very low cover values may include *Antennaria rosea*, *Penstemon rydbergii*, *Juncus* sp., and/or *Horkelia fusca*. This dwarf-shrubland occurs on slopes and ridges in the subalpine regions of California. It is generally present in the zone between meadow and forest, growing on gravelly, carbonate-rich soils. Elevations range from 2000-3100 m. The nominal species' growth occurs mainly in early to mid summer, with flowering in late summer. The species is dormant in the fall, winter, and early spring due to cold.

Classification Comments: *Artemisia rothrockii* is a California endemic and grows on lower slopes and aprons between forests and valley bottom meadows (Benedict 1982, Ratliff 1985). Soils developed from granitic grus in the Sierra Nevada (Keeler-Wolf et al. 2003a) and from carbonate-rich dolomite and limestone in the Inyo and White mountains (Major and Taylor 1977) are droughty.

Internal Comments:**Other Comments:****Similar NVC Types:**

Diagnostic Characteristics: This dwarf-shrubland is heavily dominated by diagnostic *Artemisia rothrockii*. Associated shrubs are *Symphoricarpos rotundifolius*, *Ribes montigenum*, and *Holodiscus discolor*. Graminoids dominate the open herbaceous layer. Characteristic herbaceous species include graminoids, *Carex filifolia*, *Danthonia intermedia*, and/or *Poa wheeleri*, and diagnostic forb *Monardella odoratissima*. Other forbs which are often present at very low cover values may include *Antennaria rosea*, *Penstemon rydbergii*, *Juncus* sp., and/or *Horkelia fusca*.

VEGETATION

Physiognomy and Structure: This extremely xeromorphic, subdesert dwarf-shrubland has an intermittent canopy of *Artemisia rothrockii* less than 1 m in height. Emergent conifers may be present. The herbaceous layer is sparse.

Floristics: In this California subalpine dwarf-shrubland *Artemisia rothrockii* is the sole or dominant shrub in the canopy. Other shrubs present may include *Ericameria discoidea*, *Ericameria suffruticosa*, *Penstemon heterodoxus*, and *Monardella odoratissima* (Sawyer et al. 2009). Emergent conifers such as *Pinus balfouriana*, *Pinus contorta* var. *murrayana*, and *Pinus albicaulis* may be present. Graminoids dominate the open herbaceous layer, and species composition may be highly variable among stands. *Carex filifolia*, *Danthonia intermedia*, and/or *Poa wheeleri* are the most common graminoid associates. Forbs only total a small amount of cover,

typified by the diagnostic forb *Monardella odoratissima*. Other forbs which are often present at very low cover values may include *Antennaria rosea*, *Penstemon rydbergii*, *Juncus* sp., and/or *Horkelia fusca*. Twenty-five other species have been recorded on sampled plots, but none achieve more than 30% constancy. The forb *Castilleja miniata* and the graminoid *Poa wheeleri* each achieve 5% cover in 30% of plots. All other recorded species (mostly graminoids) only contribute a trace to the overall cover.

ENVIRONMENT & DYNAMICS

Environmental Description: This dwarf-shrubland occurs on slopes and ridges in the subalpine regions of California. It is generally present in the zone between meadow and forest, growing on gravelly, carbonate-rich soils. Elevations range from 2000 to 3500 m (Sawyer et al. 2009). The nominal species' growth occurs mainly early to mid-summer, with flowering in late summer. The species is dormant in the fall, winter, and early spring due to cold.

Dynamics: The soils that support this alliance are often carbonate-rich. These carbonates can form a hardpan 20-40 cm below the surface. Water runs downslope along this hardpan, reducing the amount of water available to plants, and making these sites droughty.

DISTRIBUTION

Geographic Range: This alliance occurs in California's Sierra Nevada at Yosemite National Park, and the Transverse and Peninsular ranges.

Nations: US

States/Provinces: CA

TNC Ecoregions [optional]: 11:C, 12:C, 16:C

USFS Ecoregions (2007): 341D:CC, M261E:CC, M262B:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Artemisia rothrockii* (Rothrock's sagebrush) Alliance (Sawyer et al. 2009) [35.140.00]
- = *Artemisia rothrockii* Shrubland Alliance (CNPS 2017) [35.140.00]
- = Rothrock sagebrush series (Sawyer and Keeler-Wolf 1995)
- ? Subalpine Sagebrush (Cheatham and Haller 1975)
- >< Subalpine Sagebrush Scrub (#35220) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEG008652 *Artemisia rothrockii* / *Monardella odoratissima* Shrubland
- CEG003014 *Artemisia rothrockii* Shrubland

AUTHORSHIP

Primary Concept Source: J.O. Sawyer, T. Keeler-Wolf, and J. Evens (2009)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by M. Schindel.

Version Date: 2014/12/18

REFERENCES

References: Bauer et al. 2002, Benedict 1982, Benedict 1983, CNPS 2017, Cheatham and Haller 1975, Faber-Langendoen et al. 2017b, Holland 1986b, Keeler-Wolf et al. 2003a, Major and Taylor 1977, Ratliff 1985, Reynolds and Berlow 2002, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Taylor 1984, West 1988

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G304. Intermountain Mountain Big Sagebrush Steppe & Shrubland

A3207. *Artemisia tridentata* ssp. *spiciformis* - *Artemisia tridentata* ssp. *vaseyana* Steppe & Shrubland Alliance

Type Concept Sentence: This alliance is widespread in mountainous areas across the western U.S. and is characterized by a moderate to dense shrub layer in which *Artemisia tridentata* ssp. *vaseyana* or *Artemisia tridentata* ssp. *spiciformis* dominates. If other shrubs are present, they have low cover and do not codominate. Stands form large, continuous stands on mid-elevation mountain slopes and foothills, and can extend above the lower treeline as patches within montane or subalpine coniferous forests.

OVERVIEW

Scientific Name: *Artemisia tridentata* ssp. *spiciformis* - *Artemisia tridentata* ssp. *vaseyana* Steppe & Shrubland Alliance

Common Name (Translated Scientific Name): Spiked Big Sagebrush - Mountain Big Sagebrush Steppe & Shrubland Alliance

Colloquial Name: Spiked Big Sagebrush - Mountain Big Sagebrush Steppe & Shrubland

Type Concept: This alliance is widespread in mountainous areas across the western U.S. and is characterized by a moderate to dense shrub layer in which *Artemisia tridentata* ssp. *vaseyana* or *Artemisia tridentata* ssp. *spiciformis* dominates. If other shrubs are present, they have low cover and do not codominate. Perennial graminoids typically dominate the open to dense herbaceous layer. The most widespread species are *Pseudoroegneria spicata* and *Festuca idahoensis*, which occur from the Columbia Basin to the Northern Rockies, although they may not be the most abundant species in individual stands. Other locally important species may include *Achnatherum occidentale* (= *Stipa occidentalis*), *Bouteloua gracilis*, *Bromus carinatus*, *Elymus trachycaulus*, *Festuca thurberi*, *Festuca viridula*, *Koeleria macrantha*, *Leucopoa kingii* (= *Festuca kingii*), *Leymus cinereus*, *Pascopyrum smithii*, *Poa fendleriana*, and *Poa secunda*. The forb layer is variable and can be very diverse. Species of *Castilleja*, *Potentilla*, *Erigeron*, *Phlox*, *Astragalus*, *Geum*, *Lupinus*, and *Eriogonum* are characteristic. Non-native grasses *Poa pratensis* and *Poa compressa* may be abundant. The alliance forms large, continuous stands on mid-elevation mountain slopes and foothills, and can extend above the lower treeline as patches within montane or subalpine coniferous forests. Sites are variable and range from flats to steep slopes to ridgetops with deep to shallow rocky soil.

Classification Comments: Diagnostic components of this alliance are phenotypically and genetically quite plastic species dominating a massive region spanning two floristic provinces, subspecies notwithstanding. There is enormous floristic variation within this alliance. Much work is needed to clarify the distribution and floristic characteristics of this alliance that will distinguish it clearly. *Artemisia tridentata* ssp. *spiciformis* as described by Shultz (1984) and Goodrich et al. (1985) includes *Artemisia rothrockii* as used by Bramble-Brodahl (1978) and described by Beetle and Johnson (1982). It does not include *Artemisia tridentata* ssp. *vaseyana* form. *spiciformis* as used by numerous authors, including Bramble-Brodahl (1978), Winward (1980b), Beetle and Johnson (1982), and Hironaka et al. (1983). Goodrich et al. (1985) reassign form. *spiciformis* to variety *vaseyana* of *Artemisia tridentata* ssp. *vaseyana*.

Internal Comments: KAS 12-24: comment from M. Jennings AE review: Users of this description might benefit from the insight that this is a case of a phenotypically and genetically quite plastic species dominating a massive region spanning two floristic provinces, subspecies notwithstanding. There is enormous floristic variation within this alliance.

Other Comments:

Similar NVC Types:

- A3208 *Artemisia tridentata* ssp. *vaseyana* - Mixed Steppe & Shrubland Alliance: is codominated by non-sagebrush shrubs.

Diagnostic Characteristics: Vegetation included in this alliance is characterized by a moderate to dense shrub layer in which diagnostic species *Artemisia tridentata* ssp. *vaseyana* or *Artemisia tridentata* ssp. *spiciformis* dominate. If other shrubs are present, then they have low cover and do not codominate. A variety of perennial graminoids typically dominate the open to dense herbaceous layer. Characteristic herbaceous species are *Achnatherum lettermanii*, *Achnatherum occidentale*, *Achnatherum pinetorum*, *Balsamorhiza sagittata*, *Bromus carinatus*, *Carex exserta*, *Carex geyeri*, *Elymus lanceolatus*, *Festuca campestris*, *Festuca idahoensis*, *Festuca thurberi*, *Hesperostipa comata*, *Koeleria macrantha*, *Leucopoa kingii*, *Leymus cinereus*, *Monardella odoratissima*, *Pascopyrum smithii*, *Phlox condensata*, *Poa fendleriana*, *Poa glauca*, *Poa secunda*, and *Pseudoroegneria spicata*.

VEGETATION

Physiognomy and Structure: The vegetation in this alliance is characterized by a sparse (<25%) cover of microphyllous evergreen shrubs, usually 0.5-1 m in height. In one association, bunchgrasses form a matrix surrounding the shrubs, occasionally matching or exceeding the shrubs in height. In another association, a sod-forming short graminoid is dominant in the herbaceous layer. Forb species are often frequent and diverse, and can be prominent in some stands.

Floristics: This alliance is characterized by a moderate to dense shrub layer in which *Artemisia tridentata* ssp. *vaseyana* or *Artemisia tridentata* ssp. *spiciformis* dominates. If other shrubs are present, they have low cover and do not codominate. Perennial graminoids typically dominate the open to dense herbaceous layer. The most widespread species are *Pseudoroegneria spicata* and *Festuca idahoensis*, which occur from the Columbia Basin to the Northern Rockies, although they may not be the most abundant species in individual stands. Other locally important species may include *Achnatherum occidentale* (= *Stipa occidentalis*), *Bouteloua gracilis*, *Bromus carinatus*, *Elymus trachycaulus*, *Festuca thurberi*, *Festuca viridula*, *Koeleria macrantha*, *Leucopoa kingii* (= *Festuca kingii*), *Leymus cinereus*, *Pascopyrum smithii*, *Poa fendleriana*, and *Poa secunda*. The forb layer is variable and can be very diverse. *Balsamorhiza sagittata*, *Monardella odoratissima*, and *Phlox condensata* are often prominent. Species of *Astragalus*, *Castilleja*, *Erigeron*, *Eriogonum*, *Geum*, *Lupinus*, *Phlox*, and *Potentilla* are characteristic. Non-native grasses *Poa pratensis* and *Poa compressa* may be abundant. Trees are uncommon in stands of this alliance, but *Abies lasiocarpa*, *Cercocarpus ledifolius*, *Juniperus occidentalis*, *Juniperus scopulorum*, *Pinus albicaulis*, *Pinus ponderosa*, and *Populus tremuloides* may occasionally occur.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance is widespread in mountainous areas across the western U.S. and forms large, continuous stands on mid-elevation mountain slopes and foothills, and can extend above the lower treeline as patches within montane or subalpine coniferous forests. The climate regime is cool, semi-arid to subhumid, with yearly precipitation ranging from 18-90 cm. Much of the yearly precipitation falls as snow, which may cover the ground for long periods in winter. Temperatures are continental with large annual and diurnal variation. The elevation range for this alliance is large, from about 1060 m in eastern Oregon and Washington, to well over 3200 m in the mountains of northern Nevada, Idaho, and Colorado. Landscape positions are variable as well, but primarily are deep-soiled to stony flats, ridges, nearly flat ridgetops, and mountain slopes. All aspects are represented, and slopes range from nearly flat to very steep. Soils generally are moderately deep to deep, somewhat well-drained, and of loam, sandy loam, clay loam, or gravelly loam textural classes, often having a substantial volume of coarse fragments. The soils are derived from a variety of parent materials (although sandstones, limestones, basalts, and crystalline rocks are common). In some cases, soils supporting stands of this alliance are unstable and prone to mass movement (Bramble-Brodahl 1978, Hironaka et al. 1983). In subalpine environments, these shrub-herbaceous communities are found on deeper soils than *Artemisia arbuscula* subalpine shrublands.

Dynamics: Complex ecological interactions between fire regimes, grazing history, and climate patterns result in equally complex patterns of species structure and composition in *Artemisia tridentata* shrublands. These present corresponding difficulties in the classification of these shrublands, which have been compounded by the influence of human settlement and agricultural patterns. What follows is a summary of some of the influences of altered fire regimes and grazing history on *Artemisia tridentata* shrublands and shrub herbaceous vegetation.

Artemisia tridentata ssp. *vaseyana* shrub-herbaceous plant associations may represent either more moist or less disturbed communities within the complex of *Artemisia tridentata* ssp. *vaseyana* shrublands and shrub-steppe. Shrub densities typically increase with overgrazing of the bunchgrass component or with increasing summer drought (West 1983c). There is considerable debate over whether present shrub-dominated stands are actually degraded "steppe" (e.g., shrub-herbaceous physiognomy), and if the stands will return to steppe with changes in grazing and fire management. *Artemisia tridentata* is inhibited by fire, and excessive grazing may decrease fire frequency due to consumption of herbaceous forage, resulting in increased shrub density. Conversely, invasion by non-native annual grasses (e.g., *Bromus tectorum* at lower elevations) may increase fire frequency sufficiently to eliminate the shrubs from the stands (Hironaka et al. 1983). With a change in fire frequency, species composition will be altered as well (West 1983c). With a high fire frequency (every 2-5 years), perennial grasses and shrubs are eliminated and non-native annual grasses dominate. At fire-return intervals of 10-30 years, short-lived resprouting shrubs such as *Chrysothamnus* or *Tetradymia* spp. dominate. At fire intervals of 30-70 years, a mixture of perennial bunchgrasses and shrubs is maintained. Finally, in the complete absence of fire, deep-rooted shrubs such as *Artemisia tridentata* may become dominant.

Artemisia tridentata ssp. *spiciformis* communities have a natural fire frequency averaging between 20 and 40 years. Presettlement fires burned unevenly, resulting in an ever-changing mosaic of different densities and ages of sagebrush plants (Winward 1991). However, *Artemisia tridentata* ssp. *spiciformis* resprouts vigorously after fire (Goodrich et al. 1985) and can return to pre-burn canopy cover very quickly (Winward 1991).

DISTRIBUTION

Geographic Range: This shrubland alliance occurs in mountainous regions from eastern California, Oregon and Washington, across the Great Basin in Nevada, the northern Rocky Mountain foothills of Idaho, and in Colorado, Wyoming and Montana. It has not been reported from Utah, Arizona or New Mexico, but it is very likely to occur in these states at high elevations. In addition, the alliance probably extends north into Alberta, Canada.

Nations: CA?, US

States/Provinces: AB?, CA, CO, ID, MT, NV, OR, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- < *Artemisia tridentata* ssp. *vaseyana* (Mountain big sagebrush) Alliance (Sawyer et al. 2009) [35.111.00]
- >> Big Sagebrush Series (Sawyer and Keeler-Wolf 1995)
- >> SRM Cover Type #314 - Big Sagebrush-Bluebunch Wheatgrass (Shiflet 1994)
- >> SRM Cover Type #315 - Big Sagebrush-Idaho Fescue (Shiflet 1994)
- >> SRM Cover Type #316 - Big Sagebrush-Rough Fescue (Shiflet 1994)
- < SRM Cover Type #402 - Mountain Big Sagebrush (Shiflet 1994)

- < SRM Cover Type #408 - Other Sagebrush Types (Shiflet 1994)
- < SRM Cover Type #612 - Sagebrush - Grass (Shiflet 1994)
- >< Western Shrub and Grasslands Combinations: 55: Sagebrush-Steppe (*Artemisia-Agropyron*) (Küchler 1964)
- >< Western Shrub: 38: Great Basin Sagebrush (*Artemisia*) (Küchler 1964)

LOWER LEVEL UNITS

Associations:

- CEG001531 *Artemisia tridentata ssp. vaseyana* / *Festuca campestris* Shrub Grassland
- CEG005423 *Artemisia tridentata ssp. vaseyana* / *Poa (glauca, secunda)* Shrubland
- CEG002990 *Artemisia tridentata ssp. spiciformis* / *Carex geyeri* Shrubland
- CEG002931 *Artemisia tridentata ssp. vaseyana* / *Hesperostipa comata* Shrubland
- CEG001033 *Artemisia tridentata ssp. vaseyana* / *Achnatherum occidentale* Shrubland
- CEG008651 *Artemisia tridentata ssp. vaseyana* / *Carex exserta* Shrubland
- CEG001023 *Artemisia tridentata ssp. vaseyana* / *Festuca idahoensis* - *Bromus carinatus* Shrubland
- CEG002993 *Artemisia tridentata ssp. spiciformis* Shrub Grassland
- CEG001026 *Artemisia tridentata ssp. vaseyana* / *Leucopoa kingii* - *Koeleria macrantha* Shrubland
- CEG001024 *Artemisia tridentata ssp. vaseyana* / *Festuca thurberi* Shrubland
- CEG001029 *Artemisia tridentata ssp. vaseyana* / *Poa secunda* Shrubland
- CEG001030 *Artemisia tridentata ssp. vaseyana* / *Pseudoroegneria spicata* Shrubland
- CEG001532 *Artemisia tridentata ssp. vaseyana* / *Carex geyeri* Shrub Grassland
- CEG001028 *Artemisia tridentata ssp. vaseyana* / *Pascopyrum smithii* Shrubland
- CEG001020 *Artemisia tridentata ssp. vaseyana* / *Balsamorhiza sagittata* Shrubland
- CEG003476 *Artemisia tridentata ssp. vaseyana* / *Monardella odoratissima* Shrubland
- CEG001021 *Artemisia tridentata ssp. vaseyana* / *Bromus carinatus* Shrubland
- CEG001027 *Artemisia tridentata ssp. vaseyana* / *Leymus cinereus* Shrubland
- CEG002770 *Artemisia tridentata ssp. vaseyana* / *Phlox condensata* Shrubland
- CEG001533 *Artemisia tridentata ssp. vaseyana* / *Festuca idahoensis* Shrub Grassland
- CEG001031 *Artemisia tridentata ssp. vaseyana* / *Pseudoroegneria spicata* - *Poa fendleriana* Shrubland
- CEG002812 *Artemisia tridentata ssp. vaseyana* / *Poa fendleriana* Shrubland
- CEG002806 *Artemisia tridentata ssp. vaseyana* / *Achnatherum pinetorum* Shrubland
- CEG002811 *Artemisia tridentata ssp. vaseyana* / *Achnatherum lettermanii* Shrubland
- CEG005318 *Artemisia tridentata ssp. vaseyana* / *Elymus lanceolatus* Shrubland
- CEG001025 *Artemisia tridentata ssp. vaseyana* / *Leucopoa kingii* Shrubland
- CEG002989 *Artemisia tridentata ssp. spiciformis* / *Bromus carinatus* Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by D. Tart and D. Sarr.

Version Date: 2014/12/18

REFERENCES

References: Beetle and Johnson 1982, Bramble-Brodahl 1978, Despain 1973a, Faber-Langendoen et al. 2017b, Francis 1983, Goodrich et al. 1985, Hess 1981, Hess and Wasser 1982, Hironaka et al. 1983, Hurd 1961, Jensen et al. 1988a, Johnson and Clausnitzer 1992, Johnston 1987, Komarkova 1986, Küchler 1964, Lewis 1971, Lewis 1975a, Mooney 1985, Mueggler and Stewart 1980, Sabinske 1978, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shiflet 1994, Smith 1966, Strong 1980, Tart 1996, Terwilliger and Smith 1978, Tiedemann et al. 1987, Tweit and Houston 1980, West 1983c, Winward 1980b, Winward 1991

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G304. Intermountain Mountain Big Sagebrush Steppe & Shrubland

A3208. *Artemisia tridentata ssp. vaseyana* - Mixed Steppe & Shrubland Alliance

Type Concept Sentence: This alliance is widespread in mountainous areas across the western U.S. The vegetation is characterized by a moderate to dense shrub layer in which *Artemisia tridentata ssp. vaseyana* is codominant with non-sagebrush shrub species *Amelanchier utahensis*, *Holodiscus dumosus*, *Purshia tridentata*, or *Symphoricarpos oreophilus*. Perennial graminoids typically dominate the open to moderately dense herbaceous layer. This alliance forms large, continuous stands on mid-elevation mountain slopes and foothills, and can extend above the lower treeline as patches within montane or subalpine coniferous forests.

OVERVIEW

Scientific Name: *Artemisia tridentata ssp. vaseyana* - Mixed Steppe & Shrubland Alliance

Common Name (Translated Scientific Name): Mountain Big Sagebrush - Mixed Steppe & Shrubland Alliance

Colloquial Name: Mountain Big Sagebrush - Mixed Steppe & Shrubland

Type Concept: This alliance is widespread in mountainous areas across the western U.S. The vegetation included in this alliance is characterized by an open to dense (10-70% cover) shrub layer in which *Artemisia tridentata ssp. vaseyana* is codominant, usually with 40-60% relative cover with non-sagebrush shrub species such as *Amelanchier utahensis*, *Holodiscus dumosus*, *Purshia tridentata*, or *Symphoricarpos oreophilus*. Perennial graminoids typically dominate the open to moderately dense herbaceous layer. The most widespread species are *Pseudoroegneria spicata* and *Festuca idahoensis*, which occur from the Columbia Basin to the northern Rockies, although they may not be the most abundant species in individual stands. Other locally important species may include *Achnatherum occidentale* (= *Stipa occidentalis*), *Bouteloua gracilis*, *Bromus carinatus*, *Elymus trachycaulus*, *Festuca thurberi*, *Festuca viridula*, *Koeleria macrantha*, *Leucopoa kingii* (= *Festuca kingii*), *Leymus cinereus*, *Pascopyrum smithii*, *Poa fendleriana*, and *Poa secunda*. The forb layer is variable and can be very diverse. Species of *Castilleja*, *Potentilla*, *Erigeron*, *Phlox*, *Astragalus*, *Geum*, *Lupinus*, and *Eriogonum* are characteristic. The alliance forms large, continuous stands on mid-elevation mountain slopes and foothills, and can extend above the lower treeline as patches within montane or subalpine coniferous forests. Sites are variable and range from flats to steep slopes to ridgetops with deep to shallow rocky soil.

Classification Comments: Although the dominant species is shared with the different *Artemisia tridentata ssp. spiciformis* - *Artemisia tridentata ssp. vaseyana* Steppe & Shrubland Alliance (A3207), Young et al. (2007) show that there are substantial compositional and environmental differences which warrant separation into two different alliances. Much of the area occupied by this widespread alliance has been moderately to severely degraded by livestock grazing and subsequent invasion by *Bromus tectorum* with a consequent alteration of its fire regime. Individuals of the dominant species do not usually survive fire and usually take a decade or more to reestablish (Tirmenstein 1999c).

Internal Comments:

Other Comments:

Similar NVC Types:

- A3207 *Artemisia tridentata ssp. spiciformis* - *Artemisia tridentata ssp. vaseyana* Steppe & Shrubland Alliance: is not codominated by non-sagebrush shrubs.

Diagnostic Characteristics: This sagebrush mixed shrub alliance is widespread in mountainous areas across the western U.S. The vegetation included in this alliance is characterized by a moderate to dense shrub layer in which *Artemisia tridentata ssp. vaseyana* is codominant with non-sagebrush shrub species *Amelanchier utahensis*, *Holodiscus dumosus*, *Purshia tridentata*, or *Symphoricarpos oreophilus*. Perennial graminoids typically dominate the open to moderately dense herbaceous layer. Characteristic grasses are *Bromus carinatus*, *Elymus trachycaulus ssp. trachycaulus*, *Festuca idahoensis*, *Hesperostipa comata*, *Muhlenbergia montana*, *Poa secunda*, and *Pseudoroegneria spicata*.

VEGETATION

Physiognomy and Structure: The shrublands in this alliance are characterized by a open to dense (10-75%) cover of microphyllous evergreen shrubs, usually 1-2 m in height. Cespitose graminoids are scattered in the shrub matrix and can occasionally match the shrubs in height. A sparse, emergent layer of scale-leaved or needle-leaved evergreen trees may also be present, but in many areas no trees are present. Forb species may be frequent, but are usually of low cover. With increasing summer rain in the southeastern edge of the range, there is an increase in the importance of sod-forming grasses in comparison to bunchgrasses. In many areas, undisturbed stands in this alliance will have a cryptogamic soil crust composed of a mix of lichens, tiny mosses, and bacteria.

Floristics: The vegetation included in this alliance is characterized by a open to dense (10-70% cover) short-shrub layer in which *Artemisia tridentata ssp. vaseyana* is codominant, usually with 40-60% relative cover, with non-sagebrush shrub species such as *Amelanchier utahensis*, *Holodiscus dumosus*, *Purshia tridentata*, or *Symphoricarpos oreophilus*. Perennial graminoids typically dominate the open to moderately dense herbaceous layer. The most widespread species are *Pseudoroegneria spicata* and *Festuca idahoensis*, which occur from the Great Basin to the Rocky Mountains, although they may not be the most abundant species in individual stands. Other locally important species may include *Bromus carinatus*, *Elymus trachycaulus*, *Hesperostipa comata*, *Koeleria macrantha*, *Muhlenbergia montana*, *Poa fendleriana*, and *Poa secunda*. The forb layer is variable and can be very diverse. Species of *Castilleja*, *Potentilla*, *Erigeron*, *Phlox*, *Astragalus*, *Geum*, *Lupinus*, and *Eriogonum* are characteristic.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance is widespread in mountainous areas across the western U.S. and forms large, continuous stands on mid-elevation mountain slopes and foothills, and can extend above the lower treeline as patches within montane or subalpine coniferous forests. The climate regime is cool, semi-arid to subhumid, with yearly precipitation ranging from 18-60 cm. Much of the yearly precipitation falls as snow, which may cover the ground for long periods in winter. Temperatures are continental

with large annual and diurnal variation. The elevation range for this alliance is large, from about 1060 m in eastern Oregon and Washington, to well over 3500 m in the mountains of northern Nevada, Idaho, and Colorado. Landscape positions are variable as well, but primarily are deep-soiled to stony flats, ridges, nearly flat ridgetops, and mountain slopes. All aspects are represented, but the higher elevation occurrences may be mainly on south- or west-facing slopes. Soils generally are moderately deep to deep, well-drained, and of loam, sandy loam, clay loam, or gravelly loam textural classes; they often have a substantial volume of coarse fragments. The soils are derived from a variety of parent materials (although sandstones, limestones, and crystalline rocks are common). In some cases, soils supporting stands of this alliance are unstable and prone to mass movement (Bramble-Brodahl 1978, Hironaka et al. 1983). In subalpine environments, these shrublands are found on deeper soils than *Artemisia arbuscula* subalpine shrublands. Although the vegetation may grow in alkaline soils at the edge of internally drained basins, *Artemisia tridentata* is a non-halophyte and requires low salinity for optimum growth.

Dynamics: Complex ecological interactions between fire regimes, grazing history, and climate patterns result in equally complex patterns of species structure and composition in *Artemisia tridentata*. These present corresponding difficulties in the classification of these shrublands, which have been compounded by the influence of human settlement and agricultural patterns. What follows is a summary of some of the influences of altered fire regimes, and grazing history on *Artemisia tridentata* shrublands and shrub herbaceous vegetation.

Artemisia tridentata ssp. vaseyana shrublands may represent either drier or more disturbed examples of the *Artemisia tridentata ssp. vaseyana* shrubland complex. Shrub densities typically increase with overgrazing of the bunchgrass component or with increasing summer drought (West 1983c). There is considerable debate over whether present shrub-dominated stands are actually degraded "steppe" (e.g., shrub-herbaceous physiognomy), and if the stands will return to steppe with changes in grazing and fire management. *Artemisia tridentata* is inhibited by fire, and excessive grazing may decrease fire frequency due to consumption of herbaceous forage, resulting in increased shrub density. Conversely, invasion by non-native annual grasses (e.g., *Bromus tectorum* at lower elevations) may increase fire frequency sufficiently to eliminate the shrubs from the stands (Hironaka et al. 1983). With a change in fire frequency, species composition will be altered as well (West 1983c). With a high fire frequency (every 2-5 years), perennial grasses and shrubs are eliminated and non-native annual grasses dominate. At fire-return intervals of 10-30 years, short-lived resprouting shrubs such as *Chrysothamnus* or *Tetradymia* spp. dominate. At fire intervals of 30-70 years, a mixture of perennial bunchgrasses and shrubs is maintained. Finally, in the complete absence of fire, deep-rooted shrubs such as *Artemisia tridentata* become the theoretical dominants.

DISTRIBUTION

Geographic Range: This shrubland alliance occurs in mountainous regions from eastern California, Oregon, and Washington, across the Great Basin in Nevada, the northern Rocky Mountain foothills of Idaho, and in Colorado, Wyoming, and Montana. It has not been reported from Utah, Arizona, or New Mexico, but it is very likely to occur in these states at high elevations. In addition, the alliance probably extends north into Alberta, Canada.

Nations: CA?, US

States/Provinces: AB?, CA, CO, ID, MT, NV, OR, UT, WY

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007): 322Ac:CCC, 322Ad:CCC, 341Fa:CCC, 341Fb:CCC, 341Fc:CCC, 341Fd:CCC, 341Ff:CCC, 341Fg:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Great Basin)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- < *Artemisia tridentata ssp. vaseyana* (Mountain big sagebrush) Alliance (Sawyer et al. 2009) [35.111.00]
- = *Artemisia tridentata ssp. vaseyana* Shrubland Alliance (Evens et al. 2014) [probably equivalent]
- >> Big Sagebrush Scrub (#35210) (Holland 1986b)
- >> Big Sagebrush Series (Sawyer and Keeler-Wolf 1995)
- < SRM Cover Type #402 - Mountain Big Sagebrush (Shiflet 1994)
- >> Western Shrub and Grasslands Combinations: 55: Sagebrush-Steppe (*Artemisia-Agropyron*) (Küchler 1964)
- >> Western Shrub: 38: Great Basin Sagebrush (*Artemisia*) (Küchler 1964)

LOWER LEVEL UNITS

Associations:

- CEG002820 *Amelanchier utahensis* - *Artemisia tridentata* (*ssp. vaseyana*, *ssp. wyomingensis*) Shrubland
- CEPP006855 *Artemisia tridentata ssp. vaseyana* - *Ephedra viridis* Shrubland
- CEG002951 *Symphoricarpos oreophilus* Shrubland
- CEG005484 *Chamaebatiaria millefolium* / *Penstemon deustus* Sparse Vegetation

- CEGLO01034 *Artemisia tridentata ssp. vaseyana* - *Symphoricarpos oreophilus* / *Elymus trachycaulus ssp. trachycaulus* Shrubland
- CEGLO01036 *Artemisia tridentata ssp. vaseyana* - *Symphoricarpos oreophilus* / *Festuca idahoensis* Shrubland
- CEGLO05474 *Artemisia tridentata ssp. vaseyana* - *Chamaebatiaria millefolium* / *Penstemon deustus* Shrubland
- CEGLO01035 *Artemisia tridentata ssp. vaseyana* - *Symphoricarpos oreophilus* / *Bromus carinatus* Shrubland
- CEGLO01038 *Artemisia tridentata ssp. vaseyana* - *Symphoricarpos oreophilus* / *Pseudoroegneria spicata* Shrubland
- CEGLO05827 *Artemisia tridentata ssp. vaseyana* - (*Purshia tridentata*) / *Muhlenbergia montana* - (*Hesperostipa comata ssp. comata*) Shrubland
- CEGLO01037 *Artemisia tridentata ssp. vaseyana* - *Symphoricarpos oreophilus* / *Poa secunda* Shrubland
- CEGLO01039 *Artemisia tridentata ssp. vaseyana* - *Symphoricarpos oreophilus* / *Hesperostipa comata* Shrubland
- CEGLO02807 *Artemisia tridentata ssp. vaseyana* - *Holodiscus dumosus* Shrubland
- CEPP005794 *Artemisia tridentata ssp. vaseyana* Shrubland
- CEGLO01003 *Artemisia tridentata* - *Ephedra* spp. Shrubland
- CEGLO01032 *Artemisia tridentata ssp. vaseyana* - *Purshia tridentata* / *Pseudoroegneria spicata* Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments: We have incorporated significant descriptive information previously compiled by D. Sarr.

Version Date: 2014/12/18

REFERENCES

References: Baker 1983c, Baker and Kennedy 1985, Blackburn 1967, Blackburn et al. 1968a, Blackburn et al. 1968c, Blackburn et al. 1969a, Blackburn et al. 1969b, Blackburn et al. 1969c, Blackburn et al. 1969d, Blackburn et al. 1971, Boyce 1977, Bramble-Brodahl 1978, Britton et al. 1981, Caicco and Wellner 1983a, Caicco and Wellner 1983f, Caicco and Wellner 1983k, Chappell et al. 1997, Cheng 2004, Cooper et al. 1999, Current 1984, Daubenmire 1970, Eddleman and Jaindl 1994, Evens et al. 2014, Faber-Langendoen et al. 1996, Faber-Langendoen et al. 2017b, Fenemore 1970, Francis 1983, Francis 1986, Franklin and Dyrness 1973, Giese 1975, Hansen et al. 1984, Harper and Jaynes 1986, Heinze et al. 1962, Hess 1981, Hess and Wasser 1982, Hironaka et al. 1983, Holecheck and Stephenson 1983, Holland 1986b, Jameson et al. 1962, Jensen et al. 1988a, Johnson and Clausnitzer 1992, Johnson and Payne 1968, Johnson and Simon 1987, Johnston 1987, Jorgensen 1979, Komarkova 1986, Kurzius 1981, Küchler 1964, Leary and Peterson 1984, Lesica and DeVelice 1992, Lewis 1971, Lewis 1975a, Loope 1969, McArthur and Welch 1986, McLean 1970, Mooney 1985, Moretti 1979, Moretti and Brotherson 1982, Nelson and Jensen 1987, ORNHP unpubl. data, Poulton 1955, Ralston 1969, Rickard and Beatley 1965, Robertson 1971, Rzedowski 1981, Savage 1968, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Sheehy and Winward 1981, Shiflet 1994, Smith 1966, Tart 1996, Terwilliger and Smith 1978, Terwilliger and Tiedemann 1978, Tiedemann et al. 1987, Tirmenstein 1999c, Tisdale and Hironaka 1981, Tueller and Blackburn 1974, Tueller and Eckert 1987, Tueller et al. 1966, Tweit and Houston 1980, USFS 1992, Warren et al. 1982, West 1983c, Winward 1970

M095. Great Basin-Intermountain Xeric-Riparian Scrub

This macrogroup covers shrublands along dry washes and valley floors dominated by *Atriplex canescens*, *Ericameria nauseosa*, *Artemisia tridentata ssp. tridentata*, and other species within the cool temperate desert of western North America.

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

3.B.1.Ne.4.a. M095 Great Basin-Intermountain Xeric-Riparian Scrub

G559. Great Basin-Intermountain Shrub & Herb Wash-Arroyo

Type Concept Sentence: This group includes sparsely to densely vegetated shrublands that occur along dry watercourses that experience periodic flash flooding, and is dominated by *Atriplex canescens*, *Atriplex confertifolia*, *Brickellia* spp., *Ephedra* spp., *Ericameria nauseosa*, and/or *Fraxinus anomala*, found throughout interior western deserts.

OVERVIEW

Scientific Name: *Atriplex canescens* - *Ericameria nauseosa* Shrub & Herb Wash-Arroyo Group

Common Name (Translated Scientific Name): Fourwing Saltbush - Rubber Rabbitbrush Shrub & Herb Wash-Arroyo Group

Colloquial Name: Fourwing Saltbush - Rubber Rabbitbrush Desert Wash

Type Concept: This is a sparsely to densely vegetated group that occurs along dry watercourses that experience periodic flash flooding. These are shrublands dominated by *Atriplex canescens*, *Atriplex confertifolia*, *Brickellia* spp., *Ephedra* spp., *Ericameria nauseosa*, and/or *Fraxinus anomala*. Other associated shrubs include *Artemisia filifolia*, *Artemisia tridentata*, *Atriplex gardneri*, *Gutierrezia sarothrae*, *Lycium andersonii*, *Purshia stansburiana*, *Quercus havardii*, *Rhus trilobata*, *Sarcobatus vermiculatus*, and/or *Suaeda moquinii* (= *Suaeda torreyana*). Herbaceous cover is sparse (<10% cover) with a variety of grasses and forbs; non-native

annuals can be abundant. This group is known from eastern Washington, eastern Oregon, the Columbia Basin, and throughout the Great Basin. Elevations range from 500-2500 m. Stands occur along the banks or edges of, in or near temporary watercourses (aka washes, dry streambeds, gullies and the like). Surfaces occupied include sandy terraces, wash bottoms, point bars, as well as basin floors that are flat or gently sloping. Substrates are rapidly drained and coarse, such as sandy or gravelly soils derived from alluvium, gneiss, shale, cinder and sandstone, that are often very rocky as well.

Classification Comments: These associations can be difficult to differentiate from surrounding upland communities.

Similar NVC Types:

- G541 Warm Semi-Desert Shrub & Herb Dry Wash & Colluvial Slope: occurs in warmer regions of the West.

Diagnostic Characteristics: This shrubland group is characterized by a sparse to dense (1-65% cover) shrub layer dominated by *Atriplex canescens*, *Atriplex confertifolia*, *Brickellia* spp., *Ephedra* spp., *Ericameria nauseosa*, and/or *Fraxinus anomala*. Stands occur in or near temporary watercourses on sandy terraces, wash bottoms, point bars, and basin floors that are flat or gently sloping.

VEGETATION

Physiognomy and Structure: This group is defined as a broadleaf deciduous shrubland with 1-65% cover. Herbaceous cover is generally low to sparse and characterized by a mixed composition of graminoids.

Floristics: Stands are sparse to dense (1-65% cover) and dominated by *Atriplex canescens*, *Atriplex confertifolia*, *Brickellia* spp., *Ephedra* spp., *Ericameria nauseosa*, and/or *Fraxinus anomala*. Associated shrubs include *Artemisia filifolia*, *Artemisia tridentata*, *Atriplex gardneri*, *Gutierrezia sarothrae*, *Lycium andersonii*, *Purshia stansburiana*, *Quercus havardii*, *Rhus trilobata*, *Sarcobatus vermiculatus*, and/or *Suaeda moquinii* (= *Suaeda torreyana*). Herbaceous cover is sparse (<10% cover) with a variety of grasses and forbs such as *Achnatherum hymenoides*, *Artemisia dracuncululus*, *Descurainia pinnata*, *Elymus elymoides*, *Glycyrrhiza lepidota*, *Hesperostipa comata*, *Hordeum jubatum*, *Muhlenbergia porteri*, *Pleuraphis jamesii*, *Sphaeralcea parvifolia*, *Sporobolus contractus*, *Sporobolus cryptandrus*, *Stanleya pinnata*, and *Scabrethia scabra* (= *Wyethia scabra*). Non-native annuals such as *Bromus tectorum* and *Salsola tragus* are sometimes present to abundant.

ENVIRONMENT & DYNAMICS

Environmental Description: *Soil/substrate/hydrology:* Substrates are rapidly drained, sandy or gravelly soils derived from alluvium, gneiss, shale, cinder and sandstone. Scattered large rocks, gravel and bare ground cover most of the unvegetated surface, although some litter is typically present.

Dynamics: This group is often associated with a combination of dry conditions, coarse-textured substrates and intermittent severe disturbance by flash floods. The vegetation is usually scattered, occurring in parts of the channel protected from the worst flooding, and shrubs have extensive root systems to allow them to resprout quickly when damaged or partially uprooted by flooding.

DISTRIBUTION

Geographic Range: This group is known from eastern Washington, eastern Oregon, the Columbia Basin, and throughout the Great Basin.

Spatial Scale & Pattern [optional]: Linear

Nations: US

States/Provinces: AZ, CA, CO, ID, MT, NV, OR, UT, WA, WY

TNC Ecoregions [optional]: 4:C, 6:C, 8:C, 9:C, 10:C, 11:C, 19:C, 20:C, 26:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313D:CC, 315H:PP, 331B:CC, 331H:C?, 331I:CC, 331J:CC, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342A:CC, 342E:CC, 342F:CC, 342G:CC, M313A:CC, M313B:CP, M331I:??, M341A:CC, M341B:CC, M341C:CC, M341D:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Alliances:

- A3266 *Atriplex canescens* - *Ericameria nauseosa* Desert Wash Alliance

AUTHORSHIP**Primary Concept Source:** K.A. Schulz, in Faber-Langendoen et al. (2011)**Author of Description:** K.A. Schulz and G. Kittel**Acknowledgments:****Version Date:** 11/06/2015**Classif Resp Region:** West**Internal Author:** MEH 10-10, mod. GK 8-15, mod. KAS 11-15**REFERENCES****References:** Comer et al. 2003, Faber-Langendoen et al. 2017a, Knight 1994, Shiflet 1994, West 1983b

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G559. Great Basin-Intermountain Shrub & Herb Wash-Arroyo

A3266. *Atriplex canescens* - *Ericameria nauseosa* Desert Wash Alliance**Type Concept Sentence:** This alliance consists of shrublands, generally dominated by *Atriplex canescens* and/or *Ericameria nauseosa*. Several other shrub species may appear in the stand. These are shrublands of cold desert washes of Arizona, Colorado, Nevada and Utah with low cover of mixes of short shrubs.**OVERVIEW****Scientific Name:** *Atriplex canescens* - *Ericameria nauseosa* Desert Wash Alliance**Common Name (Translated Scientific Name):** Fourwing Saltbush - Rubber Rabbitbrush Desert Wash Alliance**Colloquial Name:** Fourwing Saltbush - Rubber Rabbitbrush Desert Wash**Type Concept:** This alliance covers desert wash shrublands dominated by *Atriplex canescens* and/or *Ericameria nauseosa*. Associated shrubs include *Artemisia filifolia*, *Artemisia tridentata*, *Atriplex confertifolia*, *Atriplex gardneri*, *Brickellia longifolia*, *Ephedra torreyana*, *Ephedra viridis*, *Fraxinus anomala*, *Gutierrezia sarothrae*, *Lycium andersonii*, *Purshia stansburiana*, *Rhus trilobata*, *Sarcobatus vermiculatus*, and *Suaeda moquinii* (= *Suaeda torreyana*). The herbaceous stratum has sparse to moderate cover of *Achnatherum hymenoides*, *Artemisia dracunculul*, *Descurainia pinnata*, *Elymus elymoides*, *Glycyrrhiza lepidota*, *Hesperostipa comata*, *Hordeum jubatum*, *Sphaeralcea parvifolia*, *Sporobolus contractus*, and *Sporobolus cryptandrus*. These shrubland are short-statured (<2 m in height), mixed species with fairly open canopy coverage. They can be found in cold desert washes of northern Arizona, Colorado, Nevada and Utah.**Classification Comments:** Alliance of cold desert washes with sparsely scattered cover of either of the three shrub species.**Internal Comments:** MSR 1-16: this alliance does not hold up; should be archived. mjr 12-14: CA added for MOJN.**Other Comments:****Similar NVC Types:****Diagnostic Characteristics:** Open to scattered cover (1-25%) of short shrubs lining arroyos and intermittent drainages.**VEGETATION****Physiognomy and Structure:** Shrublands of facultatively deciduous, extremely xeromorphic shrubs with open to moderately dense canopy that is less than 2 m tall. The herbaceous layer is relatively sparse (20-30% cover) and is usually less than 0.5 m tall. It is codominated by perennial grasses and forbs. Annual graminoids and forbs are seasonally present.**Floristics:** These shrublands lining desert washes are dominated by *Atriplex canescens* and/or *Ericameria nauseosa*. Associated shrubs may include scattered *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Gutierrezia sarothrae*, *Krascheninnikovia lanata*, *Parthenium confertum*, *Prunus virginiana*, *Purshia stansburiana* (= *Purshia mexicana* var. *stansburiana*), *Rhus trilobata*, *Sarcobatus vermiculatus*, *Symphoricarpos occidentalis*, *Tetradymia glabrata*, and occasional *Artemisia tridentata*. The herbaceous layer can vary from moderately dense and dominated by graminoids to absent. Common native grasses include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Distichlis spicata*, *Elymus elymoides*, *Elymus trachycaulus* ssp. *trachycaulus*, *Leymus flavescens* (= *Elymus flavescens*), *Pseudoroegneria spicata*, *Sporobolus airoides*, *Sporobolus cryptandrus*, *Sporobolus flexuosus*, *Sporobolus nealleyi*, and *Sporobolus wrightii*. Native forbs generally have low cover, but may include species such as *Abronia fragrans*, *Cleome lutea*, *Gayophytum ramosissimum*, *Lygodesmia grandiflora*, *Machaeranthera canescens* (= *Aster canescens*), *Mentzelia multiflora*, *Navarretia* sp., *Phacelia hastata* (= *Phacelia leucophylla*), *Phacelia* spp., *Psoralidium lanceolatum* (= *Psoralea lanceolata*), and *Sphaeralcea coccinea*. Disturbed stands typically have high cover of introduced annual *Bromus* species such as *Bromus tectorum*,

Bromus arvensis (= *Bromus japonicus*), and *Bromus rubens*. Introduced forbs may include *Melilotus officinalis*, *Salsola kali*, and *Bassia scoparia* (= *Kochia scoparia*).

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance occurs in areas of high natural disturbance such as on steep colluvial slopes, along drainages or in floodplains and washes. The soils are well-drained, moderately deep and coarse-textured with a sandy surface over sandy loams. Soils are derived from sandy/gravelly alluvium. Elevations range from 670-2250 m (2198-7381 feet). Substrates may be eolian, alluvial, colluvial or derived from sandstone residuum. Soils are variable but are generally well-drained and coarse-textured.

Shrublands included in this alliance occur on lowland and upland sites throughout much of the arid and semi-arid western U.S. with elevations ranging from 75 m below sea level to 2400 m. Lowland sites include alluvial flats, drainage terraces, playas, washes and interdunal basins. The lowland sites may be moderately saline or alkaline. Bare ground usually dominates the ground surface.

Dynamics: This alliance occurs in washes and therefore experiences flash floods from time to time. Shrubs generally resprout after severe flood scour.

DISTRIBUTION

Geographic Range: This alliance is found in Arizona, Colorado, Nevada and Utah.

Nations: US

States/Provinces: AZ, CA, CO, NV, UT

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007): 322Av:CCC, 322Ay:CCC, 322Az:CCC, 341Fc:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Joshua Tree, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Atriplex canescens* Association (153.272) (Brown 1982a) [included within Chihuahuan Desertscrub, Saltbush Series.]
- > *Ericameria nauseosa* (Rubber rabbitbrush scrub) Alliance (Sawyer et al. 2009) [35.310.00]
- > *Ericameria nauseosa* Shrubland Alliance (Evens et al. 2014)
- > *Lepidospartum squamatum* (Scale broom scrub) Alliance (Sawyer et al. 2009) [32.070.00]
- > *Lepidospartum squamatum* Alliance (Scale broom scrub) (Buck-Diaz et al. 2012)

LOWER LEVEL UNITS

Associations:

- CEG002261 *Ericameria nauseosa* Desert Wash Shrubland
- CEG003470 *Atriplex canescens* Desert Wash Shrubland

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2015/12/19

REFERENCES

References: Aldous and Shantz 1924, BIA 1979, Brown 1982a, Buck-Diaz et al. 2012, Culver et al. 1996, Evens et al. 2012, Evens et al. 2014, Faber-Langendoen et al. 2017b, Hyder et al. 1966, Maxwell 1975, Miller et al. 1977, Peterson 2008, Reid et al. 1994, Roberts et al. 1992, Sawyer et al. 2009, Shaw et al. 1989, Shute and West 1978, Soil Conservation Service 1978, Soil Conservation Service n.d., Stout et al. 2013, USBOR 1976, USFS 1937, VegCAMP and AIS 2013, Vest 1962a, Warren et al. 1982

M093. Great Basin Saltbush Scrub

This widespread cool semi-desert macrogroup centers in the Intermountain West of the U.S. and is typically composed of saltbush shrublands. Dominants include *Atriplex canescens*, *Atriplex confertifolia*, *Atriplex corrugata*, *Atriplex cuneata*, *Atriplex gardneri*, *Atriplex lentiformis*, *Atriplex obovata*, *Atriplex polycarpa*, and *Atriplex spinifera*, either singly or mixed, sometimes codominated by other associated species. Substrates are typically saline, alkaline, fine-textured soils developed from shale or alluvium.

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

3.B.1.Ne.5.a. M093 Great Basin Saltbush Scrub

G301. Intermountain Dwarf Saltbush - Sagebrush Scrub

Type Concept Sentence: This dwarf-shrub scrub group occurs on gentle slopes and rolling plains in the Colorado Plateau and Uinta Basin on Mancos shale and arid, windswept basins and plains across parts of Wyoming and Montana. It is characterized by an open canopy of dwarf-shrubs composed of relatively pure stands of *Artemisia pedatifida*, *Atriplex corrugata*, or *Atriplex gardneri* sometimes with *Artemisia longifolia*, *Artemisia pygmaea*, or *Picrothamnus desertorum* dominant or codominant.

OVERVIEW

Scientific Name: *Atriplex corrugata* - *Atriplex gardneri* - *Artemisia pedatifida* Dwarf-Scrub Group

Common Name (Translated Scientific Name): Mat Saltbush - Gardner's Saltbush - Birdfoot Sagebrush Dwarf-Scrub Group

Colloquial Name: Pygmy Sagebrush Low Scrub

Type Concept: This semi-arid dwarf-shrub scrub group occurs in the interior western U.S. and is found on windswept basins and plains, often on marine shales. The vegetation is characterized by an open canopy of dwarf-shrubs composed of relatively pure stands of *Artemisia pedatifida* (important in Wyoming), *Atriplex corrugata* (western Colorado and Utah), or *Atriplex gardneri* (Wyoming and Montana into Canada). Other dominant or codominant dwarf-shrubs may include *Artemisia longifolia*, *Artemisia pygmaea*, or *Picrothamnus desertorum*, sometimes with a mix of other low shrubs, such as *Krascheninnikovia lanata* or *Tetradymia spinosa*. Occasional individuals or small clumps of *Atriplex confertifolia*, *Atriplex canescens*, or *Artemisia tridentata ssp. wyomingensis* may be present in some stands within this group but do not codominate. The herbaceous layer is typically sparse. Scattered perennial forbs occur, such as *Xylorhiza glabriuscula* and *Sphaeralcea grossulariifolia*; perennial grasses *Achnatherum hymenoides*, *Bouteloua gracilis* (not in Wyoming), *Elymus elymoides*, *Elymus lanceolatus ssp. lanceolatus*, *Pascopyrum smithii*, *Poa secunda*, or *Sporobolus airoides* may dominate the herbaceous layer. In less saline areas, there may be inclusions of grasslands dominated by *Hesperostipa comata*, *Leymus salinus*, *Pascopyrum smithii*, or *Pseudoroegneria spicata*. Stands occur on gentle slopes and rolling plains. Substrates are shallow, typically saline, alkaline, fine-textured soils developed from shale or alluvium that may be associated with shale badlands. Infiltration rate is typically low. In Wyoming and possibly elsewhere, inclusions of non-saline, gravelly barrens or rock outcrops dominated by cushion plants such as *Arenaria hookeri* and *Phlox hoodii* without dwarf-shrubs may be present (these are not restricted to this group and larger patches would likely be classified in a sparse vegetation group).

Classification Comments: This group is more broadly defined than just low, mat-forming saltbush on shaly sites (*Atriplex corrugata*, *Atriplex gardneri*), but includes few dwarf sagebrush species that occur with similar habits and in similar habitats. Generally, it does not include stands mixed with taller species of saltbush or sagebrush. Stands in this group may grade into sparse vegetation groups on shale barrens/badlands. Welsh (1957) observed that *Atriplex corrugata* stands were restricted to north and east aspects on Mancos shale, with south and west aspects nearly barren. In Montana, *Atriplex gardneri* also occurs associated with badlands, and determining which group it falls into may be difficult. Scrub stands dominated by *Picrothamnus desertorum* are placed in Intermountain Shadscale - Saltbush Scrub Group (G300) because they often codominate with the widespread shrub *Atriplex confertifolia*. However, *Picrothamnus desertorum* is often short (10-25 cm tall) so it could also be classified as a dwarf-shrubland.

Similar NVC Types:

Diagnostic Characteristics: This open dwarf-shrubland is typically dominated by relatively pure stands of *Atriplex corrugata* (in Colorado and Utah) or *Atriplex gardneri* (Wyoming and Montana into Canada). Other dominant or codominant dwarf-shrubs may include *Artemisia longifolia*, *Artemisia pedatifida* (very important in Wyoming, rare in Colorado stands), or *Artemisia pygmaea*, sometimes with a mix of other low shrubs, such as *Krascheninnikovia lanata* or *Tetradymia spinosa*. Occasional individuals or small clumps of *Atriplex confertifolia*, *Atriplex canescens*, or *Artemisia tridentata ssp. wyomingensis* may be present in some stands within this group but do not codominate.

VEGETATION

Physiognomy and Structure: This group is a facultatively deciduous, subdesert dwarf-shrubland. It typically has an open woody canopy of clumps of low, mat-forming dwarf-shrubs and a sparse herbaceous layer.

Floristics: This dwarf-shrubland group is characterized by an open canopy of dwarf-shrubs typically composed of relatively pure stands of *Atriplex* spp., such as *Atriplex corrugata* (in Colorado and Utah), *Atriplex gardneri* (Wyoming and Montana into Canada), or *Artemisia pedatifida* (very important in Wyoming, rare in Colorado stands). Other dominant or codominant dwarf-shrubs may include *Artemisia longifolia*, *Artemisia pygmaea*, or *Picrothamnus desertorum*, sometimes with a mix of other low shrubs, such as *Krascheninnikovia lanata* or *Tetradymia spinosa*. Occasional individuals or small clumps of *Atriplex confertifolia*, *Atriplex canescens*, or *Artemisia tridentata ssp. wyomingensis* may be present in some stands within this group but do not codominate. The herbaceous layer is typically sparse. Scattered perennial forbs occur, such as *Xylorhiza glabriuscula* and *Sphaeralcea grossulariifolia*; perennial grasses *Achnatherum hymenoides*, *Bouteloua gracilis* (not in Wyoming), *Elymus elymoides*, *Elymus lanceolatus ssp. lanceolatus*, *Pascopyrum smithii*, *Poa secunda*, or *Sporobolus airoides* may dominate the herbaceous layer. In less saline areas, there may be

inclusions of grasslands dominated by *Hesperostipa comata*, *Leymus salinus*, *Pascopyrum smithii*, or *Pseudoroegneria spicata*. In Wyoming and possibly elsewhere, inclusions of non-saline, gravelly barrens or rock outcrops dominated by cushion plants such as *Arenaria hookeri* and *Phlox hoodii* without dwarf-shrubs may be present (these are not restricted to this group and larger patches would likely be classified in a sparse vegetation group). Annuals are seasonally present and may include *Eriogonum inflatum*, *Plantago tweedyi*, *Monolepis nuttalliana*, and the introduced annual grass *Bromus tectorum*.

ENVIRONMENT & DYNAMICS

Environmental Description: This group occurs on gentle slopes and rolling plains in the northern Colorado Plateau and Uinta Basin on Mancos shale and arid, windswept plains and basins across parts of Wyoming. On Mancos shale (and possibly other saline marine shales), stands may be restricted to gentler slopes and cooler north and east aspects, with steeper south and west aspects nearly barren (Welsh 1957). *Climate:* Climate is temperate and semi-arid. Summers are generally hot, and freezing temperatures are common in the winter. Mean annual precipitation ranges from 13-33 cm. In Montana and Wyoming, approximately two-thirds of the annual precipitation falls in spring and early summer. In Colorado and Utah, over half the precipitation occurs in the late-summer monsoons as high-intensity thunderstorms. *Soil/substrate/hydrology:* Substrates are typically saline, alkaline, fine-textured soils developed from shale or alluvium and may be associated with shale badlands. Infiltration rate is typically low. In Wyoming and possibly elsewhere, inclusions of non-saline, gravelly barrens or rock outcrops may be present.

Dynamics: *Atriplex corrugata*-dominated shrublands are the most saline-tolerant of the Mancos shale plant communities studied by Branson et al. (1976). *Atriplex corrugata* can completely dominate these extremely saline sites (Branson et al. 1976). It is a true evergreen dwarf-shrub retaining leaves for several years, and branches are capable of rooting at the nodes. This plant utilizes winter soil moisture, beginning new growth in March when the soils are relatively warm and moist. It flowers in April, and by mid-July fruits are shattered (Branson et al. 1976). If the soils dry out in mid-summer, it can go dormant until the late-summer monsoon rains begin. Large areas of *Atriplex corrugata* died during the extreme drought of 2002 in the Four Corners area. By 2004, new seedlings were established and spreading; shrub cover recovered to approximately 50% of what it was before the drought. *Atriplex gardneri*-dominated vegetation is another saline/drought-tolerant example of the Mancos Shale plant communities studied by Branson et al. (1976). Although very slow-growing, it can completely dominate these extremely saline sites (Branson et al. 1976).

DISTRIBUTION

Geographic Range: This group occurs on gentle slopes and rolling plains in the Colorado Plateau and Uinta Basin on Mancos shale and arid, windswept basins and plains across parts of Wyoming and Montana, and into Canada.

Spatial Scale & Pattern [optional]: Matrix

Nations: CA, US

States/Provinces: AZ, CO, MT, NM, NV, UT, WY

TNC Ecoregions [optional]: 10:C, 11:P, 19:C, 20:P, 26:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 341B:CC, 341C:CC, 342E:C?, 342F:C?, 342G:CC, 342J:C?, M331B:CC, M331D:C?, M331E:CC, M331G:CC, M331H:CC, M331J:C?, M341B:CC, M341C:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate. The distinction between this group and Intermountain Basins Cliff, Scree & Badland Sparse Vegetation Group (G570) is unclear, as both occur on shale "badlands" and are floristically quite similar. The differences possibly relate more to total biomass, as opposed to floristic shifts.

SYNONYMY

- = Mat-*Atriplex* Association (Graham 1937)
- >< Other Sagebrush Types (408) (Shiflet 1994)
- >< Saltbush - Greasewood (501) (Shiflet 1994)
- = Vegetation on Manco Shale (Welsh 1957)

LOWER LEVEL UNITS

Alliances:

- A1127 *Artemisia pedatifida* Low Scrub Alliance
- A1110 *Atriplex gardneri* Low Scrub Alliance
- A1109 *Atriplex corrugata* Low Scrub Alliance
- A1106 *Artemisia pygmaea* Low Scrub Alliance

AUTHORSHIP

Primary Concept Source: S.L. Welsh (1957)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 11/06/2015

Classif Resp Region: West

Internal Author: KAS 2-10, 11-15

REFERENCES

References: Branson et al. 1976, Faber-Langendoen et al. 2017a, Graham 1937, Knight 1994, Knight et al. 1987, Potter et al. 1985, Shiflet 1994, Welsh 1957

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G301. Intermountain Dwarf Saltbush - Sagebrush Scrub

A1106. Artemisia pygmaea Low Scrub Alliance

Type Concept Sentence: These communities are characterized by a sparse dwarf-shrub layer of *Artemisia pygmaea* and occur in relatively dry areas of the sagebrush desert of Nevada and Utah, from 1200-1800 m in elevation.

OVERVIEW

Scientific Name: *Artemisia pygmaea* Low Scrub Alliance

Common Name (Translated Scientific Name): Pygmy Sagebrush Low Scrub Alliance

Colloquial Name: Pygmy Sagebrush Low Scrub

Type Concept: This alliance is characterized by a sparse dwarf-shrub layer of *Artemisia pygmaea*, with other shrubs scattered through the stands. Only one association from central Nevada is presently described for this alliance. In addition to *Artemisia pygmaea*, that association included *Artemisia nova*, *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, and *Ephedra nevadensis* in the shrub layer. According to the authors, none of these associated shrubs is constant or characteristic of these communities. A sparse graminoid layer is usually present, including *Achnatherum hymenoides* (= *Oryzopsis hymenoides*) and *Elymus elymoides*. Forbs include *Astragalus* spp., *Eriogonum caespitosum*, and *Sphaeralcea coccinea*. Adjacent vegetation types are most often dominated by *Artemisia nova*, which often forms the vegetation matrix surrounding these unique communities. These communities often harbor regionally rare plant species. They occur in relatively dry areas of the sagebrush desert of Nevada and Utah, from 1200-1800 m in elevation. Precipitation averages 15-20 cm annually, with a significant proportion arriving as snow. Growing-season drought is characteristic. Soils are usually shallow and often unique, including Green River shale, heavy clays, or calcareous outcrops or gravels.

Classification Comments: Although these communities are classified as dwarf-shrublands, examination of stand data for the one association linked to this alliance indicates this vegetation may be better classified as sparsely vegetated. Total shrub cover is less than 15% and total vegetation cover is less than 25% for all species. Further inventory and classification work are needed to document this alliance.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Nearly sparsely vegetated low shrublands of the Nevada and Utah deserts where *Artemisia pygmaea* has <15% total cover, but remains the dominant shrub species.

VEGETATION

Physiognomy and Structure: These are sparse dwarf-shrublands dominated by a microphyllous evergreen shrub from 0.05-0.2 m in height. Larger shrubs are often scattered through these communities, but are of low cover and constancy. Scattered cespitose graminoids are also usually present, but of low cover (<10%).

Floristics: This alliance is characterized by a sparse dwarf-shrub layer of *Artemisia pygmaea*, with other shrubs scattered through the stands. Only one association from central Nevada is presently described for this alliance (Blackburn et al. 1968c). In addition to *Artemisia pygmaea*, that association includes *Artemisia nova*, *Atriplex confertifolia*, *Chrysothamnus viscidiflorus*, and *Ephedra nevadensis* in the shrub layer. According to the authors, none of these associated shrubs is constant or characteristic of these communities. A sparse graminoid layer is usually present, including *Achnatherum hymenoides* (= *Oryzopsis hymenoides*) and *Elymus elymoides*. Forbs include *Astragalus* spp., *Eriogonum caespitosum*, and *Sphaeralcea coccinea*.

ENVIRONMENT & DYNAMICS

Environmental Description: These communities occur in relatively dry areas of the sagebrush desert of Nevada and Utah, from 1200-1800 m in elevation. Precipitation averages 15-20 cm annually, with a significant proportion arriving as snow. Growing-season

drought is characteristic. Soils are usually shallow and often unique, including Green River shale, heavy clays, or calcareous outcrops or gravels.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance has been quantitatively described from Nevada and also occurs in Utah (Welsh et al. 1993).

Nations: US

States/Provinces: NV, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- < SRM Cover Type #408 - Other Sagebrush Types (Shiflet 1994)

LOWER LEVEL UNITS

Associations:

- CEG001436 *Artemisia pygmaea* / *Elymus elymoides* - *Achnatherum hymenoides* Shrubland

AUTHORSHIP

Primary Concept Source: D. Sarr, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Blackburn et al. 1968c, Faber-Langendoen et al. 2017b, Shiflet 1994, Welsh et al. 1987, Welsh et al. 1993

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G301. Intermountain Dwarf Saltbush - Sagebrush Scrub

A1110. *Atriplex gardneri* Low Scrub Alliance

Type Concept Sentence: This dwarf-shrubland alliance has a very sparse to moderately dense cover of dwarf-shrubs that is dominated by *Atriplex gardneri* and occurs in western Colorado and eastern Utah, Wyoming and Montana on mesas, plateaus, plains, low hills and eroded "badlands."

OVERVIEW

Scientific Name: *Atriplex gardneri* Low Scrub Alliance

Common Name (Translated Scientific Name): Gardner's Saltbush Low Scrub Alliance

Colloquial Name: Gardner's Saltbush Low Scrub

Type Concept: Stands of this alliance have a very sparse to moderately dense cover of dwarf-shrubs that is dominated by *Atriplex gardneri*. *Artemisia tridentata* and *Picrothamnus desertorum* (= *Artemisia spinescens*) are codominants in some stands. Many other shrubs and dwarf-shrubs may be present, including *Atriplex* spp., *Krascheninnikovia lanata*, *Sarcobatus vermiculatus*, *Suaeda* spp., and *Tetradymia spinosa*. The herbaceous layer, if present, may be dominated by graminoids or forbs. Common species include *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Eriogonum pauciflorum*, *Leymus salinus*, *Monolepis nuttalliana*, *Pascopyrum smithii*, *Pleuraphis jamesii* (= *Hilaria jamesii*), or *Xylorhiza venusta*. This dwarf-shrubland alliance occurs in western Colorado and eastern Utah, Wyoming and Montana. Stands occur on mesas, plateaus, plains, low hills and eroded "badlands." Sites are nearly flat to moderately steep with moderately deep to deep, usually saline, alkaline soils. Soils are typically fine-textured and often have high erosion rates because of poor infiltration and high runoff. The soil surface is often mostly barren.

Classification Comments: Vegetation cover in this alliance may vary greatly depending on soil chemistry and slope. Some stands could be classified as dwarf-shrublands with 25-60% dwarf-shrub cover (Branson et al. 1976, DeVelice and Lesica 1993, DeVelice et al. 1995). Other stands are in the 3-20% shrub cover range and could be classified in a sparsely vegetated or dwarf-shrub herbaceous alliance (West and Ibrahim 1968, Ibrahim et al. 1972, Baker and Kennedy 1985, Knight et al. 1987, DeVelice and Lesica 1993,

DeVelice et al. 1995). In addition, heavy grazing by livestock has impacted some of these stands by nearly eliminating herbaceous species.

There is taxonomic confusion in some of the research done on these vegetation types. Some of the studies report the name *Atriplex nuttallii* to describe the taxon that is now called *Atriplex gardneri*, and yet *Atriplex nuttallii* is still a valid name (Kartesz 1999). Also, Welsh et al. (1987) described six varieties of *Atriplex gardneri*, most of which are now separate species of *Atriplex*. Further investigation is needed throughout the range of these taxa to clarify these taxonomic questions. New associations may need to be described or perhaps the concepts of these associations and the alliance need to be broadened to include the other species. DeVelice et al. (1995) have described two new *Atriplex gardneri*-dominated plant associations that have not yet been included in the U.S. National Vegetation Classification (named by DeVelice et al. (1995) as *Atriplex nuttallii* / perennial grass and *Atriplex nuttallii* / *Eriogonum pauciflorum*). The first plant association is very similar to current plant associations with the herbaceous layer dominated by either *Pascopyrum smithii*, *Pseudoroegneria spicata*, or *Sporobolus airoides*.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Diagnostic of this dwarf-shrubland alliance is the dominance or codominance of *Atriplex gardneri* in western Colorado and eastern Utah, Wyoming and Montana on mesas, plateaus, plains, low hills and eroded "badlands."

VEGETATION

Physiognomy and Structure: Vegetation in this alliance is dominated by sparse to moderate cover of xeromorphic evergreen dwarf-shrubs (<0.3 m tall). A sparse to moderately dense herbaceous layer that is dominated by perennial graminoids or forbs may be present. Annual forbs and grasses are seasonally present.

Floristics: Stands have a very sparse to moderately dense cover of woody species that is dominated by the halophytic evergreen dwarf-shrub *Atriplex gardneri*. Some stands are completely dominated by this plant and have very low species diversity. Depending on soil salinity and moisture, other plants may be present. *Artemisia tridentata* and *Picrothamnus desertorum* (= *Artemisia spinescens*) are codominants in some stands. Other shrubs and dwarf-shrubs may include *Atriplex* spp., *Krascheninnikovia lanata*, *Sarcobatus vermiculatus*, *Suaeda* spp. and *Tetradymia spinosa*. The herbaceous layer is very sparse to moderately dense. It may be dominated by graminoids such as *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Leymus salinus*, *Pascopyrum smithii*, *Pleuraphis jamesii* (= *Hilaria jamesii*), or the by forbs *Eriogonum pauciflorum*, *Monolepis nuttalliana* (an annual), or *Xylorhiza venusta*. Other frequent plants include *Allium textile*, *Aristida* spp., *Elymus elymoides*, *Eriogonum inflatum*, *Lappula* spp., *Opuntia polyacantha*, *Plantago patagonica*, *Poa secunda*, *Sphaeralcea coccinea*, and *Sporobolus* spp.

ENVIRONMENT & DYNAMICS

Environmental Description: Dwarf-shrublands in this alliance are found on mesas, plateaus, plains, low hills and eroded "badlands" in western Colorado and eastern Utah, Wyoming and Montana. Elevation ranges from 1150-2200 m. Climate is temperate and semi-arid. Summers are generally hot and freezing temperatures are common in the winter. Mean annual precipitation ranges from 13-33 cm. In Montana and Wyoming, approximately two-thirds of the annual precipitation falls in spring and early summer. In Colorado and Utah, over half the precipitation occurs in the late-summer monsoons as high-intensity thunderstorms. Sites are nearly flat to moderately steep. Soils are moderately deep to deep, usually saline, moderately alkaline, poorly developed and typically have high erosion rates because of poor infiltration and high runoff. Soil texture is typically fine, but ranges from sandy loam to clay and may be gravelly. Parent material is typically shale, alluvium and bentonite. The soil surface is often mostly barren. In the Badger Wash basin in Colorado, the soil surface has 74% bare ground and 6% litter (Branson et al. 1976).

Dynamics: *Atriplex gardneri*-dominated vegetation is the most saline/drought-tolerant of the Mancos shale plant communities studied by Branson et al. (1976). Although very slow-growing, it can completely dominate these extremely saline sites (Branson et al. 1976). This plant utilizes winter soil moisture, beginning new growth in March when the soils are relatively warm and moist. It flowers in April and by mid-July fruits are shattered (Branson et al. 1976).

DISTRIBUTION

Geographic Range: Dwarf-shrublands included in this alliance occur on mostly alkaline and barren plains and hills in western Colorado, eastern Utah, Wyoming and Montana.

Nations: US

States/Provinces: CO, MT, OR?, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- ? *Atriplex gardnerae* association (Ibrahim et al. 1972)
- ? *Atriplex nuttallii* Community Type (Cooper et al. 1995)
- ? *Atriplex nuttallii* plant community (Branson et al. 1976)
- ? *Atriplex* spp. Series (Johnston 1987) [includes *Atriplex gardneri*/*Elytrigia smithii* plant association.]
- >< Saltbush Desert Shrubland (Knight et al. 1987)

LOWER LEVEL UNITS

Associations:

- CEGLO01441 *Atriplex gardneri* / *Pleuraphis jamesii* Dwarf-shrubland
- CEGLO01443 *Atriplex gardneri* / *Monolepis nuttalliana* Dwarf-shrubland
- CEGLO01439 *Atriplex gardneri* - *Picrothamnus desertorum* Dwarf-shrubland
- CEGLO01440 *Atriplex gardneri* / *Artemisia tridentata* Dwarf-shrubland
- CEGLO01446 *Atriplex gardneri* / *Xylorhiza venusta* Dwarf-shrubland
- CEGLO01438 *Atriplex gardneri* Dwarf-shrubland
- CEGLO01445 *Atriplex gardneri* / *Pascopyrum smithii* Dwarf-shrubland
- CEGLO01442 *Atriplex gardneri* / *Leymus salinus* Dwarf-shrubland
- CEGLO01444 *Atriplex gardneri* / *Achnatherum hymenoides* Dwarf-shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/03/14

REFERENCES

References: Baker and Kennedy 1985, Branson et al. 1976, Cooper et al. 1995, DeVelice and Lesica 1993, DeVelice et al. 1995, Faber-Langendoen et al. 2017b, Ibrahim et al. 1972, Johnston 1987, Kartesz 1999, Knight et al. 1987, Welsh et al. 1987, West and Ibrahim 1968

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

3.B.1.Ne.5.b. M093 Great Basin Saltbush Scrub

G300. Intermountain Shadscale - Saltbush Scrub

Type Concept Sentence: This widespread semi-arid scrub group is found in basins, plains, alluvial flats and slopes in the intermountain western U.S. and western Great Plains and is characterized by a typically open to moderately dense shrub layer dominated or codominated by *Atriplex canescens*, *Atriplex confertifolia*, *Atriplex cuneata*, *Atriplex hymenelytra*, *Atriplex obovata*, *Atriplex polycarpa*, *Grayia spinosa*, and/or *Picrothamnus desertorum* often with other shrubs present to codominant.

OVERVIEW

Scientific Name: *Atriplex confertifolia* - *Atriplex canescens* - *Grayia spinosa* Scrub Group

Common Name (Translated Scientific Name): Shadscale Saltbush - Fourwing Saltbush - Spiny Hopsage Scrub Group

Colloquial Name: Fourwing Saltbush Scrub

Type Concept: This extensive group includes open-canopied shrublands of typically saline basins, alluvial slopes and plains across the intermountain western U.S. and western Great Plains. The vegetation is characterized by a typically open to moderately dense shrubland composed of one or more *Atriplex* species, such as *Atriplex canescens*, *Atriplex confertifolia*, *Atriplex cuneata*, *Atriplex hymenelytra*, *Atriplex obovata*, or *Atriplex polycarpa*. Other shrubs present to codominant may include *Artemisia tridentata* ssp. *wyomingensis*, *Chrysothamnus viscidiflorus*, *Ericameria nauseosa*, *Ephedra nevadensis*, *Krascheninnikovia lanata*, *Grayia spinosa*, *Lycium* spp., *Picrothamnus desertorum*, or *Tetradymia* spp. Northern occurrences lack *Atriplex* species and are typically dominated by *Grayia spinosa*. In Wyoming, occurrences are typically a mix of *Artemisia tridentata* ssp. *wyomingensis*, *Atriplex confertifolia*, *Grayia spinosa*, *Krascheninnikovia lanata*, *Sarcobatus vermiculatus*, and various *Ericameria* or *Chrysothamnus* species. Some places are a mix of *Atriplex confertifolia* and *Artemisia tridentata* ssp. *wyomingensis*. In the Great Basin, *Sarcobatus vermiculatus* is generally absent but, if present, does not codominate. The herbaceous layer varies from sparse to moderately dense and is dominated by perennial graminoids such as *Achnatherum hymenoides*, *Bouteloua gracilis*, *Elymus lanceolatus* ssp. *lanceolatus*,

Pascopyrum smithii, *Pleuraphis jamesii*, *Pleuraphis rigida*, *Poa secunda*, or *Sporobolus airoides*. Various forbs are also present. Substrates are often saline and calcareous, medium- to fine-textured, alkaline soils, but include some coarser-textured soils.

Classification Comments: Some *Grayia spinosa*-dominated stands tends to occur on coppice dunes that have a silty component to them. If they occur on deep sand or dunes, then consider a dune group. Scrub stands dominated by *Picrothamnus desertorum* are placed in this group because *Picrothamnus desertorum* is frequently present to codominant with the widespread shrub *Atriplex confertifolia* in the Great Basin (Mozingo 1987). However, *Picrothamnus desertorum* is often short (10-25 cm tall) so could also be classified as Intermountain Dwarf Saltbush - Sagebrush Scrub Group (G301).

Similar NVC Types:

- G299 Chihuahuan Desert Lowland Basin Scrub

Diagnostic Characteristics: The vegetation is characterized by a typically open to moderately dense shrubland composed of one or more shrub species, such as *Atriplex canescens*, *Atriplex confertifolia*, *Atriplex cuneata*, *Atriplex hymenelytra*, *Atriplex obovata*, *Atriplex polycarpa*, *Grayia spinosa*, and/or *Picrothamnus desertorum*.

VEGETATION

Physiognomy and Structure: This group is a facultatively deciduous, extremely xeromorphic, subdesert short shrubland with a typically open shrub canopy and sparse to moderately dense herbaceous layer dominated by perennial graminoids.

Floristics: This widespread cool semi-desert scrub group is highly variable and ranges from almost pure occurrences of a single species to fairly complex mixtures. The characteristic mix of low shrubs and grasses is sparse, with large open spaces between the plants (Blaisdell and Holmgren 1984). Occurrences have a sparse to moderately dense cover of woody species that is often dominated by one of several shrubs such as *Atriplex canescens* (also codominated by *Artemisia tridentata*, *Ephedra viridis*, or *Krascheninnikovia lanata*), *Atriplex confertifolia* (also codominated by several species of *Lycium* and *Ephedra*, *Picrothamnus desertorum*, or *Sarcobatus vermiculatus*), *Atriplex cuneata*, *Atriplex obovata*, *Atriplex hymenelytra*, *Atriplex polycarpa*, *Grayia spinosa*, or *Picrothamnus desertorum* (= *Artemisia spinescens*). Other shrubs may be present, especially in transition areas with desert or montane scrub. Species include *Acacia greggii*, *Artemisia frigida*, *Chrysothamnus* spp., *Encelia frutescens*, *Ericameria nauseosa*, *Ephedra nevadensis*, *Frankenia salina*, *Larrea tridentata*, *Lycium andersonii*, *Lycium pallidum*, *Parthenium confertum*, *Psoralea polydenius*, *Purshia stansburiana*, *Suaeda* spp., *Tetradymia glabrata*, *Tetradymia spinosa*, *Tiquilia latior*, and *Yucca glauca*. Dwarf-shrubs include *Gutierrezia sarothrae* and several species of *Eriogonum*, but generally do not form a distinct layer as the main shrub layer is often >0.5 m tall.

Warm-season medium-tall and short perennial grasses dominate in the sparse to moderately dense graminoid layer. The species present depend on the geographic range of the grasses, soil alkalinity/salinity, and past land use. Species may include *Achnatherum hymenoides*, *Bouteloua gracilis*, *Distichlis spicata*, *Elymus elymoides*, *Hesperostipa comata*, *Leymus ambiguus*, *Leymus salinus*, *Muhlenbergia torreyi*, *Pascopyrum smithii*, *Pleuraphis jamesii*, *Poa secunda*, *Pseudoroegneria spicata*, *Sporobolus airoides*, and *Sporobolus cryptandrus*. A number of annual species may also grow in association with the shrubs and grasses, although they are usually rare and confined to areas of recent disturbance (Blaisdell and Holmgren 1984). Forb cover is generally sparse. Perennial forbs that might occur include *Chaetopappa ericoides*, *Descurainia* spp., *Mentzelia* spp., *Sphaeralcea coccinea*, and *Xylorhiza venusta*. Annual natives include *Monolepis nuttalliana*, *Plantago* spp., or *Vulpia octoflora*. Associated halophytic annuals include *Salicornia bigelovii*, *Salicornia rubra*, and *Suaeda* species. Exotic annuals that may occur include *Salsola kali*, *Bromus rubens*, and *Bromus tectorum*. Cacti such as species of *Opuntia* and *Echinocereus* may be present in some occurrences. Trees are not usually present but some scattered *Juniperus* spp. may be found.

ENVIRONMENT & DYNAMICS

Environmental Description: This salt-desert shrubland group is matrix-forming in the Intermountain West. This group composes arid to semi-arid shrublands on lowland and upland sites usually at elevations between 1520 and 2200 m (4987-7218 feet). Sites can be found on all aspects and include valley bottoms, alluvial and alkaline flats, mesas and plateaus, playas, drainage terraces, washes and interdune basins, bluffs, and gentle to moderately steep sandy or rocky slopes. Slopes are typically gentle to moderately steep but are sometimes unstable and prone to surface movement. Many areas within this group are degraded due to erosion and may resemble "badlands." Soil surface is often very barren and interspaces between the characteristic plant clusters are commonly covered by a microphytic crust (West 1982).

Climate: This is typically a vegetation group of extreme climatic conditions, with warm to hot summers and freezing winters. Annual precipitation ranges from approximately 13-33 cm. In much of the group, the period of greatest moisture will be mid to late summer, although in the more northern areas, a moist period is to be expected in the cold part of the year. However, plotted seasonality of occurrence is probably of less importance on this desert vegetation than in other types because desert precipitation comes with an extreme irregularity that does not appear in graphs of long-term seasonal or monthly averages (Blaisdell and Holmgren 1984). **Soil/substrate/hydrology:** Soils are shallow to moderately deep, poorly developed, and a product of an arid climate

and little precipitation. Soils are often alkaline or saline. Vegetation within this group is tolerant of these soil conditions but not restricted to it. The shallow soils of much of the area are poorly developed Entisols. Vegetation within this group can occur on level pediment remnants where coarse-textured and well-developed soil profiles have been derived from sandstone gravel and are alkaline, or on Mancos shale badlands, where soil profiles are typically fine-textured and non-alkaline throughout (West and Ibrahim 1968). They can also occur in alluvial basins where parent materials from the other habitats have been deposited over Mancos shale and the soils are heavy-textured and saline-alkaline throughout the profile (West and Ibrahim 1968).

Dynamics: West (1982) stated that "salt desert shrub vegetation occurs mostly in two kinds of situations that promote soil salinity, alkalinity, or both. These are either at the bottom of drainages in enclosed basins or where marine shales outcrop." However, salt-desert shrub vegetation may be an indication of climatically dry as well as physiologically dry soils (Blaisdell and Holmgren 1984). Not all salt-desert shrub soils are salty, and their hydrologic characteristics may often be responsible for the associated vegetation (Naphan 1966). Species of the salt-desert shrub complex have different degrees of tolerance to salinity and aridity, and they tend to sort themselves out along a moisture/salinity gradient (West 1982). Species and communities are apparently sorted out along physical, chemical, moisture, and topographic gradients through complex relations that are not understood and are in need of further study (Blaisdell and Holmgren 1984).

The winter months are a good time for soil moisture accumulation and storage within stands in this group. There is generally at least one good snowstorm per season that will provide sufficient moisture to the vegetation. The winter moisture accumulation amounts will affect spring plant growth. Plants may grow as little as a few inches to 1 m. Unless more rains come in the spring, the soil moisture will be depleted in a few weeks, growth will slow and ultimately cease, and the perennial plants will assume their various forms of dormancy (Blaisdell and Holmgren 1984). If effective rain comes later in the warm season, some of the species will renew their growth from the stage at which it had stopped. Others, having died back, will start over as if emerging from winter dormancy (Blaisdell and Holmgren 1984). *Atriplex confertifolia* shrubs often develop large leaves in the spring, which increase the rate of photosynthesis. As soil moisture decreases, the leaves are lost, and the plant takes on a dead appearance. During late fall, very small overwintering leaves appear which provide some photosynthetic capability through the remainder of the year. Other communities are maintained by intra- or inter-annual cycles of flooding followed by extended drought, which favor accumulation of transported salts. The moisture supporting these intermittently flooded wetlands is usually derived off-site, and they are dependent upon natural watershed function for persistence (Reid et al. 1999).

In summary, desert communities of perennial plants are dynamic and changing. The composition within this group may change dramatically and may be both cyclic and unidirectional. Superimposed on the compositional change is great variation from year to year in growth of all the vegetation, the sum of varying growth responses of individual species to specific conditions of different years (Blaisdell and Holmgren 1984). Desert plants grow when temperature is satisfactory, but only if soil moisture is available at the same time. Because the amount of moisture is variable from year to year and because different species flourish under different seasons of soil moisture, seldom do all components of the vegetation thrive in the same year (Blaisdell and Holmgren 1984).

DISTRIBUTION

Geographic Range: The distribution of this widespread group centers in the Intermountain West of the U.S., and extends in limited distribution across northern New Mexico into the southern Great Plains. In Wyoming, this group occurs in the Great Divide and Bighorn basins.

Spatial Scale & Pattern [optional]: Large patch

Nations: MX?, US

States/Provinces: AZ, CA, CO, ID, KS, MT, NM, NV, OR, TX, UT, WA, WY

TNC Ecoregions [optional]: 4:?, 6:C, 8:?, 9:C, 10:C, 11:C, 18:C, 19:C, 20:C, 21:C, 26:C, 27:C, 28:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313D:CC, 315A:CC, 315B:CP, 315H:CC, 321A:CC, 322A:CC, 331A:CP, 331B:CC, 331F:CC, 331G:CC, 331H:CC, 331I:CC, 331J:CC, 341A:CC, 341B:CC, 341C:CC, 341D:CC, 341E:CC, 341F:CC, 341G:CC, 342A:CC, 342B:CC, 342C:CC, 342D:CC, 342E:CC, 342F:CC, 342G:CC, 342H:CC, 342I:CC, 342J:CC, M242C:PP, M261D:CP, M261E:CP, M261G:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:C?, M332A:CP, M332E:CC, M332F:CC, M332G:CP, M341A:CC, M341B:CC, M341C:CC, M341D:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Arches)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

- < Biotic Matrix of the Shadscale and Associated Communities (Fautin 1946)
- = Intermountain salt desert shrublands (West 1983b)
- < Salt Desert Shrub (414) (Shiflet 1994)

LOWER LEVEL UNITS

Alliances:

- A3174 *Atriplex polycarpa* Scrub Alliance
- A0869 *Atriplex canescens* Scrub Alliance
- A3180 *Atriplex obovata* - *Atriplex cuneata* Scrub Alliance
- A0870 *Atriplex confertifolia* Scrub Alliance
- A3171 *Grayia spinosa* Scrub Alliance

AUTHORSHIP

Primary Concept Source: N.E. West (1983b)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 11/06/2015

Classif Resp Region: West

Internal Author: KAS 2-10, 11-15

REFERENCES

References: Barbour and Major 1988, Blaisdell and Holmgren 1984, Branson et al. 1967, Branson et al. 1976, Brown 1982a, Brown et al. 1979, Campbell 1977, Faber-Langendoen et al. 2017a, Fautin 1946, Francis 1986, Holland and Keil 1995, Knight 1994, Knight et al. 1987, Mozingo 1987, Naphan 1966, Reid et al. 1999, Shiflet 1994, Stout et al. 2013, West 1979, West 1982, West 1983b, West and Ibrahim 1968

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G300. Intermountain Shadscale - Saltbush Scrub

A0869. *Atriplex canescens* Scrub Alliance

Type Concept Sentence: Stands typically have a sparse to moderately dense (10-60% cover) short-shrub canopy (approximately 1.5 m tall) that is dominated by the facultative deciduous, xeromorphic shrub *Atriplex canescens*.

OVERVIEW

Scientific Name: *Atriplex canescens* Scrub Alliance

Common Name (Translated Scientific Name): Fourwing Saltbush Scrub Alliance

Colloquial Name: Fourwing Saltbush Scrub

Type Concept: This alliance occurs primarily in arid and semi-arid areas of the southwestern U.S. from western Texas to southern and eastern California and into Chihuahua, Mexico. It is also found in the western Great Plains to the Great Basin from western Kansas, Colorado, and Wyoming to Utah, Nevada and eastern Oregon. Stands typically have a sparse to moderately dense short-shrub canopy that is dominated by *Atriplex canescens*. Associated shrubs may include *Artemisia bigelovii*, *Artemisia tridentata*, *Ephedra viridis*, *Krascheninnikovia lanata*, *Purshia stansburiana* (= *Purshia mexicana* var. *stansburiana*), *Psoralea polydenius*, *Parthenium confertum*, *Sarcobatus vermiculatus*, and species of *Chrysothamnus*, *Ericameria*, and *Lycium*. The herbaceous layer is sparse to moderately dense and dominated by warm-season, medium-tall and short grasses depending on geographic range of the grasses. Species may include *Bouteloua gracilis*, *Distichlis spicata*, *Elymus elymoides*, *Hesperostipa comata*, *Pleuraphis jamesii* (= *Hilaria jamesii*), *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Muhlenbergia porteri*, *Scleropogon brevifolius*, *Pascopyrum smithii*, and *Sporobolus* spp. Overall, shrublands in this alliance occur on lowland and upland sites with elevation ranging from 75 m below sea level to 2400 m. Lowland sites include alluvial flats, drainage terraces, playas, washes and interdune basins. Upland sites include bluffs and gentle to moderately steep, sandy or rocky slopes. Stands occur on all aspects. Soils are variable with depths ranging from shallow to moderately deep, and texture ranging from sand to loam to clay.

Classification Comments: Shrublands in this alliance can grade into grasslands dominated by *Sporobolus airoides* or *Pleuraphis mutica*, or occur within a matrix of other desert shrublands. Further review of this alliance is necessary before comparisons can be made with other vegetation types. Some of the stands referenced, such as in Francis (1986), may not have enough vegetation cover to be classified as shrublands.

Given the geographic extent of this alliance, it may be warranted to split this into two alliances that reflect ecoregional variation.

Internal Comments:

Other Comments:

Similar NVC Types:

- A3151 *Atriplex canescens* Lowland Basin Desert Scrub Alliance

Diagnostic Characteristics: Nearly sparse to moderately dense stands of short shrubs dominated by *Atriplex canescens*. Due to the wide geographic range of this alliance, associated species composition is highly variable.

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a sparse to moderately dense layer of facultatively deciduous, extremely xeromorphic shrubs up to 2 m in height. A sparse to dense graminoid layer of warm-season grasses may be present.

Floristics: Stands have a sparse to moderately dense (10-60% cover) short-shrub canopy (to approximately 1.5 m tall) that is dominated by the facultatively deciduous, xeromorphic shrub *Atriplex canescens*. Associated shrubs may include *Artemisia tridentata*, *Artemisia bigelovii*, *Krascheninnikovia lanata*, *Purshia stansburiana* (= *Purshia mexicana* var. *stansburiana*), *Psoralea polydenius*, *Ephedra viridis*, *Parthenium confertum*, *Sarcobatus vermiculatus*, and species of *Chrysothamnus* and *Lycium*. Dwarf-shrubs such as *Gutierrezia sarothrae* or *Eriogonum* spp. may be common in some stands. Warm-season, medium-tall and short grasses typically dominate the sparse to moderately dense (1-60% cover) graminoid layer. The species present depend on geographic range of the grasses, alkalinity/salinity and past land use. Species may include *Bouteloua gracilis*, *Distichlis spicata*, *Elymus elymoides*, *Hesperostipa comata*, *Pleuraphis jamesii* (= *Hilaria jamesii*), *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Pascopyrum smithii*, *Muhlenbergia porteri*, *Scleropogon brevifolius*, *Sporobolus airoides*, *Sporobolus cryptandrus*, *Sporobolus flexuosus*, *Sporobolus nealleyi*, and *Sporobolus wrightii*. Forb cover is generally sparse, but annual forbs such as *Calycoseris parryi* may be abundant in wet years. Common forbs include species of *Sphaeralcea*, *Dalea*, *Cymopterus*, *Chenopodium*, *Bassia* (= *Kochia*), *Iva*, *Picradeniopsis*, and *Ratibida*. Cacti from the genus *Opuntia* are associated species in some stands. Trees are typically not present, but occasionally scattered *Juniperus* spp. may occur.

ENVIRONMENT & DYNAMICS

Environmental Description: Shrublands included in this alliance occur on lowland and upland sites throughout much of the arid and semi-arid western U.S. with elevations ranging from 75 m below sea level to 2400 m. Lowland sites include alluvial flats, drainage terraces, playas, washes and interdune basins. Upland sites include bluffs and gentle to moderately steep, sandy or rocky slopes. Stands occur on all aspects. Soils are variable with depths ranging from shallow to moderately deep, and textures ranging from sands to loams to clay. The lowland sites may be moderately saline or alkaline. Bare ground usually dominates the ground surface. Francis (1986) described stands in northwestern New Mexico with approximately 80% bare soil and 15% litter.

Dynamics: *Atriplex canescens* is tolerant of saline or alkaline soils, but is not restricted to those soils. Therefore, it is not a reliable indicator of those conditions (USFS 1937). This shrub is considered good forage for deer and many classes of livestock because it is highly nutritious and palatable (USFS 1937).

DISTRIBUTION

Geographic Range: Shrublands included in this alliance occur primarily in arid and semi-arid areas of the southwestern U.S. from west Texas to southern and eastern California and into Chihuahua, Mexico. They also are found in the western Great Plains to the Great Basin, from western Kansas, Colorado, and Wyoming to Utah, Nevada and eastern Oregon.

Nations: MX, US

States/Provinces: AZ, CA, CO, ID, KS, MXCH, NM, NV, OR, TX, UT, WY

TNC Ecoregions [optional]: 6:C, 11:C, 13:C, 15:C, 17:C, 23:C

USFS Ecoregions (2007): 262A:CC, 322Ab:CCC, 322Ai:CCC, 322Aj:CCC, 322Az:CCC, 322B:CC, 322C:CC, 341Fb:CCC, 341Fc:CCC, 341Fe:CCC, 341Ff:CCC, 342B:CC, M262A:CC, M262B:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Joshua Tree, Lake Mead, Mojave); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Atriplex canescens* (Fourwing saltbush scrub) Alliance (Sawyer et al. 2009) [36.310.00]
- = *Atriplex canescens* Shrubland Alliance (Evens et al. 2014)
- = *Atriplex canescens* Shrubland Alliance (Evens et al. 2012)
- = *Atriplex canescens* Shrubland Alliance (CNPS 2017) [36.310.00]
- >< Desert Saltbush Scrub (#36110) (Holland 1986b)
- = Fourwing saltbush series (Sawyer and Keeler-Wolf 1995)
- >< Interior Coast Range Saltbush Scrub (#36320) (Holland 1986b)
- >< Relictual Interior Dunes (#23200) (Holland 1986b)
- >< Sierra-Tehachapi Saltbush Scrub (#36310) (Holland 1986b)

- >< Valley Saltbush Scrub (#36220) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEGLO01283 *Atriplex canescens* / *Bouteloua gracilis* Shrubland
- CEGLO01285 *Atriplex canescens* - *Krascheninnikovia lanata* Shrubland
- CEGLO01286 *Atriplex canescens* / *Purshia stansburiana* Shrubland
- CEGLO01284 *Atriplex canescens* / *Calycoseris parryi* Shrubland
- CEGLO01291 *Atriplex canescens* / *Sporobolus airoides* Shrubland
- CEGLO05385 *Atriplex canescens* / *Muhlenbergia porteri* Shrubland
- CEGLO01289 *Atriplex canescens* / *Achnatherum hymenoides* Shrubland
- CEGLO01288 *Atriplex canescens* / *Pleuraphis jamesii* Shrubland
- CEGLO01281 *Atriplex canescens* Shrubland
- CEGLO03828 *Atriplex canescens* - *Ephedra viridis* Shrubland
- CEGLO01282 *Atriplex canescens* - *Artemisia tridentata* Shrubland

AUTHORSHIP

Primary Concept Source: K.A. Schulz after Sawyer et al. (2009)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/01/08

REFERENCES

References: Aldous and Shantz 1924, BIA 1979, BLM 1979a, BLM 1979b, Baker 1984a, Beatley 1976, Beatley 1993, Betancourt and Van Devender 1981, Brown 1982a, Burk 1977, CNPS 2017, Chappell et al. 1997, Culver et al. 1996, Diamond 1993, Dick-Peddie 1993, Donart et al. 1978a, Evens and Hartman 2007, Evens et al. 2012, Evens et al. 2014, Faber-Langendoen et al. 2017b, Francis 1986, Holland 1986b, Howard 2003, Hyder et al. 1966, Johnson 1976, Johnston 1987, Keeler-Wolf and Thomas 2000, Keeler-Wolf et al. 1998a, Klipple and Costello 1960, MacMahon 1988, MacMahon and Wagner 1985, Maxwell 1975, McHargue 1973, Miller et al. 1977, Muldavin and Mehlhop 1992, Muldavin et al. 2000b, Paysen et al. 1980, Peterson 1984a, Peterson 1984b, Price et al. 1981, Roberts et al. 1992, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shaw et al. 1989, Shute and West 1978, Soil Conservation Service 1978, Soil Conservation Service n.d., Stout et al. 2013, Thomas et al. 2004, USBOR 1976, USFS 1937, Vasek and Barbour 1988, VegCAMP and AIS 2013, Vest 1962a, Warren et al. 1982

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G300. Intermountain Shadscale - Saltbush Scrub

A0870. *Atriplex confertifolia* Scrub Alliance

Type Concept Sentence: Shrublands occurring across the western U.S. characterized by a sparse to moderately dense shrub layer dominated or codominated by *Atriplex confertifolia* and/or *Picrothamnus desertorum*.

OVERVIEW

Scientific Name: *Atriplex confertifolia* Scrub Alliance

Common Name (Translated Scientific Name): Shadscale Saltbush Scrub Alliance

Colloquial Name: Shadscale Saltbush Scrub

Type Concept: This shrubland alliance occurs across the western U.S. from the eastern Mojave Desert and Great Basin east to the western Great Plains and north to Montana. The vegetation included in this alliance is characterized by a sparse to moderately dense shrub layer dominated or codominated by *Atriplex confertifolia* and/or *Picrothamnus desertorum*. Shrub associates may include *Atriplex polycarpa*, *Ephedra nevadensis*, *Chrysothamnus* spp., *Krascheninnikovia lanata*, *Lycium* spp., *Sarcobatus vermiculatus*, and *Tetradymia* spp. The usually sparse herbaceous layer is dominated by graminoids such as *Elymus elymoides*, *Pleuraphis jamesii* (= *Hilaria jamesii*), *Pleuraphis rigida* (= *Hilaria rigida*), *Leymus salinus*, *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Pseudoroegneria spicata*, *Hesperostipa* spp., and other perennial bunchgrasses. These shrublands are usually associated with margins of large playas, valley bottoms or alluvial slopes with medium- to fine-textured soils but may occur on coarser soils of erosional slopes with calcareous substrates. In most cases, the soils are alkaline and may have substantial salt accumulation.

Classification Comments: One of the associations in this alliance, *Picrothamnus desertorum* Shrubland (CEGL001452), is very poorly documented. There is only one reference source presently known for this association, Montana Natural Heritage Program, Data on File (n.d.). The Montana Heritage Program ecologist was consulted and could find no data for this association in the files. The

alliance is also reported from Oregon, as described above, but further data collection and inventory efforts are needed to confirm this alliance and its characteristics as described here.

Some associations currently placed in this alliance are likely to be sparsely vegetated and would be better placed into the sparse vegetation class.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Nearly sparse to moderately dense stands of short shrubs dominated by *Atriplex confertifolia* or codominated by *Picrothamnus desertorum*. Due to the wide geographic range of this alliance, associated species composition is highly variable.

VEGETATION

Physiognomy and Structure: These are broad-leaved deciduous shrublands of somewhat sparse to moderate cover (15-60%). The deciduous character is as much drought-related as cold-related. The interstices between the shrubs may be very sparsely vegetated (<10% cover) in low desert or highly alkaline habitats or moderately vegetated (20-40%) with caespitose graminoids and forbs. In addition, these communities often harbor an ephemeral ground layer of short-lived annual forbs and graminoids which vary in abundance with local precipitation.

Floristics: *Atriplex confertifolia* and/or *Picrothamnus desertorum* (= *Artemisia spinescens*) are the dominant shrubs. Other codominant or associate shrub species may include *Atriplex canescens*, *Atriplex polycarpa*, *Ephedra nevadensis*, *Ericameria nauseosa* (= *Chrysothamnus nauseosus*), *Grayia spinosa*, *Krascheninnikovia lanata*, *Lycium* sp., *Tetradymia glabrata*, and *Tetradymia axillaris*. There is typically a depauperate understory of perennial bunchgrasses, including *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Elymus elymoides*, *Hesperostipa* spp., *Pleuraphis jamesii* (= *Hilaria jamesii*), *Pleuraphis rigida* (= *Hilaria rigida*), *Pseudoroegneria spicata*, and *Psoralea polydenius*. *Yucca brevifolia* may form a scattered emergent tree layer in these stands.

ENVIRONMENT & DYNAMICS

Environmental Description: Extensive stands of the vegetation types in this alliance occur in the transition between the Mojave and Great Basin deserts of North America. Outlying stands also occur northward and eastward in valley bottom sites that have substantial salt accumulation. This alliance occurs at middle elevations (1000-1950 m [3300-6400 feet]) with annual precipitation averaging 10-25 cm. These shrublands are usually associated with margins of large playas, valley bottoms or alluvial slopes with medium- to fine-textured soils but may occur on coarser soils of erosional slopes with calcareous substrates. In most cases, the soils are alkaline (pH 7.5-8.5).

Dynamics: Many of the plant species commonly present in stands of this alliance grow from late winter to late spring or early summer, when soil moisture becomes depleted. *Atriplex confertifolia* shrubs often develop large leaves in the spring which increase the rate of photosynthesis. As soil moisture decreases, the leaves are lost, and the plant takes on a dead appearance. During late fall, very small overwintering leaves appear which provide some photosynthetic capability through the remainder of the year. The species is valued as winter range for native herbivores and livestock. During winter or drought periods, minor defoliation from herbivory may actually increase drought tolerance by lowering leaf area and transpiration losses.

DISTRIBUTION

Geographic Range: The plant associations in this alliance occur throughout the eastern Mojave and Great Basin deserts, northward to southern Idaho, north-central Wyoming, and south-central Montana. Stands have also been reported from the Colorado Plateau of western Colorado, Arizona, New Mexico and Utah.

Nations: US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WY

TNC Ecoregions [optional]: 6:C, 11:C, 12:C, 13:C, 15:C, 17:C

USFS Ecoregions (2007): 262A:CC, 322Ab:CCC, 322Ad:CCC, 322Ae:CCC, 322Az:CCC, 341D:CC, 341Fa:CCC, 341Fb:CCC, 341Fc:CCC, 341Fd:CCC, 341Fe:CCC, 341Ff:CCC, 341Fg:CCC, 342B:CC, M261E:CC, M262A:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Lake Mead)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Atriplex confertifolia* (Shadscale scrub) Alliance (Sawyer et al. 2009) [36.320.00]

- = *Atriplex confertifolia* Shrubland Alliance (Evens et al. 2014)
- = *Atriplex confertifolia* Shrubland Alliance (CNPS 2017) [36.320.00]
- < Shadscale Scrub (#36140) (Holland 1986b)
- = Shadscale series (Sawyer and Keeler-Wolf 1995)

LOWER LEVEL UNITS

Associations:

- CEGLO01294 *Atriplex confertifolia* Great Basin Shrubland
- CEPP005797 *Atriplex confertifolia* - *Suaeda moquinii* Shrubland
- CEGLO01313 *Atriplex confertifolia* - *Sarcobatus vermiculatus* Shrubland
- CEGLO01299 *Atriplex confertifolia* - *Atriplex polycarpa* Shrubland
- CEGLO01309 *Atriplex confertifolia* - *Lycium pallidum* / *Mirabilis pudica* Shrubland
- CEGLO01310 *Atriplex confertifolia* - *Lycium shockleyi* Shrubland
- CEGLO01302 *Atriplex confertifolia* / *Elymus elymoides* Shrubland
- CEGLO01311 *Atriplex confertifolia* / *Achnatherum hymenoides* Shrubland
- CEGLO01307 *Atriplex confertifolia* / *Leymus salinus* Shrubland
- CEGLO01297 *Atriplex confertifolia* - *Picrothamnus desertorum* / *Achnatherum hymenoides* Shrubland
- CEGLO01301 *Atriplex confertifolia* - *Krascheninnikovia lanata* Shrubland
- CEGLO01314 *Atriplex confertifolia* / *Hesperostipa comata* Shrubland
- CEGLO01296 *Atriplex confertifolia* - *Picrothamnus desertorum* / *Krascheninnikovia lanata* Shrubland
- CEGLO01306 *Atriplex confertifolia* / *Leymus salinus* ssp. *salmonis* Shrubland
- CEGLO01300 *Atriplex confertifolia* / *Ericameria nauseosa* Shrubland
- CEGLO01452 *Picrothamnus desertorum* Shrubland
- CEGLO01312 *Atriplex confertifolia* / *Pseudoroegneria spicata* Shrubland
- CEGLO01315 *Atriplex confertifolia* / *Tetradymia glabrata* Shrubland
- CEGLO01295 *Atriplex confertifolia* - *Picrothamnus desertorum* Shrubland
- CEGLO01305 *Atriplex confertifolia* / *Bassia americana* Shrubland
- CEGLO01298 *Atriplex confertifolia* - *Picrothamnus desertorum* / *Sarcobatus vermiculatus* Shrubland
- CEGLO01308 *Atriplex confertifolia* - *Lycium andersonii* Shrubland
- CEGLO01304 *Atriplex confertifolia* / *Pleuraphis jamesii* Shrubland
- CEGLO02992 *Picrothamnus desertorum* / *Elymus elymoides* Shrubland
- CEGLO03762 *Atriplex confertifolia* / *Sporobolus cryptandrus* Shrubland
- CEGLO03830 *Atriplex confertifolia* Sparse Shrubland
- CEPP005685 *Atriplex confertifolia* - (*Acamptopappus sphaerocephalus*, *Picrothamnus desertorum*) / (*Pleuraphis jamesii*) Scrub
- CEPP005795 *Atriplex confertifolia* - *Atriplex canescens* Shrubland
- CEGLO05739 *Atriplex confertifolia* - *Ambrosia dumosa* Shrubland
- CEPP005796 *Atriplex confertifolia* - *Lepidium fremontii* Shrubland
- CEGLO01293 *Atriplex confertifolia* Wyoming Basins Shrubland
- CEGLO01303 *Atriplex confertifolia* - *Ephedra nevadensis* Shrubland

AUTHORSHIP

Primary Concept Source: D. Sarr, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/01/08

REFERENCES

References: Annable 1985, BLM 1979a, Baker 1982b, Baker 1983b, Baker 1983c, Baker and Kennedy 1985, Barbour and Major 1977, Beatley 1975, Beatley 1976, Billings 1949, Blackburn et al. 1968a, Blackburn et al. 1969b, Blackburn et al. 1969d, Bradley 1964, Branson and Owen 1970, Branson et al. 1976, Brotherson and Brotherson 1979, Burk 1977, CNPS 2017, Caicco and Wellner 1983c, Caicco and Wellner 1983g, Campbell 1977, Charlton 2000a, Dastrup 1963, Empire Engineering and Land Surveying 1986, Evens et al. 2014, Faber-Langendoen et al. 2017b, Faden 1977, Fautin 1946, Fenemore 1970, Graham 1937, Harper and Jaynes 1986, Holland 1986b, Ibrahim et al. 1972, Keammerer 1974b, Keammerer 1977, Keeler-Wolf and Thomas 2000, Leary and Peterson 1984, Lesica and DeVelice 1992, Lusby et al. 1963, MTNHP unpubl. data, MacMahon 1988, MacMahon and Wagner 1985, McHargue 1973, Miller et al. 1977, ORNHP unpubl. data, Paysen et al. 1980, Peterson 1984a, Potter et al. 1985, Rickard and Beatley 1965, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Schramm 1982, Simonin 2001a, Singh and West 1971, Soil Conservation Service 1978, Thomas et al. 2004, Thorne 1982, Tuhy and MacMahon 1988, Turner 1982b, USBOR 1976, Vasek and Barbour 1988, VegCAMP and AIS 2013, Vest 1962b, Ward et al. 1974, Warren et al. 1982, West 1983b, West and Ibrahim 1968, Young et al. 1977, Young et al. 1986

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G300. Intermountain Shadscale - Saltbush Scrub

A3174. Atriplex polycarpa Scrub Alliance

Type Concept Sentence: Shrublands in this alliance occur in desert valleys, basins, playas, bajadas, foothills and plains characterized by a sparse to moderately dense shrub layer dominated or codominated by *Atriplex polycarpa*.

OVERVIEW

Scientific Name: *Atriplex polycarpa* Scrub Alliance

Common Name (Translated Scientific Name): Cattle Saltbush Scrub Alliance

Colloquial Name: Cattle Saltbush Scrub

Type Concept: Shrublands in this alliance occur in desert valleys, basins, playas, bajadas, foothills and plains in southern New Mexico, Nevada and southern California. The vegetation included in this alliance is characterized by a sparse to moderately dense shrub layer dominated or codominated by *Atriplex polycarpa*. Shrub associates may include *Larrea tridentata*, *Ambrosia dumosa*, *Eriogonum fasciculatum*, *Hymenoclea salsola*, *Atriplex canescens*, *Atriplex confertifolia*, *Gutierrezia sarothrae*, and *Suaeda moquinii*. Perennial graminoids are present to abundant in some habitats and may include *Distichlis spicata*, *Pleuraphis mutica* (= *Hilaria mutica*), and *Sporobolus* spp. Sites are generally flat to gently sloping and moderately saline, but the alliance also occurs on rolling to hilly fans and slopes.

Classification Comments: This alliance has been segregated from the previously defined *Atriplex lentiformis*-*A. polycarpa* alliance (Sawyer and Keeler-Wolf 1995). Based on plot data collected over the past 10 years, both of these species apparently segregate and form their own alliances with frequently different environmental and species characteristics.

Brown (1982a) describes stands in the Saltbush Series that are dominated by *Atriplex polycarpa*. No *Atriplex polycarpa* associations have yet been described in Arizona by ecologists. The stands described by Peterson (1984a) are too sparse to be classified as shrublands. Little other quantitative data were available.

Whitfield and Anderson (1938) describe *Atriplex polycarpa*-dominated stands in the Chihuahuan Desert where other characteristic shrubs include *Atriplex canescens*, *Atriplex confertifolia*, *Ambrosia dumosa*, *Larrea tridentata*, *Gutierrezia sarothrae*, the phreatophyte *Suaeda moquinii*, and perennial grasses such as *Sporobolus airoides*, *Pleuraphis mutica*, *Sporobolus cryptandrus*, and *Muhlenbergia porteri*. The perennial grass cover is possible because of the late summer rains. In the Mojave Desert, grass cover is sparse. In Death Valley (Peterson 1984a) described stands with 10% aerial cover of *Atriplex polycarpa* and 1% or less of *Ambrosia dumosa*, *Larrea tridentata*, and *Hymenoclea salsola*. Total shrubs cover was 13%. In addition to *Atriplex polycarpa*, stands in the California Central Valley include a variety of dune, playa or uplands species such as *Distichlis spicata*, *Ephedra californica*, *Eriogonum fasciculatum*, *Hymenoclea salsola*, *Cleome isomeris* (= *Isomeris arborea*), *Isocoma acradenia*, and *Prosopis glandulosa* (Sawyer and Keeler-Wolf 1995).

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: *Atriplex polycarpa* >2% absolute cover in the shrub canopy; >50% relative cover in the shrub canopy (Keeler-Wolf et al. 1998, Thomas et al. 2004).

VEGETATION

Physiognomy and Structure: Vegetation included in this alliance has a sparse to moderately dense woody layer dominated by facultative deciduous and microphyllous evergreen shrubs. The usually sparse herbaceous layer has a few perennial species of grasses and forbs with sometimes abundant cover of seasonally present annual grasses and forbs.

Floristics: The vegetation has a sparse to moderately dense woody layer usually less than 1 m tall, but occasionally over 2 m tall in mixed-shrub stands. *Atriplex polycarpa*, a facultative deciduous xeromorphic shrub, is the dominant species and may occur in nearly pure stands. Other characteristic shrubs may include *Larrea tridentata*, *Ambrosia dumosa*, and *Hymenoclea salsola*. Perennial graminoids such as *Distichlis spicata*, *Pleuraphis mutica* (= *Hilaria mutica*), and *Sporobolus* spp. may be present and abundant in some habitats. Exotic annual grasses may dominate the understory in stands in California. Secondary species vary widely depending on site characteristics and geographic location.

ENVIRONMENT & DYNAMICS

Environmental Description: Shrublands in this alliance occur in desert valleys, basins, playas, bajadas, foothills and plains in southern New Mexico, Nevada and southern California. Climate is arid to semi-arid with hot summers. Sites are generally flat to

gently sloping and moderately saline, but the alliance also occurs on rolling to hilly fans and slopes. Other characteristics vary by site and region. In the Chihuahuan Desert (1200-1500 m elevation), annual precipitation has a bimodal distribution with about half the precipitation occurring during the late summer months. Sites occur on lower foothills and plains. Soils are fine-textured, alkaline and typically saline.

Dynamics: *Atriplex polycarpa* is a facultative phreatophyte and occurs on moderately saline soil (<2%) just above the water table or xeric non-saline upland sites (Barbour and Major 1977). It has limited salt tolerance and is very drought-tolerant (Barbour and Major 1977). These two factors interact to control water stress in plants and define habitat boundaries.

DISTRIBUTION

Geographic Range: This alliance includes shrublands from valleys and basins in the Chihuahuan, Mojave and Sonoran deserts, and in the southern part of the Great Central Valley of California.

Nations: US

States/Provinces: CA, NM, NV

TNC Ecoregions [optional]: 11:C, 17:C

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Lake Mead, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Atriplex polycarpa* (Allscale scrub) Alliance (Sawyer et al. 2009) [36.340.00]
- = *Atriplex polycarpa* Alliance (Allscale scrub) (Buck-Diaz et al. 2012)
- = *Atriplex polycarpa* Shrubland Alliance (Evens et al. 2014)

LOWER LEVEL UNITS

Associations:

- CEGLO01319 *Atriplex polycarpa* / *Pleuraphis mutica* Shrubland
- CEGLO01318 *Atriplex polycarpa* Shrubland

AUTHORSHIP

Primary Concept Source: M.E. Hall, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/01/08

REFERENCES

References: Barbour and Major 1977, Beatley 1976, Brown 1982a, Buck-Diaz et al. 2012, Evens et al. 2014, Faber-Langendoen et al. 2017b, Faden 1977, Holland 1986b, Keeler-Wolf and Thomas 2000, Keeler-Wolf et al. 1998a, Peterson 1984a, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Stout et al. 2013, Thomas et al. 2004, VegCAMP and AIS 2013, Whitfield and Anderson 1938

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G300. Intermountain Shadscale - Saltbush Scrub

A3171. *Grayia spinosa* Scrub Alliance

Type Concept Sentence: This alliance occurs in the Great Basin and the eastern Mojave Desert, and is characterized by a sparse to moderately dense shrub layer of *Grayia spinosa*. Other shrubs are species of Mojavean or Great Basin affinities.

OVERVIEW

Scientific Name: *Grayia spinosa* Scrub Alliance

Common Name (Translated Scientific Name): Spiny Hopsage Scrub Alliance

Colloquial Name: Spiny Hopsage Scrub

Type Concept: Vegetation in this alliance occurs throughout the lower to middle elevations (600-1600 m) of the Great Basin and the eastern Mojave Desert. The vegetation is more drought-tolerant than *Artemisia tridentata*-dominated communities and typically occurs where local climate or salty soils create high moisture stress. This alliance is characterized by a sparse to moderately dense shrub layer of *Grayia spinosa*. Shrub associates include *Artemisia nova*, *Artemisia tridentata*, *Atriplex confertifolia*, *Atriplex canescens*, *Chrysothamnus* spp., *Coleogyne ramosissima*, *Ephedra nevadensis*, *Ephedra viridis*, *Larrea tridentata*, *Picrothamnus*

desertorum (= *Artemisia spinescens*), and *Prunus andersonii*. The herbaceous layer is typically sparse with *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Achnatherum speciosum* (= *Stipa speciosa*), *Elymus elymoides*, *Navarretia* spp., *Pleuraphis jamesii* (= *Hilaria jamesii*), and *Poa secunda* being common associates. Stands usually occur on mountain slopes or alluvial fans bordering intermountain basins. Soils are highly variable, but are generally coarse-textured and well-drained, and often alkaline.

Classification Comments: During the ecological group revision, all *Grayia spinosa* associations were placed across several groups. The associations within this alliance had been split across Intermountain Shadscale - Saltbush Scrub Group (G300) and Mojave Mid-Elevation Mixed Desert Scrub Group (G296). They have been combined within G300 and this alliance as they appear to represent inclusions within the greater matrix-forming communities of the shadscale - saltbush communities.

Currently there are no associations placed in this alliance from California. Sawyer and Keeler-Wolf (1995) do report a Hop-sage Series that is included as part of this alliance. Further classification and inventory work are needed to develop the association-level classification of this alliance.

Internal Comments: KAS 11-16: CEG001349 *Grayia spinosa* - *Menodora spinescens* Shrubland Association was moved from A3171 *Grayia spinosa* Scrub Alliance to A2515 *Menodora spinescens* Scrub Alliance because *Menodora spinescens* is considered to be more diagnostic than the ubiquitous *Grayia spinosa* and reference citation for CEG001349 is from the Grapevine Mountains in Death Valley NP.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Vegetation in this alliance can be differentiated from other alliances by the strong dominance of *Grayia spinosa* in the shrub layer, and its broad distribution in non-wetland locations.

VEGETATION

Physiognomy and Structure: These communities are characterized by somewhat low to moderate cover (15-40%) of cold-deciduous or evergreen shrubs. The herbaceous layer is typically sparse (<20% cover) and dominated by caespitose perennial grasses or annual forbs and grasses. Scattered trees may form a sparse (0-10%) emergent layer in some stands, especially at the upper elevation margin and in the southwestern part of the range.

Floristics: Species found in southern stands include *Atriplex canescens*, *Atriplex confertifolia*, *Coleogyne ramosissima*, *Ephedra nevadensis*, *Larrea tridentata*, and *Picrothamnus desertorum* (= *Artemisia spinescens*). Occasionally, scattered individuals of *Yucca brevifolia* may be emergent through the shrub layer. The herbaceous layer in these xeric southern stands is typically sparse with *Achnatherum hymenoides* (= *Oryzopsis hymenoides*), *Achnatherum speciosum* (= *Stipa speciosa*), *Eriogonum* spp., *Navarretia* spp., and *Pleuraphis jamesii* (= *Hilaria jamesii*) being common associates. Northward, and at higher elevations, the Mojavean element drops out and common shrub associates include *Artemisia nova*, *Artemisia tridentata*, *Chrysothamnus* spp., *Ephedra viridis*, and *Prunus andersonii*. Herbaceous associates include *Elymus elymoides*, *Festuca* spp., and *Poa secunda*.

ENVIRONMENT & DYNAMICS

Environmental Description: Vegetation in this alliance occurs throughout the lower to middle elevations (600-1600 m) of the Great Basin and the eastern Mojave Desert, usually on mountain slopes or alluvial fans bordering intermountain basins. The climate is arid to semi-arid with precipitation ranging from 15-30 cm annually. Winter precipitation dominates in the western area, with summer rain becoming more important eastward. Temperatures are continental, with large annual and diurnal ranges. Soils are highly variable, but are generally coarse-textured and well-drained, and often alkaline.

Dynamics: *Grayia spinosa* shrubs concentrate chemical elements in their leaves and fruits, and soils beneath the shrubs often show high levels of magnesium and potassium. Seeds remain viable for long periods (4 years or more) before germination (Mozingo 1987). Due to its wide geographic range, the species may demonstrate considerable ecotypic variation. For example, seeds from Mojave Desert individuals can germinate at 40°C, but seeds from Great Basin plants can not germinate at that high temperature (Mozingo 1987).

DISTRIBUTION

Geographic Range: This alliance occurs throughout the Great Basin, Columbia Plateau, and eastern Mojave regions of Colorado, Utah, Nevada, Oregon, Washington, and eastern California. It is most extensive in the southwestern portion of the Great Basin.

Nations: US

States/Provinces: CA, CO, NV, OR, UT, WA

TNC Ecoregions [optional]: 4:C, 6:C, 11:C, 12:C, 17:C

USFS Ecoregions (2007): 322Ad:CCC, 322Af:CCC, 322Aj:CCC, 322Al:CCC, 341D:CC, 341Fa:CCC, 341Fb:CCC, 341Fc:CCC, 341Fe:CCC, 341Ff:CCC, 341Fg:CCC, 342B:CC, M261E:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Joshua Tree, Mojave)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Grayia spinosa* (Spiny hop sage scrub) Alliance (Sawyer et al. 2009) [33.180.00]
- = *Grayia spinosa* Shrubland Alliance (Evens et al. 2014)
- = *Grayia spinosa* Shrubland Alliance (Evens et al. 2012)
- = *Grayia spinosa* Shrubland Alliance (CNPS 2017) [33.180.00]
- = Hop-sage series (Sawyer and Keeler-Wolf 1995)
- < Shadscale Scrub (#36140) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

- CEGLO02681 *Grayia spinosa* / *Achnatherum thurberianum* Shrubland
- CEGLO01345 *Grayia spinosa* / *Picrothamnus desertorum* Shrubland
- CEGLO01350 *Grayia spinosa* / *Achnatherum hymenoides* Shrubland
- CEGLO01352 *Grayia spinosa* - *Prunus andersonii* Shrubland
- CEGLO01351 *Grayia spinosa* / *Poa secunda* Shrubland
- CEGLO02358 *Grayia spinosa* Shrubland
- CEGLO01344 *Grayia spinosa* / *Artemisia nova* / *Achnatherum speciosum* Shrubland

AUTHORSHIP

Primary Concept Source: M.S. Reid, D. Sarr, G. Kittel, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2016/11/11

REFERENCES

References: Beatley 1975, Blackburn et al. 1968a, Blackburn et al. 1968c, Blackburn et al. 1969d, Blaisdell and Holmgren 1984, CNPS 2017, Daubenmire 1970, Evens et al. 2012, Evens et al. 2014, Faber-Langendoen et al. 2017b, Holland 1986b, Keeler-Wolf 2007, Keeler-Wolf and Thomas 2000, Kurzius 1981, Mozingo 1987, Paysen et al. 1980, Peterson 1984a, Ralston 1969, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Shaw et al. 2002, Shiflet 1994, Thomas et al. 2004, Thorne 1976, Thorne 1982, VegCAMP and AIS 2013, Webb et al. 1987, Young et al. 1977, Young et al. 2007b

M118. Intermountain Basins Cliff, Scree & Badland Sparse Vegetation

This sparsely vegetated macrogroup occurs in a variety of landscapes and a variety of exposed rock and badland substrates the interior western U.S. from the Columbia Plateau south to the Great Basin and Colorado Plateau, and east into Wyoming basins. Characteristic species are variable depending on substrate and other environmental condition and most of the species also occur in non-sparse vegetation macrogroups, although some of the sites with harsh soil properties may have of endemic species.

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

3.B.1.Ne.6.a. M118 Intermountain Basins Cliff, Scree & Badland Sparse Vegetation

G570. Intermountain Basins Cliff, Scree & Badland Sparse Vegetation

Type Concept Sentence: This group consists of barren and sparsely vegetated cliffs, scree slopes, badlands and other similar harsh habitats from low to high elevations, with a wide variety of trees or shrubs, such as species of *Artemisia*, *Atriplex*, *Cercocarpus*, *Eriogonum*, *Fallugia*, *Grayia*, *Juniperus*, *Pinus*, *Purshia*, and others, distributed throughout the interior western U.S.

OVERVIEW

Scientific Name: *Atriplex* spp. - *Cercocarpus* spp. - *Ephedra* spp. Intermountain Basins Sparse Vegetation Group

Common Name (Translated Scientific Name): Saltbush species - Mountain-mahogany species - Joint-fir species Intermountain Basins Sparse Vegetation Group

Colloquial Name: Intermountain Shale Badlands Cold Desert Sparse Vegetation

Type Concept: This group consists of barren and sparsely vegetated cliffs, scree slopes, badlands and other similar areas from a variety of landscapes in the interior western U.S. from eastern Washington and Oregon, the Columbia Plateau south to the Great Basin and Colorado Plateau, east into Wyoming basins and plains. Characteristic shrub species in lower elevation semi-desert, lava

field, and badland areas include *Artemisia pedatifida*, *Artemisia tridentata*, *Atriplex canescens*, *Atriplex confertifolia*, *Atriplex corrugata*, *Atriplex gardneri*, *Ephedra* spp., *Eriogonum corymbosum*, *Eriogonum heermannii*, *Eriogonum ovalifolium*, *Fallugia paradoxa*, *Grayia spinosa*, *Purshia tridentata*, *Salvia dorrii*, and *Sarcobatus vermiculatus*. Characteristic herbs include species of *Achnatherum*, *Camissonia*, *Cleome*, *Eriogonum*, and *Mentzelia*. Foothill sites include *Pinus edulis* and *Pinus ponderosa* (Colorado Plateau), *Pinus monophylla*, *Pinus longaeva* (Great Basin), *Juniperus osteosperma*, *Cercocarpus intricatus*, and *Cercocarpus ledifolius*. At montane and subalpine elevations, scattered trees may be present, such as *Abies concolor*, *Picea engelmannii*, *Pinus flexilis*, *Pinus ponderosa*, and *Pseudotsuga menziesii*. Shrubs may include *Arctostaphylos patula*, *Artemisia tridentata*, *Cercocarpus ledifolius*, *Ephedra* spp., *Holodiscus* spp., *Ivesia* sp., and *Purshia tridentata*. Landforms include cliffs and canyon sides, mesas and plateaus, and mountains. Sparse vegetation also occurs on special substrates such as shale outcrops, badlands and volcanic deposits such as lava, cinder, ash, tuff and basalt dikes. Rock substrates include bedrock, slickrock, and unstable talus and scree slopes. Some substrates, such as marine shales, are strongly alkaline and/or saline which chemically limits plant growth. Active substrates such as scree slopes are difficult sites for plants to grow. Physical properties of substrates may also limit plant growth. Some massive rock substrates lack cracks where vascular plants can root. Badland sites often have heavy clay soils that reduce water infiltration increasing erosion rates and reducing soil moisture for plants. Vegetation is variable depending on environmental variables of the sites, which range from relatively low-elevation semi-desert to subalpine cliffs and rock outcrops. Lower elevation sites often have herbaceous or shrub species present, whereas foothill, montane and subalpine sites may also include trees. Most of the species also occur in non-sparse vegetation groups. However, some of the sites with harsh soil properties have a high number of endemic perennial species.

Classification Comments: This group is very diverse floristically and so it is difficult to determine indicator species. More diagnostic is the sparse cover of vascular plants and/or presence and sometimes dominance of nonvascular (lichen) species. This broadly defined lithomorphic group was developed by NatureServe. M. Reid (9-13): I am removing dune communities from this group; they are now placed in Intermountain Sparsely Vegetated Dune Scrub & Grassland Group (G775). We need to revisit and get clear on criteria for differentiating this group from other vegetated groups. Generally this group is conceived of as sparsely vegetated associations occurring on rocky or badland substrates.

Similar NVC Types:

- G569 North American Warm Semi-Desert Cliff, Scree & Pavement Sparse Vegetation
- G567 Great Plains Cliff, Scree & Rock Vegetation
- G565 Rocky Mountain Cliff, Scree & Rock Vegetation

Diagnostic Characteristics: Diagnostic characteristics of this lithomorphic group are barren to sparsely vegetation substrates and its geographic location, which is the intermountain western U.S. However, it is often composed of a mix of woody vegetation, especially shrubs and herbs (particularly cushion plants), although either may be absent on a given site.

VEGETATION

Physiognomy and Structure: This lithomorphic group may be composed of woody plants, including both trees and shrubs, herbaceous plants, and/or nonvascular plants. Shrubs are especially common and were chosen as indicator species, however, herbs, especially cushion plants, and nonvasculars such as mosses or lichens may be more common.

Floristics: This group consists of sparsely vegetated substrates which are variable depending on environmental factors of the sites. Sites range from relatively low-elevation semi-desert to subalpine cliffs and rock outcrops. Lower elevation sites often have herbaceous or shrub species present, whereas foothill, montane and subalpine sites may also include trees. Most of the species also occur in non-sparse vegetation groups. However, some of the sites with harsh soil properties have a high number of endemic perennial species (Welsh 1979, Welsh and Chatterly 1985). Characteristic shrub species in lower elevation semi-desert, lava field, and badland areas include *Artemisia pedatifida*, *Artemisia tridentata*, *Atriplex canescens*, *Atriplex confertifolia*, *Atriplex corrugata*, *Atriplex gardneri*, *Ephedra* spp., *Eriogonum corymbosum*, *Eriogonum heermannii*, *Eriogonum ovalifolium*, *Fallugia paradoxa*, *Grayia spinosa*, *Purshia tridentata*, *Salvia dorrii*, and *Sarcobatus vermiculatus*. Characteristic herbs include species of *Achnatherum*, *Camissonia*, *Cleome*, *Eriogonum*, and *Mentzelia*. Foothill sites include *Pinus edulis* and *Pinus ponderosa* (Colorado Plateau), *Pinus monophylla*, *Pinus longaeva* (Great Basin), *Juniperus osteosperma*, *Cercocarpus intricatus*, *Cercocarpus ledifolius*, and *Ephedra* spp. At montane and subalpine elevations, scattered trees may be present, such as *Pinus ponderosa*, *Pinus flexilis*, *Abies concolor*, *Pseudotsuga menziesii*, and *Picea engelmannii*. Shrubs may include *Arctostaphylos patula*, *Artemisia tridentata*, *Cercocarpus ledifolius*, *Ephedra* spp., *Holodiscus* spp., and *Purshia tridentata*.

ENVIRONMENT & DYNAMICS

Environmental Description: This group consists of barren and sparsely vegetated substrates from a variety of landscapes in the interior western U.S. from the Columbia Plateau south to the Great Basin and Colorado Plateau, east into Wyoming basins and plains. Landforms include cliffs and canyon sides, mesas and plateaus, and mountains. Sparse vegetation also occurs on special substrates such as shale outcrops, active sand dunes, badlands and volcanic deposits such as lava, cinder, ash, tuff and basalt dikes.

Rock substrates include bedrock and unstable talus and scree slopes. Some substrates, such as marine shales, are strongly alkaline and/or saline which chemically limits plant growth. Active substrates such as scree slopes are difficult sites for plants to grow. Physical properties of substrates may also limit plant growth. Some massive rock substrates lack cracks where vascular plants can root. Badland sites often have heavy clay soils that reduce water infiltration increasing erosion rates and reducing soil moisture for plants.

Dynamics: Following wildfire, various associations which are typically woodland and shrubland will have transitional stages that are sparsely vegetated. *Populus tremuloides* will slowly re-colonize steep, unstable talus and scree slopes following ten-year-old forest fires in Great Basin National Park, although the seral community is transitional.

DISTRIBUTION

Geographic Range: This sparsely vegetated group occurs in the interior western U.S. from the Columbia Plateau south to the Great Basin and Colorado Plateau, east into Wyoming basins and plains.

Spatial Scale & Pattern [optional]: Large patch

Nations: US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]: 4:C, 6:C, 8:C, 9:C, 10:C, 11:C, 12:?, 18:C, 19:C, 20:C, 21:C

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: BLM (Grand Staircase-Escalante); NPS (Arches, Canyonlands, Capitol Reef, Glen Canyon, Great Basin, Petrified Forest); USFS (Spring Mountains)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- >< Littleleaf Mountain-Mahogany (417) (Shiflet 1994)
- >< Pinyon - Juniper: 239 (Eyre 1980)

LOWER LEVEL UNITS

Alliances:

- A4053 *Eriogonum ovalifolium* - *Fallugia paradoxa* - *Andropogon hallii* Lava & Cinder Sparse Vegetation Alliance
- A4051 *Pinus ponderosa* - *Cercocarpus intricatus* Bedrock Cliff & Canyon Wooded Scrub Alliance
- A4052 *Ephedra* spp. - *Leymus salinus* - *Eriogonum corymbosum* Badlands Cold Desert Sparse Vegetation Alliance
- A4050 *Ephedra viridis* - *Chrysothamnus viscidiflorus* - *Rhus trilobata* Talus Sparse Scrub Alliance

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al.

Author of Description: K.A. Schulz, M.S. Reid and G. Kittel

Acknowledgments:

Version Date: 11/06/2015

Classif Resp Region: West

Internal Author: KAS 12-10, 11-15, mod. MSR 9-13, mod. GK 8-15

REFERENCES

References: Barbour and Billings 2000, Brodo et al. 2001, Day and Wright 1985, ENTRIX, Inc. 2007, Eyre 1980, Faber-Langendoen et al. 2017a, Graybosch and Buchanan 1983, Hansen et al. 2004c, Logan Simpson Design 2011, Nachlinger and Reese 1996, Shiflet 1994, Tisdale et al. 1965, Welsh 1979, Welsh and Chatterly 1985

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G570. Intermountain Basins Cliff, Scree & Badland Sparse Vegetation

A4052. *Ephedra* spp. - *Leymus salinus* - *Eriogonum corymbosum* Badlands Cold Desert Sparse Vegetation Alliance

Type Concept Sentence: This alliance consists of sparsely vegetated (<10% vascular cover) areas with varied characteristic species such as *Enceliopsis nudicaulis*, *Eriogonum brevicaulis*, *Leymus salinus* ssp. *salinus*, *Leymus salinus* ssp. *salmonis*, *Lupinus argenteus*, *Pseudoroegneria spicata*, and/or *Zuckia brandegeei*. This alliance occurs throughout the Intermountain West on badlands of shales, siltstones or mudstones on typically rounded hills and plains that form a rolling topography that can be steep and highly eroded.

OVERVIEW

Scientific Name: *Ephedra* spp. - *Leymus salinus* - *Eriogonum corymbosum* Badlands Cold Desert Sparse Vegetation Alliance

Common Name (Translated Scientific Name): Joint-fir species - Saline Wildrye - Crispleaf Buckwheat Badlands Cold Desert Sparse Vegetation Alliance

Colloquial Name: Intermountain Shale Badlands Cold Desert Sparse Vegetation

Type Concept: This alliance consists of sparsely vegetated (<10% vascular cover) areas with varied characteristic species such as *Enceliopsis nudicaulis*, *Eriogonum brevicaule*, *Leymus salinus* ssp. *salinus*, *Leymus salinus* ssp. *salmonis*, *Lupinus argenteus*, *Pseudoroegneria spicata*, and/or *Zuckia brandegeei*. Other species include dwarf-shrubs such as *Atriplex confertifolia*, *Gutierrezia* spp., and *Chrysothamnus viscidiflorus* var. *stenophyllus*. Characteristic forbs and grasses include *Achnatherum hymenoides*, *Arenaria hookeri*, *Astragalus* spp., *Cryptantha* spp., *Eriogonum pauciflorum*, *Machaeranthera grindelioides*, *Pleuraphis jamesii*, *Platyschkuhria integrifolia*, *Poa secunda*, and/or *Xylorhiza venusta*. This alliance occurs throughout the Intermountain West. Habitats are badlands of marine shales, siltstones and mudstones (clay). Landforms are typically rounded hills and plains that form a rolling topography, but at time can be steep and highly eroded. The harsh soil properties and high rate of erosion and deposition are driving environmental variables.

Classification Comments: Exactly where this transitions to ecological system Western Great Plains Badlands (CES303.663) in central Wyoming needs to be clarified.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure: Vegetation in this alliance has a sparse herbaceous layer codominated by perennial bunchgrasses and forbs. There are also sparsely scattered short shrubs and scale-leaved trees. Annual forbs and grasses are seasonally present.

Floristics: This alliance consists of sparsely vegetated (<10% vascular cover) areas with varied characteristic species such as *Enceliopsis nudicaulis*, *Eriogonum brevicaule*, *Leymus salinus* ssp. *salinus*, *Leymus salinus* ssp. *salmonis*, *Lupinus argenteus*, *Pseudoroegneria spicata* and/or *Zuckia brandegeei*. Other species include dwarf-shrubs such as *Atriplex confertifolia*, *Gutierrezia* spp., and *Chrysothamnus viscidiflorus* var. *stenophyllus*. Characteristic forbs and grasses include *Achnatherum hymenoides*, *Arenaria hookeri*, *Astragalus* spp., *Cryptantha* spp., *Eriogonum pauciflorum*, *Machaeranthera grindelioides*, *Pleuraphis jamesii*, *Platyschkuhria integrifolia*, *Poa secunda*, and/or *Xylorhiza venusta*.

ENVIRONMENT & DYNAMICS

Environmental Description: This alliance occurs on steep slopes composed of fine volcanic tuffs or clays at low elevations, from roughly 1280 to 1890 m. This substrate is typically unstable, with constant downslope movement of soil surface layers, and a high shrink-swell ratio. Chronic soil disturbance is therefore a major factor in the species composition of the alliance. Soil textures range from sandy clay, clay to clay loam, and may be alkaline. The effects of shrink-swell action and sheet erosion in these soils are evident in the high percentage of bare ground.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is found in the cool semi-desert region of the intermountain western U.S., from Arizona and New Mexico north to Idaho and Montana. It is confirmed by Oregon and Washington reviewers to not occur in either of those states.

Nations: US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, UT, WY

TNC Ecoregions [optional]: 6:P, 9:C, 10:C, 11:C, 12:?, 18:C, 19:C, 20:C, 21:C

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: NPS (Lake Mead)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Chrysothamnus nauseosus*/*Eriogonum brevicaulis* Community Type (DeVelice and Lesica 1993) [synonym for the sole association in this alliance.]
- ? *Ephedra torreyana*-*Psoralea fremontii* Sparsely Vegetated Alliance (Evens et al. 2014)
- ? Mixed Desert Shrubland (Knight et al. 1987) [This alliance may correspond to this general type if *Eriogonum brevicaulis* is substituted for *Eriogonum pauciflorum*.]

LOWER LEVEL UNITS**Associations:**

- CEG002745 *Leymus salinus* Shale Sparse Vegetation
- CEPP006743 *Psoralea fremontii* / Cryptogamic Crust (Gypsum) Sparse Vegetation
- CEG001643 *Leymus salinus* ssp. *salmonis* - *Lupinus argenteus* Sparse Vegetation
- CEG002979 *Eriogonum corymbosum* Badlands Sparse Vegetation
- CEG001642 *Leymus salinus* ssp. *salmonis* - *Enceliopsis nudicaulis* Sparse Vegetation
- CEG001343 *Eriogonum corymbosum* / *Leymus salinus* Dwarf-shrubland
- CEG002493 *Zuckia brandegeei* Sparse Vegetation
- CEG002349 *Ephedra torreyana* - (*Atriplex* spp.) / Nonvascular Gypsum Sparse Vegetation
- CEG002350 *Ephedra torreyana* - *Artemisia bigelovii* Sparse Vegetation
- CEG002353 *Ephedra torreyana* Sparse Vegetation
- CEG004013 *Eriogonum leptophyllum* Sparse Vegetation
- CEG005319 *Eriogonum brevicaulis* - Cushion Plants Sparse Vegetation
- CEG005116 *Ephedra trifurca* Badlands Shrubland
- CEG001667 *Pseudoroegneria spicata* - *Eriogonum brevicaulis* Sparse Vegetation
- CEG002976 *Ephedra nevadensis* / Lichens Sparse Vegetation

AUTHORSHIP

Primary Concept Source: M.S. Reid, in Faber-Langendoen et al. (2013)

Author of Description: M.S. Reid

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: DeVelice and Lesica 1993, Evens et al. 2014, Faber-Langendoen et al. 2017b, Knight et al. 1987, Lesica and DeVelice 1992, Moseley 1987b, Tiedemann et al. 1987

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G570. Intermountain Basins Cliff, Scree & Badland Sparse Vegetation

A4050. Ephedra viridis - Chrysothamnus viscidiflorus - Rhus trilobata Talus Sparse Scrub Alliance

Type Concept Sentence: This alliance consists of very open to sparse shrubs; typical species include *Artemisia bigelovii*, *Atriplex canescens*, *Brickellia* spp., *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ericameria nauseosa*, *Fallugia paradoxa*, and/or *Rhus trilobata*. It occupies sparsely vegetated (<10% vascular plant cover) talus and colluvial slopes in the intermountain western U.S.

OVERVIEW

Scientific Name: *Ephedra viridis* - *Chrysothamnus viscidiflorus* - *Rhus trilobata* Talus Sparse Scrub Alliance

Common Name (Translated Scientific Name): Mormon-tea - Yellow Rabbitbrush - Skunkbush Sumac Talus Sparse Scrub Alliance

Colloquial Name: Intermountain Talus Sparse Scrub

Type Concept: This alliance consists of very open to sparse shrubs (<10% vascular plant cover); typical species include *Artemisia bigelovii*, *Atriplex canescens*, *Brickellia* spp., *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ericameria nauseosa*, *Fallugia paradoxa*, and/or *Rhus trilobata*. It occupies sparsely vegetated talus and colluvial slopes. Sites range from dry and warm through some cooler aspects. Many types occur on tablelands and cliffs with talus and colluvial slopes below them. Substrates are predominantly sedimentary rocks, such as sandstone, shale, and limestone. These species are utilizing moisture from cracks and pockets where soil accumulates, and can tolerate rock-fall and movement since generally these are unstable substrates. This alliance occurs throughout the intermountain western U.S.

Classification Comments: Other associations in the west occur on talus and scree slopes from subalpine into the intermountain basins or low-elevation canyons. Most of these are currently placed into other groups. For now this alliance is constrained to generally sparsely vegetated talus, scree and colluvial slopes, but this treatment will need further review.

CBR alliances

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure: Sparsely vegetated with <10% vascular plant cover of evergreen and deciduous shrubs, generally <2 m in height.

Floristics: This alliance consists of very open to sparse shrubs (<10% vascular plant cover); typical species include *Artemisia bigelovii*, *Atriplex canescens*, *Brickellia* spp., *Chrysothamnus viscidiflorus*, *Ephedra viridis*, *Ericameria nauseosa*, *Fallugia paradoxa*, and/or *Rhus trilobata*.

ENVIRONMENT & DYNAMICS

Environmental Description: Sites occur predominantly on talus and colluvial slopes. Aspects are mostly dry and warm but range to cool. Many types occur on tablelands and cliffs with talus and colluvial slopes below them. Substrates are predominantly sedimentary rocks, such as sandstone, shale, and limestone. Plants are utilizing moisture from cracks and pockets where soil accumulates, and can tolerate rockfall and movement, since generally these are unstable substrates.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance occurs on the Colorado Plateau and extends west throughout the Great Basin and northeast into Wyoming.

Nations: US

States/Provinces: AZ, CO, ID, NM, NV, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- C EGL001287 *Atriplex canescens* - *Ephedra viridis* Talus Shrubland
- C EGL003496 *Fallugia paradoxa* - *Brickellia* spp. - (*Holodiscus dumosus*) Scree Shrubland
- C EGL002927 *Atriplex canescens* - (*Ephedra viridis*) / (*Muhlenbergia porteri*) Sandstone Sparse Vegetation
- C EPP006704 *Ericameria cuneata* var. *spathulata* Shrubland
- C EGL003755 *Artemisia bigelovii* - *Ephedra* (*viridis*, *torreyana*) Talus Shrubland
- C EGL003961 *Ericameria nauseosa* - (*Xylorhiza tortifolia*) Talus Sparse Shrubland
- C EGL003776 *Rhus trilobata* - *Ephedra* (*viridis*, *torreyana*) Talus and Slickrock Shrubland
- C EGL002347 *Chrysothamnus viscidiflorus* Talus Shrubland

AUTHORSHIP

Primary Concept Source: M.S. Reid, in Faber-Langendoen et al. (2013)

Author of Description: M.S. Reid

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Faber-Langendoen et al. 2017b, Hansen et al. 2004b

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G570. Intermountain Basins Cliff, Scree & Badland Sparse Vegetation

A4053. *Eriogonum ovalifolium* - *Fallugia paradoxa* - *Andropogon hallii* Lava & Cinder Sparse Vegetation Alliance

Type Concept Sentence: This alliance consists of woody, scrub and subshrub-dominated sparse vegetation (<10% cover) with species such as *Artemisia filifolia*, *Atriplex canescens*, *Ephedra* spp., *Eriogonum corymbosum*, *Eriogonum ovalifolium*, and/or *Fallugia paradoxa*. This alliance occurs in the intermountain western U.S. on lava flows, cinder fields, and sand dunes.

OVERVIEW

Scientific Name: *Eriogonum ovalifolium* - *Fallugia paradoxa* - *Andropogon hallii* Lava & Cinder Sparse Vegetation Alliance

Common Name (Translated Scientific Name): Cushion Buckwheat - Apache Plume - Sand Bluestem Lava & Cinder Sparse Vegetation Alliance

Colloquial Name: Intermountain Basins Lava & Cinder Sparse Vegetation

Type Concept: This alliance consists of woody, scrub and subshrub-dominated sparse vegetation (<10% cover) with either trees such as *Pinus ponderosa*, *Pinus flexilis*, or *Juniperus* spp. or shrubs such as *Artemisia filifolia*, *Atriplex canescens*, *Ephedra* spp., *Eriogonum corymbosum*, *Eriogonum ovalifolium*, and/or *Fallugia paradoxa*. The grass *Andropogon hallii* may be dominant (yet sparse) on some sites. Other forbs present may include *Chaenactis douglasii*, *Cryptantha interrupta*, *Machaeranthera canescens*, *Phacelia hastata*, *Stephanomeria minor* (= *Stephanomeria tenuifolia*), and *Pleiocanthus spinosus* (= *Stephanomeria spinosa*). *Allium simillimum*, *Lewisia rediviva*, *Mimulus nanus*, and *Mimulus suksdorfii* may be present in the spring. This alliance occurs in the intermountain western U.S. Sites are lava flows, cinder fields and sand dunes. Volcanic substrates include basalt lava and dikes with associated colluvium, basalt cliff faces and uplifted "backbones," tuff, and cinder cones or cinder fields. It may occur as large-patch, small-patch and linear (dikes) spatial patterns.

Classification Comments: Other associations occur on volcanic substrates throughout the western U.S., and are placed into other groups and alliances. This alliance is restricted to sparsely vegetated situations, but distinguishing it from others where the vegetation is more dense may be difficult. Rules will need to be determined.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure: This alliance has sparsely vegetated (<10%) vascular cover and includes conifer trees, evergreen and deciduous shrubs, subshrubs, and graminoids.

Floristics: Stands have either trees such as *Pinus ponderosa*, *Pinus flexilis*, or *Juniperus* spp. or shrubs such as *Artemisia filifolia*, *Atriplex canescens*, *Ephedra* spp., *Eriogonum corymbosum*, *Eriogonum ovalifolium*, and/or *Fallugia paradoxa*. The grass *Andropogon hallii* may be dominant (yet sparse) on some sites. Other forbs present may include *Chaenactis douglasii*, *Cryptantha interrupta*, *Machaeranthera canescens*, *Phacelia hastata*, *Stephanomeria minor* (= *Stephanomeria tenuifolia*), and *Pleiocanthus spinosus* (= *Stephanomeria spinosa*). *Allium simillimum*, *Lewisia rediviva*, *Mimulus nanus*, and *Mimulus suksdorfii* may be present in the spring.

ENVIRONMENT & DYNAMICS

Environmental Description:

Dynamics:

DISTRIBUTION

Geographic Range: This alliance occurs in the intermountain western U.S. and is limited to barren and sparsely vegetated volcanic substrates. It occurs in Montana along the Rocky Mountain Front (east of the Continental Divide).

Nations: US

States/Provinces: AZ, ID, MT, NM, NV, OR, UT, WY

TNC Ecoregions [optional]: 4:C, 6:C, 8:C, 9:C, 11:C, 18:C, 19:C, 20:C, 21:C

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL**USNVC Confidence Level with Comments:** Moderate.**SYNONYMY****LOWER LEVEL UNITS****Associations:**

- C EGL001401 *Eriogonum ovalifolium* var. *depressum* Dwarf-shrubland
- C EGL005803 *Eriogonum corymbosum* Cinder Sparse Vegetation
- C EGL002785 *Andropogon hallii* Colorado Plateau Open Rock Vegetation
- C EGL005807 *Juniperus monosperma* Cinder Open Scrub Rock Vegetation
- C EGL002929 *Pinus ponderosa* - (*Populus tremuloides*) / *Fallugia paradoxa* - (*Holodiscus dumosus*) Lava Bed Sparse Vegetation
- C EGL005806 *Fallugia paradoxa* - (*Atriplex canescens*, *Ephedra torreyana*) Cinder Shrubland

AUTHORSHIP**Primary Concept Source:** M.S. Reid, in Faber-Langendoen et al. (2013)**Author of Description:** M.S. Reid**Acknowledgments:****Version Date:** 2014/12/18**REFERENCES****References:** Day 1985, Day and Wright 1985, Faber-Langendoen et al. 2017b, Hansen et al. 2004c, Reid et al. 1994

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G570. Intermountain Basins Cliff, Scree & Badland Sparse Vegetation

A4051. *Pinus ponderosa* - *Cercocarpus intricatus* Bedrock Cliff & Canyon Wooded Scrub Alliance [Low - Poorly Documented]

Type Concept Sentence: This alliance consists of widely scattered trees and shrubs (with <10% vascular plant cover), including *Atriplex* spp., *Cercocarpus intricatus*, *Cercocarpus montanus*, *Coleogyne ramosissima*, *Juniperus* spp., and *Pinus ponderosa*. It ranges from Wyoming and Utah west across the intermountain western U.S., is found from foothill to lower montane elevations and includes steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types.

OVERVIEW**Scientific Name:** *Pinus ponderosa* - *Cercocarpus intricatus* Bedrock Cliff & Canyon Wooded Scrub Alliance**Common Name (Translated Scientific Name):** Ponderosa Pine - Littleleaf Mountain-mahogany Bedrock Cliff & Canyon Wooded Scrub Alliance**Colloquial Name:** Intermountain Bedrock Cliff & Canyon Wooded Scrub

Type Concept: This alliance consists of widely scattered trees and shrubs (with <10% vascular plant cover), including *Atriplex* spp., *Cercocarpus intricatus*, *Cercocarpus montanus*, *Coleogyne ramosissima*, *Juniperus* spp., and *Pinus ponderosa*. Other shrubs present may include *Amelanchier utahensis*, *Arctostaphylos patula*, *Artemisia bigelovii*, *Cercocarpus montanus*, *Glossopetalon spinescens* var. *meionandrum* (= *Forsellesia meionandra*), or *Ephedra viridis*. The herbaceous layer is diverse, variable and low in cover. Occasional dwarfed individuals (often only 1-1.5 m tall) of *Pinus edulis* or *Juniperus osteosperma* may occur. Colorful lichens may cover much of the surface of the exposed bedrock. This alliance ranges from Wyoming and Utah west across the intermountain western U.S. Sites are found from foothill to lower montane elevations and include steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types.

Classification Comments: Needs to be reviewed and additional floristics added. Other associations from different groups may belong in this alliance.

Internal Comments:**Other Comments:****Similar NVC Types:****Diagnostic Characteristics:**

VEGETATION**Physiognomy and Structure:**

Floristics: This alliance consists of widely scattered trees and shrubs (with <10% vascular plant cover), including *Atriplex* spp., *Cercocarpus intricatus*, *Cercocarpus montanus*, *Coleogyne ramosissima*, *Juniperus* spp., and *Pinus ponderosa*. Other shrubs present may include *Amelanchier utahensis*, *Arctostaphylos patula*, *Artemisia bigelovii*, *Cercocarpus montanus*, *Glossopetalon spinescens* var. *meionandrum* (= *Forsellesia meionandra*), or *Ephedra viridis*. The herbaceous layer is diverse, variable and low in cover. Occasional dwarfed individuals (often only 1-1.5 m tall) of *Pinus edulis* or *Juniperus osteosperma* may occur. Colorful lichens may cover much of the surface of the exposed bedrock.

ENVIRONMENT & DYNAMICS

Environmental Description: Stands occur on a variety of exposed parent materials, rocky exposed sites, and massive sandstones, such as the Navajo, Weber, Cedar Mesa, White Rim, Kayenta and Wingate formations on the Colorado Plateau. Elevations range between 1412 and 2348 m (4630-7700 feet). Slopes range from level to vertical, and all aspects are possible. The vegetation roots in crevices where sandy soil collects.

Dynamics:**DISTRIBUTION**

Geographic Range: This alliance ranges from Colorado and Utah west but occurs predominantly in the Colorado Plateau region.

Nations: US

States/Provinces: AZ, CO, NM, NV, UT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY**LOWER LEVEL UNITS****Associations:**

- C EGL002741 *Pinus (ponderosa, jeffreyi)* Sparse Vegetation
- C EGL003767 *Atriplex* spp. Desert Pavement Sparse Vegetation
- C EGL002977 *Cercocarpus intricatus* Slickrock Sparse Vegetation
- C EGL003834 *Coleogyne ramosissima* Sparse Shrubland
- C EGL002978 *Cercocarpus montanus* Rock Pavement Sparse Vegetation
- C EGL002972 *Pinus ponderosa* Slickrock Sparse Vegetation

AUTHORSHIP

Primary Concept Source: M.S. Reid, in Faber-Langendoen et al. (2013)

Author of Description: M.S. Reid

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Faber-Langendoen et al. 2017b

M499. Western North American Cool Semi-Desert Ruderal Scrub & Grassland

This upland cool semi-desert scrub and grassland macrogroup contains disturbed dry grasslands and shrublands dominated by non-native species or ruderal native species and is found from low-elevation basins to foothills throughout the western U.S. and Canada.

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

3.B.1.Ne.90.a. M499 Western North American Cool Semi-Desert Ruderal Scrub & Grassland

G600. Great Basin-Intermountain Ruderal Dry Shrubland & Grassland

Type Concept Sentence: This semi-desert interior western U.S. ruderal shrubland and grassland group includes shrubland, shrub-steppe and grassland stands that are strongly dominated (>90% relative canopy cover) by invasive, exotic species. Additionally, this group contains shrubland and shrub-steppe that are dominated or codominated by native shrub species (>10% relative cover) with a significant herbaceous understory (>10% absolute cover) that is strongly dominated (>90% relative canopy cover) by exotic herbaceous species.

OVERVIEW

Scientific Name: Great Basin-Intermountain Ruderal Dry Shrubland & Grassland Group

Common Name (Translated Scientific Name): Great Basin-Intermountain Ruderal Dry Shrubland & Grassland Group

Colloquial Name: Western Ruderal Crested Wheatgrass Grassland

Type Concept: This semi-desert interior western U.S. ruderal shrubland and grassland group includes shrubland, shrub-steppe and grassland stands that are strongly dominated (>90% relative canopy cover) by invasive, exotic species. Diagnostic invasive shrubs include *Alhagi maurorum*, *Cytisus striatus*, *Zygophyllum fabago*, or other exotic shrubs. Herbaceous stands include open to dense grasslands and forblands composed of either exotic annual or biennial grasses or forbs with low cover of perennial species (<10% absolute cover) or stands with a significant perennial herbaceous layer (>10% absolute cover) strongly dominated by exotics (>90% relative cover) with or without annuals and biennials present to dominant. There are relatively few cool, semi-arid invasive perennial graminoids such as *Agropyron cristatum*. Relatively mesic, invasive perennial hay grasses such as *Bromus inermis*, *Dactylis glomerata*, and *Phleum pratense* are typically absent or have low cover and are restricted to mesic microsites as they are more common in higher elevation or higher latitude, temperate climates or relatively mesic sites. Numerous exotic perennial herbaceous species may compose these stands, such as *Acroptilon repens*, *Cardaria draba*, *Centaurea calcitrapa*, *Centaurea diffusa*, *Centaurea iberica*, *Centaurea stoebe* ssp. *micranthos*, *Centaurea virgata*, *Euphorbia esula*, *Hypericum perforatum*, *Lepidium latifolium*, *Peganum harmala*, or a mixture of other exotic forbs and graminoids. Stands dominated by annuals may be composed of annual grasses such as *Bromus arvensis* (= *Bromus japonicus*), *Bromus hordeaceus*, *Bromus madritensis*, *Bromus tectorum*, *Taeniatherum caput-medusae*, or annual forbs, including *Bassia scoparia* (= *Kochia scoparia*), *Brassica nigra*, *Centaurea melitensis*, *Centaurea solstitialis*, *Crupina vulgaris*, *Cynoglossum officinale*, *Descurainia sophia*, *Erodium cicutarium*, *Hyoscyamus niger*, *Isatis tinctoria*, *Salsola tragus*, *Sisymbrium altissimum*, *Taraxacum officinale*, or a mixture of other exotic annual forbs and grasses. Additionally, this group contains semi-desert shrublands and shrub-steppe that are dominated or codominated by native shrub species such as *Artemisia tridentata* with a significant herbaceous understory (>10% absolute cover) that is strongly dominated (>90% relative canopy cover) by exotic herbaceous species such as *Agropyron cristatum* or *Bromus tectorum*. Stands occur in disturbed dry to mesic basins, alluvial fans, and foothills elevations up to 2200 m and are restricted to areas with the cool, semi-arid climate found in the intermountain western U.S. region. Stands can be large areas or narrow strips adjacent to roadsides or under powerlines and other disturbed areas. Soils are mostly mineral and well-drained. Due to disturbance, soils may be compacted. It is an early-successional type that may occur in areas disturbed by fire, grazing or mining. This group may grade into wetter areas and may have transition zones where mesic forbs intermix with wetter forbs and graminoids found in Western North American Ruderal Marsh, Wet Meadow & Shrubland Group (G524). This group does not include the mesic introduced hay grasses such as *Bromus inermis*, *Dactylis glomerata*, and *Phleum pratense* that have escaped from improved pasture and irrigated meadow to invade montane grasslands. These grasslands are classified in the more temperate Western North American Interior Ruderal Grassland & Shrubland Group (G624).

Classification Comments: This group may be difficult to determine from native degraded shrublands and grasslands when non-native species codominate. The test is that the non-native species, especially invasive species, far outweigh (>90% relative cover) native species in abundance and richness, such that a well-trained observer cannot tell what the native counterpart may have been or to do so is only speculation. Dominant and diagnostic semi-arid exotic species *Agropyron cristatum* can be present to codominant in Western North American Interior Ruderal Grassland & Shrubland Group (G624) when codominated by relatively mesic species such as *Bromus inermis* or exotic forage grasses such as *Agrostis stolonifera*, *Dactylis glomerata*, *Phleum pratense*, and *Poa pratensis* that are characteristic of more temperate climates.

This group may grade into wetter areas and may have transition zones where mesic forbs intermix with wetter forbs and graminoids found in Western North American Ruderal Marsh, Wet Meadow & Shrubland Group (G524). This group does not include the mesic introduced hay grasses such as *Bromus inermis*, *Dactylis glomerata*, and *Phleum pratense* that have escaped from improved pasture and irrigated meadow to invade montane grasslands. These grasslands are classified in the more temperate Western North American Interior Ruderal Grassland & Shrubland Group (G624).

Similar NVC Types:

- G648 Southern Vancouverian Lowland Ruderal Grassland & Shrubland: may include similar alliances, but is restricted to lowlands west of the Cascade Range.

- G624 Western North American Ruderal Grassland & Shrubland: has similar ruderal alliances but rather than occurring in cool, semi-arid sites, stands occur in cool, temperate regions and include montane, subalpine and alpine areas. Vegetation lacks obligate wetland species and is not dominated by facultative wetland species.
- G524 Western North American Ruderal Marsh, Wet Meadow & Shrubland: has similar ruderal alliances but occurs on mesic to wet sites and vegetation either includes obligate wetland species or is dominated by facultative wetland species.
- G819 North American Warm Desert Ruderal Scrub
- G677 North American Warm Desert Ruderal Grassland: may include similar alliances, but is restricted warm, semi-arid desert regions.

Diagnostic Characteristics: This ruderal shrubland and grassland group occurs in the semi-arid interior western U.S. and includes shrubland, shrub-steppe and grassland stands that are strongly dominated (>90% relative canopy cover) by invasive, exotic species. Additionally, this group contains shrubland and shrub-steppe that is dominated or codominated by native shrub species (>10% relative cover) with a significant herbaceous understory (>10% absolute cover) that is strongly dominated (>90% relative canopy cover) by exotic herbaceous species.

VEGETATION

Physiognomy and Structure: This group includes shrubland and shrub-steppe stands that have an open to dense shrub canopy, and annual and perennial grasslands and forblands with an open to dense herbaceous layer.

Floristics: This ruderal shrubland and grassland group includes shrubland and shrub-steppe stands that have an open to dense shrub canopy (>10% absolute cover) that is strongly dominated (>90% relative canopy cover) by invasive, introduced shrub species such as *Alhagi maurorum*, *Cytisus striatus*, *Zygophyllum fabago*, or other exotic shrubs. Additionally, this group includes shrubland and shrub-steppe that is dominated or codominated by native shrub species (>10% relative cover) with a significant herbaceous understory (>10% absolute cover) that is strongly dominated (>90% relative canopy cover) by exotic herbaceous species. Herbaceous layers are composed of either exotic annuals with low cover of perennial species, or high cover of exotic perennials. Also included in this group are open to dense ruderal herbaceous stands without a shrub layer (<10% absolute cover). The herbaceous understory (>10% absolute cover) is strongly dominated (>90% relative canopy cover) by exotic herbaceous species. Herbaceous layers are composed of either exotic annuals with low cover of perennial species (<5% absolute cover), or moderate perennial cover (>10% absolute cover) dominated by of exotic perennials, either graminoids or forbs or a combination. There are relatively few cool, semi-arid perennial graminoids such as *Agropyron cristatum* (which has frequently been purposefully seeded to prevent soil erosion or provide livestock forage). The relatively mesic, invasive perennial hay grasses such as *Bromus inermis*, *Dactylis glomerata*, and *Phleum pratense* are typically absent or have low cover and are restricted to mesic microsites as they are more common in higher elevation or higher latitude, temperate climates or relatively mesic sites. Numerous exotic perennial herbaceous species may compose these stands such as *Acroptilon repens*, *Cardaria draba*, *Centaurea calcitrapa*, *Centaurea diffusa*, *Centaurea iberica*, *Centaurea stoebe ssp. micranthos*, *Centaurea virgata*, *Hypericum perforatum*, *Lepidium latifolium*, *Peganum harmala*, or a mixture of other exotic forbs and graminoids. Stands dominated by annuals may be composed of annual grasses such as *Bromus arvensis* (= *Bromus japonicus*), *Bromus hordeaceus*, *Bromus madritensis*, *Bromus tectorum*, *Taeniatherum caput-medusae*, or annual forbs, including *Bassia scoparia* (= *Kochia scoparia*), *Brassica nigra*, *Centaurea melitensis*, *Centaurea solstitialis*, *Crupina vulgaris*, *Cynoglossum officinale*, *Descurainia sophia*, *Erodium cicutarium*, *Hyoscyamus niger*, *Isatis tinctoria*, *Lepidium perfoliatum*, *Salsola tragus*, *Sisymbrium altissimum*, *Taraxacum officinale*, or a mixture of other exotic annual forbs and grasses.

ENVIRONMENT & DYNAMICS

Environmental Description: This interior western U.S. ruderal shrubland and grassland group is found on disturbed dry to mesic, basins, alluvial fans, and foothills elevations (up to 2200 m). Stands can be large areas or narrow strips adjacent to roadsides or under powerlines, in waste places such as abandoned agricultural fields that are no longer irrigated, oil and gas development areas, and other disturbed areas. *Climate:* This group occurs in the cool, semi-arid, continental, climate found intermountain western U.S. region. *Soil/substrate/hydrology:* Soils are mostly mineral and well-drained. Due to disturbance, soils may be compacted. It is an early-successional type that may occur in areas disturbed by fire, grazing or mining. However, it also occurs over vast acres of heavily overgrazed lands in the arid west, where livestock such as cows and horses have broken soil biotic crust, compacted soil and reduced native plant vigor.

Dynamics: Most of the invasive diagnostic species are cool-season (C3) plants such as *Agropyron cristatum* and *Bromus tectorum*. Cheatgrass expansion has radically changed fire regimes and vegetation over large areas in the Intermountain West. Cheatgrass invades native vegetation such as big sagebrush shrubland, then produces large amounts of fine fuels that readily carry fire, increasing the number, size and frequency of burns (fire-return interval = 3-5 year) which reduces cover of perennial vegetation and favors dominance by annual grasses (Young and Evans 1978, Zouhar 2003). Crested wheatgrass burns quickly and is therefore less susceptible to damage by fire than some native bunchgrass species that have a thick cespitose growth form. The fire may stay longer in the culms, resulting in heat transfer to the ground and the death of the plant (DePuit 1986). In crested wheatgrass, there is usually

little heat transfer into the soil, so the tillers and root system are usually undamaged (DePuit 1986). Thus the more frequent fire regime caused by the introduction of *Bromus tectorum* also favors the maintenance of *Agropyron cristatum* over the establishment or survival of native bunchgrasses (S. Rust pers. comm. 2014).

DISTRIBUTION

Geographic Range: This ruderal group contains disturbed semi-arid grasslands, meadows, shrublands and shrub-steppe found in the interior western U.S. on disturbed dry to mesic, basins, alluvial fans, and foothills elevations (up to 2200 m). Stands do not extend up into the cool, temperate zone in included mountain ranges. This group does not extend south to the warm deserts or east into the Great Plains or west into cismontane California or the west side of the Cascades.

Spatial Scale & Pattern [optional]:

Nations: CA, US

States/Provinces: AZ, CA, CO, ID, MT, ND, NV, OR, SD, SK, UT, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Alliances:

- A4213 *Artemisia* spp. - Mixed Shrub Ruderal Understory Shrubland Alliance
- A3257 *Centaurea solstitialis* - *Isatis tinctoria* - *Salsola tragus* Ruderal Annual Forb Alliance
- A3253 *Alhagi maurorum* - *Zygophyllum fabago* Ruderal Shrubland Alliance
- A1814 *Bromus tectorum* - *Taeniatherum caput-medusae* Ruderal Annual Grassland Alliance
- A3255 *Cardaria draba* - *Centaurea* spp. - *Lepidium latifolium* Ruderal Perennial Forb Alliance
- A4148 *Agropyron cristatum* Western Ruderal Perennial Grassland Alliance

AUTHORSHIP

Primary Concept Source: Faber-Langendoen et al. (2015)

Author of Description: G. Kittel and K.A. Schulz

Acknowledgments:

Version Date: 04/16/2015

Classif Resp Region: West

Internal Author: GK 5-12, mod. KAS 4-13, 4-15

REFERENCES

References: DePuit 1986, Faber-Langendoen et al. 2017a, Johnson and O'Neil 2000, Maser et al. 1984, Rust pers. comm., Young and Evans 1978, Zouhar 2003

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G600. Great Basin-Intermountain Ruderal Dry Shrubland & Grassland

A4148. *Agropyron cristatum* Western Ruderal Perennial Grassland Alliance

Type Concept Sentence: This semi-arid interior western U.S. ruderal perennial grassland alliance is strongly dominated (>90% relative canopy cover) by invasive, exotic perennial grasses, especially *Agropyron cristatum*, which can occur as a near-monoculture or mixed grassland with other exotic perennial grasses such as *Poa pratensis* and exotic perennial forbs and annuals.

OVERVIEW

Scientific Name: *Agropyron cristatum* Western Ruderal Perennial Grassland Alliance

Common Name (Translated Scientific Name): Crested Wheatgrass Western Ruderal Perennial Grassland Alliance

Colloquial Name: Western Ruderal Crested Wheatgrass Grassland

Type Concept: This ruderal perennial grassland alliance occurs in the interior western U.S. The vegetation is strongly dominated (>90% relative canopy cover) by invasive, exotic perennial grasses, especially *Agropyron cristatum*, which can occur as a near-monoculture or mixed grassland with other exotic perennial species such as *Poa pratensis*, and exotic perennial forbs and annuals. *Agropyron cristatum* has been purposefully seeded to prevent soil erosion and provide livestock forage in many areas and has

naturalized outside these plantings. Scattered shrubs may be present but have low cover (<10% absolute cover). Native perennial graminoid species may be present but cover is low (<10% relative cover). Highly invasive and wind- and animal-distributed exotic forb and annual grass species may be present, including *Sisymbrium altissimum*, *Descurainia sophia*, *Halogeton glomeratus*, and *Salsola tragus*. Although exotic forbs and annual grasses may be abundant in the herbaceous layer and contribute to its ruderal nature, exotic perennial graminoids characterize the site. Stands occur in disturbed dry to mesic basins, alluvial fans, and foothills at elevations up to 2200 m throughout the cool, semi-arid interior western U.S. Vegetation dominated by relatively mesic, invasive perennial hay grasses such as *Bromus inermis*, *Dactylis glomerata*, *Phleum pratense*, and *Poa pratensis* generally occurs at higher elevations, higher latitudes or mesic microsites such as north slopes and generally has a more temperate climate and relatively mesic site conditions.

Classification Comments: *Agropyron cristatum* is an Old World introduction that grows in many alliances, especially on disturbed sites. Ranchers have planted thousands of hectares in the arid and semi-arid West to improve forage for use by livestock; it is palatable to wildlife, including antelope, deer, elk, birds, and small rodents. It naturalizes and dominates large areas, especially from northern parts of transmontane California east to the northwestern Great Plains (Ogle 2001, Kittel et al. 2012a). In conjunction with plantings, grazing pressures and changes in fire regime have caused shifts in native sagebrush stands with native understories of *Achnatherum hymenoides*, *Elymus elymoides*, *Festuca idahoensis*, *Leymus cinereus*, and *Poa secunda* into non-native understories or stands of *Agropyron cristatum* and/or *Bromus tectorum*.

Internal Comments:

Other Comments:

Similar NVC Types: Western North American Interior Ruderal Grassland & Shrubland Group (G624) has similar ruderal alliances but rather than occurring in cool, semi-arid sites, stands occur in cool, temperate regions and includes montane, subalpine and alpine areas. Vegetation lacks obligate wetland species and is not dominated by facultative wetland species. Western North American Ruderal Marsh, Wet Meadow & Shrubland Group (G524) has similar ruderal alliances but occurs on mesic to wet sites and vegetation either includes obligate wetland species or is dominated by facultative wetland species. Southern Vancouverian Lowland Ruderal Grassland & Shrubland Group (G648) may include similar alliances, but is restricted to lowlands west of the Cascade Range. North American Warm Desert Ruderal Grassland Group (G677) may include similar alliances, but is restricted warm, semi-arid desert regions.

- A3254 *Agropyron cristatum* - *Bromus inermis* - *Poa pratensis* Ruderal Grassland Alliance: is very similar floristically, but is restricted to the western Great Plains.

Diagnostic Characteristics: Dominant diagnostic species for this alliance are invasive, perennial grass species such as *Agropyron cristatum*. There are relatively few cool, semi-arid perennial exotic grasses, but there are usually abundant annual exotic species present, seasonally.

VEGETATION

Physiognomy and Structure: This ruderal alliance is characterized by sparse to dense herbaceous layer dominated by perennial grasses with low cover of shrubs or annual graminoids and forbs (<5% absolute cover).

Floristics: The vegetation is strongly dominated (>90% relative canopy cover) by invasive, exotic perennial grasses, especially *Agropyron cristatum*, which can occur as a near-monoculture or mixed grassland with other exotic perennial species such as *Poa pratensis*, and exotic perennial forbs and annuals. *Agropyron cristatum* has been purposefully seeded to prevent soil erosion and provide livestock forage in many areas and has naturalized outside these plantings. Scattered shrubs may be present but have low cover (<10% absolute cover). Native perennial graminoid species such as *Hesperostipa comata* may be present but cover is low (<10% relative cover). Highly invasive and wind- and animal-distributed exotic forb and annual grass species may be present, including *Sisymbrium altissimum*, *Descurainia sophia*, *Halogeton glomeratus*, and *Salsola tragus*. Although exotic forbs and annual grasses may abundant in the herbaceous layer and contribute to its ruderal nature, exotic perennial graminoids characterize the site. Relatively mesic, invasive perennial hay grasses such as *Bromus inermis*, *Dactylis glomerata*, and *Phleum pratense* are absent or have low cover as they are more common in at higher elevations, higher latitudes or mesic microsites and generally occur in more temperate climates or relatively mesic sites.

ENVIRONMENT & DYNAMICS

Environmental Description: This ruderal perennial grassland alliance occurs in the interior western U.S. Stands occur in disturbed dry to mesic basins, alluvial fans, and foothills at elevations up to approximately 2200 m throughout the cool, semi-arid interior western U.S. Vegetation dominated by relatively mesic, invasive perennial hay grasses generally occurs at higher elevations, higher latitudes or mesic microsites such as north slopes and generally has a more temperate climate and relatively mesic site conditions. Stands can occur in a wide variety of human-disturbed habitats, including highway rights-of-way, revegetation projects, etc.

Dynamics: *Agropyron cristatum* burns quickly and is less susceptible to fire damage than native bunchgrasses. Its heat transfer is minimal into the soil, so the tillers and root system are usually undamaged. Tracks of *Agropyron cristatum* carry fires easily; they may promote the expansion and persistence of the type (Johnson 1986c). Managers plant *Agropyron cristatum* extensively in the Great Basin after burns and for erosion control. Its persistence following plantings involves shifts in the ecological function. Established plants replace natives; some plantings have resulted in pure stands (Johnson 1986c). Bakker et al. (2003) found that the control of *Agropyron cristatum* was possible without suppressing native bunchgrasses by both annual and early spring spraying with a generalist herbicide (glyphosate). This herbicide selectively killed the cool-season *Agropyron cristatum*. Bakker et al. (2003) found *Agropyron cristatum* persisting over 4 years in spite of annual herbicide application, and cover in control plots particularly increased with increased summer precipitation. They suggested that management focus on controlling *Agropyron cristatum* during dry years and on establishing native species during wet years.

DISTRIBUTION

Geographic Range: This alliance occurs at plains, basins, and foothill elevations (up to 2200 m) throughout the cool, semi-arid interior western U.S.

Nations: US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]: 4:C, 11:C

USFS Ecoregions (2007): 341D:CC, 341F:CC, 342B:CC, M261G:CC

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- = *Agropyron cristatum* (Crested wheatgrass rangelands) Semi-natural Stands (Sawyer et al. 2009) [42.030.00]
- = *Agropyron cristatum* Herbaceous Semi-Natural Alliance (CNPS 2017) [42.030.00]
- < Crested wheatgrass series (Sawyer and Keeler-Wolf 1995)
- < Great Basin Grassland (#43000) (Holland 1986b)

LOWER LEVEL UNITS

Associations:

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2014)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Allen-Diaz and Bartolome 1998, Asay and Knowles 1985, Bakker et al. 2003, CNPS 2017, Coffin et al. 1996, Dillman 1946, Eckert et al. 1961, Faber-Langendoen et al. 2017b, Garrison et al. 1977, Holland 1986b, Johnson 1986c, Kittel et al. 2012a, Ogle 2001, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, USFS 1937, Whitson et al. 2000, Zlatnik 1999d

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G600. Great Basin-Intermountain Ruderal Dry Shrubland & Grassland

A3253. *Alhagi maurorum* - *Zygophyllum fabago* Ruderal Shrubland Alliance

Type Concept Sentence: This cool, semi-arid interior western U.S. ruderal shrubland alliance is strongly dominated (>90% relative canopy cover) by invasive, exotic shrub species such as *Alhagi maurorum*, *Cytisus striatus*, or *Zygophyllum fabago* and occurs in disturbed dry to mesic basins, alluvial fans, and foothills at elevations up to 2200 m.

OVERVIEW

Scientific Name: *Alhagi maurorum* - *Zygophyllum fabago* Ruderal Shrubland Alliance

Common Name (Translated Scientific Name): Camelthorn - Syrian Bean-caper Ruderal Shrubland Alliance

Colloquial Name: Ruderal Camelthorn - Syrian Bean-caper Shrubland

Type Concept: This interior western U.S. ruderal shrubland alliance has an open to dense shrub canopy (>10% absolute cover) that is strongly dominated (>90% relative canopy cover) by invasive, introduced shrub species such as *Alhagi maurorum*, *Cytisus striatus*, or *Zygophyllum fabago*. Additionally, this alliance includes shrublands dominated or codominated by native shrub species (>10%

relative cover) with a significant herbaceous understory (>10% absolute cover) that is strongly dominated (>90% relative canopy cover) by exotic herbaceous species. Herbaceous layers are composed of either exotic annuals with low cover of perennial species, or high cover of exotic perennials. Numerous exotic herbaceous species may compose the introduced herbaceous layer such as *Bromus tectorum*, *Brassica nigra*, and *Agropyron cristatum*. Stands occur in disturbed dry to mesic basins, alluvial fans, and foothills from sea level to 2200 m elevation throughout the cool, semi-arid intermountain western U.S. region. It is an early-successional type that may occur in areas disturbed by fire, grazing or mining.

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types: Western North American Interior Ruderal Grassland & Shrubland Group (G624) has similar ruderal alliances but rather than occurring in cool, semi-arid sites, stands occur in cool, temperate regions and includes montane, subalpine and alpine areas. Vegetation lacks obligate wetland species and is not dominated by facultative wetland species. Western North American Ruderal Marsh, Wet Meadow & Shrubland Group (G524) has similar ruderal alliances but occurs on mesic to wet sites and vegetation either includes obligate wetland species or is dominated by facultative wetland species. Southern Vancouverian Lowland Ruderal Grassland & Shrubland Group (G648) may include similar alliances, but is restricted to lowlands west of the Cascade Range. North American Warm Desert Ruderal Grassland Group (G677) may include similar alliances, but is restricted warm, semi-arid desert regions.

Diagnostic Characteristics: Dominant diagnostic species for this alliance are invasive shrubs such as *Alhagi maurorum*, *Cytisus striatus*, or *Zygophyllum fabago*. Additionally, this alliance includes shrublands dominated or codominated by native shrub species (>10% absolute shrub cover) with a significant herbaceous understory (>10% absolute cover) that is strongly dominated (>90% relative canopy cover) by exotic herbaceous species.

VEGETATION

Physiognomy and Structure: This ruderal alliance is characterized by an open to dense shrub canopy (>10% absolute cover) that is strongly dominated (>90% relative canopy cover) by invasive, introduced shrub and sparse to dense herbaceous layer dominated by perennial forbs with low cover of shrubs or annual graminoids and forbs (<5% absolute cover).

Floristics: This interior western U.S. ruderal shrubland alliance has an open to dense shrub canopy (>10% absolute cover) that is strongly dominated (>90% relative canopy cover) by invasive, introduced shrub species such as *Alhagi maurorum*, *Cytisus striatus*, or *Zygophyllum fabago*. Additionally, this alliance includes shrublands dominated or co-dominated by native shrub species (>10% relative cover) with a significant herbaceous understory (>10% absolute cover) that is strongly dominated (>90% relative canopy cover) by exotic herbaceous species. Herbaceous layers are composed of either exotic annuals with low cover of perennial species, or high cover of exotic perennials. Numerous exotic herbaceous species may compose the introduced herbaceous layer such as *Agropyron cristatum*, *Bromus tectorum*, *Cardaria draba*, or *Centaurea solstitialis*.

ENVIRONMENT & DYNAMICS

Environmental Description: This ruderal shrubland alliance occurs in the cool, semi-arid interior western U.S. Elevations range from sea level up to 2200 m. Stands occur in disturbed dry to mesic basins, alluvial fans, and foothills. Substrates are variable. Disturbance is important to initiating and maintaining many of these stands.

Dynamics:

DISTRIBUTION

Geographic Range: This ruderal shrubland alliance occurs in the cool, semi-arid interior western U.S.

Nations: US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY**LOWER LEVEL UNITS****Associations:**

- C EGL002784 *Alhagi maurorum* Ruderal Scrub

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Faber-Langendoen et al. 2017b, USFS 1937, Whitson et al. 2000

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G600. Great Basin-Intermountain Ruderal Dry Shrubland & Grassland

A4213. *Artemisia* spp. - Mixed Shrub Ruderal Understory Shrubland Alliance [Low - Poorly Documented]

Type Concept Sentence: Sagebrush shrublands with native shrubs in the overstory canopy and non-native herbaceous species in the understory; a wide spread example is *Artemisia tridentata* / *Bromus tectorum* shrubland.

OVERVIEW

Scientific Name: *Artemisia* spp. - Mixed Shrub Ruderal Understory Shrubland Alliance

Common Name (Translated Scientific Name): Sagebrush species - Mixed Shrub Ruderal Understory Shrubland Alliance

Colloquial Name: Great Basin-Intermountain Ruderal Understory Shrubland

Type Concept: This alliance covers those native shrublands that have had their herbaceous component completely replaced by non-native, invasive herbaceous species. Overstory shrubs include *Artemisia tridentata* (all subspecies), *Artemisia tridentata* ssp. *spiciformis* (= *Artemisia spiciformis*), *Artemisia arbuscula*, and *Artemisia tripartita*. Understory dominant herbaceous non-native species include graminoids *Bromus tectorum*, *Agropyron cristatum*, *Agrostis stolonifera*, *Taeniatherum caput-medusae*, *Poa bulbosa*, *Bromus diandrus*, and forbs *Sisymbrium altissimum*, *Descurainia pinnata*, *Onopordum acanthium*, *Cirsium* spp., *Centaurea* spp., *Lepidium* spp., and many others. Native herbaceous species may be present, but occur in very low abundance, less than 10% relative cover of all herbaceous cover. These stands occur in all areas where native sagebrush stands occur throughout the western US.

Classification Comments:

Internal Comments: GK 9-16: CA & OR confirmed and MT & NM added.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Stands are dominated in the understory layer by non-natives, such that the native association cannot be determined.

VEGETATION

Physiognomy and Structure:

Floristics:

ENVIRONMENT & DYNAMICS

Environmental Description:

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is found throughout the western U.S.

Nations: US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- C EGL005480 *Artemisia tripartita* ssp. *tripartita* / *Bromus tectorum* Ruderal Shrubland
- C EGL002528 *Artemisia tridentata* ssp. *vaseyana* / *Poa pratensis* Ruderal Shrubland
- C EGL005593 *Chrysothamnus viscidiflorus* / *Poa secunda* - *Bromus tectorum* Ruderal Shrubland
- C EGL005591 *Chrysothamnus viscidiflorus* / *Bromus tectorum* Ruderal Shrubland
- C EGL002985 *Artemisia arbuscula* ssp. *longicaulis* / *Bromus tectorum* Ruderal Shrubland
- C EGL002699 *Artemisia tridentata* - (*Ericameria nauseosa*) / *Bromus tectorum* Ruderal Shrubland
- C EGL002937 *Ericameria nauseosa* / *Bromus tectorum* Ruderal Shrubland
- C EGL005472 *Artemisia arbuscula* ssp. *arbuscula* / *Bromus tectorum* Ruderal Shrubland
- C EGL005475 *Artemisia tridentata* ssp. *vaseyana* / *Bromus tectorum* Ruderal Shrubland
- C EGL005590 *Chrysothamnus viscidiflorus* / *Agropyron cristatum* Ruderal Shrubland
- C EGL005477 *Artemisia tridentata* ssp. *wyomingensis* / *Bromus tectorum* Ruderal Shrubland
- C EGL002083 *Artemisia tridentata* ssp. *wyomingensis* / Disturbed Understory Ruderal Shrubland
- C EGL002339 *Artemisia tridentata* ssp. *vaseyana* / *Poa (pratensis, compressa)* Ruderal Shrub Grassland
- C EGL002355 *Ephedra viridis* / *Bromus tectorum* Ruderal Shrubland
- C EGL002185 *Artemisia tridentata* ssp. *wyomingensis* / (*Agropyron cristatum*, *Psathyrostachys juncea*) Seeded Grasses Ruderal Shrubland
- C EGL002933 *Chrysothamnus viscidiflorus* / *Poa pratensis* Ruderal Shrub Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2015)

Author of Description: G. Kittel

Acknowledgments:

Version Date: 2016/09/28

REFERENCES

References: Faber-Langendoen et al. 2017b, Hickman 1993, Sawyer et al. 2009

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G600. Great Basin-Intermountain Ruderal Dry Shrubland & Grassland

A1814. *Bromus tectorum* - *Taeniatherum caput-medusae* Ruderal Annual Grassland Alliance

Type Concept Sentence: This cool, semi-arid interior western U.S. ruderal annual grassland alliance is strongly dominated (>90% relative canopy cover) by invasive, exotic annual grass species such as *Bromus tectorum*, and less commonly *Bromus arvensis*, *Bromus hordeaceus*, *Bromus madritensis*, or *Taeniatherum caput-medusae*. It occurs in disturbed dry to mesic basins, alluvial fans, and foothills at elevations up to 2200 m.

OVERVIEW

Scientific Name: *Bromus tectorum* - *Taeniatherum caput-medusae* Ruderal Annual Grassland Alliance

Common Name (Translated Scientific Name): Cheatgrass - Medusa-head Ruderal Annual Grassland Alliance

Colloquial Name: Ruderal Cheatgrass - Medusa-head Annual Grassland

Type Concept: This interior western U.S. ruderal annual grassland alliance is strongly dominated (>90% relative canopy cover) by invasive, exotic annual grass species such as *Bromus tectorum*, and less commonly *Bromus arvensis* (= *Bromus japonicus*), *Bromus hordeaceus*, *Bromus madritensis*, *Onopordum acanthium*, *Taeniatherum caput-medusae*, or a mixture of other exotic annual grasses. Cover of perennials is low (<5% absolute cover). Stands occur in disturbed dry to mesic basins, alluvial fans, and foothills at elevations up to 2200 m throughout the cool, semi-arid interior western U.S. region. It is an early-successional type that may occur in areas disturbed by fire, grazing or mining.

Classification Comments: This alliance includes grasslands dominated by other Eurasian introduced annual *Bromus* species. It is distinct from the annual *Bromus* communities found along the Pacific coast with Mediterranean or maritime climates because it

does not have the introduced annual oatgrass (*Avena barbata* and *Avena fatua*), or other species typical of the California annual grassland (Sawyer and Keeler-Wolf 1995).

Internal Comments:

Other Comments:

Similar NVC Types: Western North American Interior Ruderal Grassland & Shrubland Group (G624) has similar ruderal alliances but rather than occurring in cool, semi-arid sites, stands occur in cool, temperate regions and includes montane, subalpine and alpine areas. Vegetation lacks obligate wetland species and is not dominated by facultative wetland species. Western North American Ruderal Marsh, Wet Meadow & Shrubland Group (G524) has similar ruderal alliances but occurs on mesic to wet sites and vegetation either includes obligate wetland species or is dominated by facultative wetland species. Southern Vancouverian Lowland Ruderal Grassland & Shrubland Group (G648) may include similar alliances, but is restricted to lowlands west of the Cascade Range. North American Warm Desert Ruderal Grassland Group (G677) may include similar alliances, but is restricted to warm, semi-arid desert regions.

Diagnostic Characteristics: This disturbed grassland alliance is strongly dominated (>90% relative canopy cover) by invasive, exotic annual grass species such as *Bromus tectorum*, and less commonly *Bromus arvensis*, *Bromus hordeaceus*, *Bromus madritensis*, *Taeniatherum caput-medusae*, or a mixture of other exotic annual grasses. Cover of perennials is low (<5% absolute cover). Stands are restricted to lower elevation sites (up to 2200 m) throughout the cool, semi-arid interior western U.S.

VEGETATION

Physiognomy and Structure: This alliance is characterized by sparse to dense annual grasslands with low cover of shrub or perennial graminoids or forbs (<5% absolute cover).

Floristics: This interior western U.S. ruderal annual grassland alliance is strongly dominated (>90% relative canopy cover) by invasive, exotic annual grass species such as *Bromus tectorum*, and less commonly *Bromus arvensis* (= *Bromus japonicus*), *Bromus hordeaceus*, *Bromus madritensis*, *Taeniatherum caput-medusae*, or a mixture of other exotic annual grasses. Cover of perennials is low (<5% absolute cover).

ENVIRONMENT & DYNAMICS

Environmental Description: Stands occur in disturbed dry to mesic basins, alluvial fans, and foothills at elevations up to 2200 m. Climate is cool, semi-arid. Substrates are variable.

Dynamics: *Bromus tectorum* is an annual grass and is able to complete its lifecycle in the spring before drying out mid-summer. Its fine structure makes it extremely flammable when dry, and it will increase the fire frequency of a site (FEIS 2001). Frequent fires favor *Bromus tectorum* because they eliminate competing perennial vegetation and increase soil nitrogen, but do not kill all the *Bromus tectorum* seeds, which survive in the unburned organic material (FEIS 2001). This altered ecological process has promoted the spread of *Bromus tectorum* and other exotic annual bromes at the expense of sagebrush shrublands in large parts of the western U.S. (Young and Evans 1973, 1978, Daubenmire 1975).

T. Naumann (pers. comm. 2005) reported successful restoration of cheatgrass-invaded systems by the use of prescribed fire, timed and controlled so as to destroy the seeds of *Bromus tectorum* while stimulating growth in remnant native warm-season grasses. She also reported that prescribed fire was least successful in areas of shallow soils, presumably because native grasses cannot develop sufficient root mass to compete with cheatgrass. Work by Redente and others (e.g., Redente et al. 1992) indicates that, under some circumstances, native grass and shrub species can regain competitive advantage over annuals such as *Bromus tectorum* if a source of carbon, such as sugar or sawdust, is added to the system. Amending the soil with carbon increases the activity of soil microbes and results in the reduction of plant-available nitrogen.

This type is most common where disturbances have eliminated or largely set back the native vegetation. Where the brome grasses are invading native vegetation, the types may still be tracked as native types, since the native species may still persist. A recent study (Karl et al. 1999) found that, despite strong seed and seedling production by the exotic brome grasses (*Bromus arvensis*, *Bromus tectorum*), the large amount of herbaceous biomass produced by the two vegetatively propagating native grasses *Bouteloua gracilis* and *Pascopyrum smithii* suggests that these native grasses may well maintain their ecological importance in the stands.

Evans et al. (2001) studied the invasion by cheatgrass of an undisturbed native grassland in Canyonlands National Park (Virginia Park). Their study showed that *Bromus* may cause a short-term decrease in nitrogen loss by decreasing substrate availability and denitrification enzyme activity, but in the long term, nitrogen loss is likely to be greater in invaded sites because of increased fire frequency and greater nitrogen volatilization during fire. A study by Englund (2004) at the same site showed decreasing levels of soil organic carbon as *Bromus tectorum*, with its shallow root systems, replaced perennial grasses with their more massive root systems.

In Nevada, Beatley (1976) found dense stands of the introduced winter annual grass *Bromus tectorum* growing in disturbed *Artemisia* shrublands. *Bromus rubens* is more common in lower elevation sites and *Bromus tectorum* is most common in higher elevation sagebrush and pinyon-juniper communities.

DISTRIBUTION

Geographic Range: This exotic annual grassland is restricted to the cool, semi-arid interior western U.S.

Nations: CA?, US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]: 11:C

USFS Ecoregions (2007): 341Fd:CCC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Death Valley, Joshua Tree); USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- > *Bromus tectorum* (Cheatgrass grassland) Semi-natural Stands (Sawyer et al. 2009) [42.020.00]
- > *Bromus tectorum* Semi-Natural Herbaceous Stands (Evens et al. 2012)
- > *Bromus tectorum* Semi-natural Herbaceous Alliance (Evens et al. 2014)

LOWER LEVEL UNITS

Associations:

- CEG003019 *Bromus tectorum* Ruderal Grassland
- CEG005614 *Sisymbrium altissimum* - *Bromus tectorum* Ruderal Grassland
- CEG005604 *Poa secunda* - *Bromus tectorum* Ruderal Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Beatley 1976, Daubenmire 1975, Englund 2004, Evans et al. 2001, Evens and San 2006, Evens et al. 2012, Evens et al. 2014, FEIS 2001, Faber-Langendoen et al. 2017b, Karl et al. 1999, Naumann pers. comm., Redente et al. 1992, Sawyer and Keeler-Wolf 1995, Sawyer et al. 2009, Thompson 2001, USFS 1937, VegCAMP and AIS 2013, Von Loh 2000, Whitson et al. 2000, Young and Evans 1973, Young and Evans 1978

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G600. Great Basin-Intermountain Ruderal Dry Shrubland & Grassland

A3255. *Cardaria draba* - *Centaurea* spp. - *Lepidium latifolium* Ruderal Perennial Forb Alliance

Type Concept Sentence: This cool, semi-arid interior western U.S. ruderal herbaceous alliance is strongly dominated (>90% relative canopy cover) by invasive, exotic perennial forbs such as *Acroptilon repens*, *Cardaria draba*, *Centaurea calcitrapa*, *Centaurea diffusa*, *Centaurea iberica*, *Centaurea stoebe* ssp. *micranthos*, *Centaurea virgata*, *Euphorbia esula*, *Hypericum perforatum*, *Lepidium latifolium*, *Linaria dalmatica*, *Linaria vulgaris*, or *Peganum harmala* and occurs in disturbed dry to mesic basins, alluvial fans, and foothills at elevations up to 2200 m.

OVERVIEW

Scientific Name: *Cardaria draba* - *Centaurea* spp. - *Lepidium latifolium* Ruderal Perennial Forb Alliance

Common Name (Translated Scientific Name): Whitetop - Knapweed species - Broadleaf Pepperweed Ruderal Perennial Forb Alliance

Colloquial Name: Ruderal Perennial Forb Meadow & Grassland

Type Concept: This interior western U.S. ruderal perennial herbaceous alliance is strongly dominated (>90% relative canopy cover) by invasive, exotic perennial forbs such as *Acroptilon repens*, *Cardaria draba*, *Centaurea calcitrapa*, *Centaurea diffusa*, *Centaurea iberica*, *Centaurea stoebe* ssp. *micranthos*, *Centaurea virgata*, *Euphorbia esula*, *Hypericum perforatum*, *Lepidium latifolium*, *Linaria dalmatica*, *Linaria vulgaris*, *Peganum harmala*, or a mixture of other exotic perennial forbs. Stands occur in disturbed dry to mesic

basins, alluvial fans, and foothills at elevations up to 2200 m throughout the cool, semi-arid intermountain western U.S. region. It is an early-successional type that may occur in areas disturbed by fire, grazing or mining.

Classification Comments:

Internal Comments:

Other Comments:

Similar NVC Types: Western North American Interior Ruderal Grassland & Shrubland Group (G624) has similar ruderal alliances but rather than occurring in cool, semi-arid sites, stands occur in cool, temperate regions and includes montane, subalpine and alpine areas. Vegetation lacks obligate wetland species and is not dominated by facultative wetland species. Western North American Ruderal Marsh, Wet Meadow & Shrubland Group (G524) has similar ruderal alliances but occurs on mesic to wet sites and vegetation either includes obligate wetland species or is dominated by facultative wetland species. Southern Vancouverian Lowland Ruderal Grassland & Shrubland Group (G648) may include similar alliances, but is restricted to lowlands west of the Cascade Range. North American Warm Desert Ruderal Grassland Group (G677) may include similar alliances, but is restricted warm, semi-arid desert regions.

Diagnostic Characteristics: This disturbed ruderal herbaceous alliance is strongly dominated (>90% relative canopy cover) by invasive, exotic perennial forb species such as *Acroptilon repens*, *Cardaria draba*, *Centaurea calcitrapa*, *Centaurea diffusa*, *Centaurea iberica*, *Centaurea stoebe ssp. micranthos*, *Centaurea virgata*, *Euphorbia esula*, *Hypericum perforatum*, *Lepidium latifolium*, *Linaria dalmatica*, *Linaria vulgaris*, *Peganum harmala*, or a mixture of other exotic perennial forbs.

VEGETATION

Physiognomy and Structure: This ruderal alliance is characterized by sparse to dense herbaceous layer dominated by annual forbs with low cover of shrubs or perennial graminoids and forbs (<5% absolute cover).

Floristics: This interior western U.S. ruderal perennial herbaceous alliance is strongly dominated (>90% relative canopy cover) by invasive, exotic perennial forbs such as *Acroptilon repens*, *Cardaria draba*, *Centaurea calcitrapa*, *Centaurea diffusa*, *Centaurea iberica*, *Centaurea stoebe ssp. micranthos*, *Centaurea virgata*, *Euphorbia esula*, *Hypericum perforatum*, *Lepidium latifolium*, *Linaria dalmatica*, *Linaria vulgaris*, *Peganum harmala*, or a mixture of other exotic perennial forbs.

ENVIRONMENT & DYNAMICS

Environmental Description: This ruderal perennial herbaceous alliance occurs in the interior western U.S. Stands occur in disturbed dry to mesic basins, alluvial fans, and foothills at elevations up to 2200 m throughout the cool, semi-arid intermountain western U.S. region. It is an early-successional type that may occur in areas disturbed by fire, grazing or mining.

Dynamics:

DISTRIBUTION

Geographic Range: This ruderal herbaceous alliance occurs in lowland and foothill sites throughout the cool, interior western U.S.

Nations: CA, US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- > *Lepidium latifolium* (Perennial pepper weed patches) Semi-natural Stands (Sawyer et al. 2009) [52.205.00]
- > *Lepidium latifolium* Semi-Natural Stands (Perennial pepper weed patches) (Buck-Diaz et al. 2012)

LOWER LEVEL UNITS

Associations:

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Buck-Diaz et al. 2012, Faber-Langendoen et al. 2017b, Sawyer et al. 2009, Sproul et al. 2011, USFS 1937, Whitson et al. 2000

3. Desert & Semi-Desert

3.B.1.Ne. Western North American Cool Semi-Desert Scrub & Grassland

G600. Great Basin-Intermountain Ruderal Dry Shrubland & Grassland

A3257. Centaurea solstitialis - Isatis tinctoria - Salsola tragus Ruderal Annual Forb Alliance

Type Concept Sentence: This cool, semi-arid interior western U.S. ruderal annual herbaceous alliance is strongly dominated (>90% relative canopy cover) by invasive, exotic annual forb species such as *Brassica nigra*, *Centaurea melitensis*, *Centaurea solstitialis*, *Crupina vulgaris*, *Cynoglossum officinale*, *Hyoscyamus niger*, *Isatis tinctoria*, or *Salsola tragus* and occurs in disturbed dry to mesic basins, alluvial fans, and foothills at elevations up to 2200 m.

OVERVIEW

Scientific Name: *Centaurea solstitialis - Isatis tinctoria - Salsola tragus* Ruderal Annual Forb Alliance

Common Name (Translated Scientific Name): Yellow Star-thistle - Dyer's Woad - Prickly Russian-thistle Ruderal Annual Forb Alliance

Colloquial Name: Ruderal Annual Forb Meadow & Grassland

Type Concept: This ruderal herbaceous alliance occurs in the interior western U.S. Vegetation is strongly dominated (>90% relative canopy cover) by invasive, exotic annual forb species such as *Brassica nigra*, *Centaurea melitensis*, *Centaurea solstitialis*, *Crupina vulgaris*, *Cynoglossum officinale*, *Hyoscyamus niger*, *Isatis tinctoria*, *Salsola tragus* or a mixture of other exotic annual forbs. Other exotic annual forbs are often present to dominant in disturbed stands, including *Bassia scoparia* (= *Kochia scoparia*), *Descurainia sophia*, *Erodium cicutarium*, *Lepidium perfoliatum*, *Onopordum acanthium*, *Sisymbrium altissimum*, and *Taraxacum officinale*. Cover of perennials is low (<5% absolute cover). Stands occur in disturbed dry to mesic basins, alluvial fans, and foothills at elevations up to 2200 m throughout the cool, semi-arid intermountain western U.S. region. It is an early-successional type that may occur in areas disturbed by fire, grazing or mining.

Classification Comments: The aggressive invasive species are an obvious problem resulting from conversion of native vegetation types. However, the less aggressive species such as *Salsola tragus* can be disruptive ecological processes when they flush after large precipitation events, stabilizing active dunes or providing fine fuels that can carry fire through fire-sensitive vegetation types similar to the annual bromes.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Dominant diagnostic species for this alliance are invasive species such as *Brassica nigra*, *Centaurea melitensis*, *Centaurea solstitialis*, *Crupina vulgaris*, *Cynoglossum officinale*, *Hyoscyamus niger*, *Isatis tinctoria*, *Salsola tragus*, or a mixture of other exotic annual forbs. Other less aggressive non-native herbaceous species often present in these disturbed stands include *Erodium cicutarium*, *Bassia scoparia*, and *Taraxacum officinale*.

VEGETATION

Physiognomy and Structure: This ruderal alliance is characterized by sparse to dense herbaceous layer dominated by annual grasses with low cover of shrubs or perennial graminoids and forbs (<5% absolute cover).

Floristics: Vegetation in this alliance is strongly dominated (>90% relative canopy cover) by invasive, exotic annual forb species such as *Brassica nigra*, *Centaurea melitensis*, *Centaurea solstitialis*, *Crupina vulgaris*, *Cynoglossum officinale*, *Hyoscyamus niger*, *Isatis tinctoria*, *Salsola tragus*, or a mixture of other exotic annual forbs. Other exotic annual forbs are often present to dominant in disturbed stands, including *Bassia scoparia* (= *Kochia scoparia*), *Descurainia sophia*, *Erodium cicutarium*, *Lepidium perfoliatum*, *Sisymbrium altissimum*, and *Taraxacum officinale*. Cover of perennials is low (<5% absolute cover).

ENVIRONMENT & DYNAMICS

Environmental Description: This ruderal herbaceous alliance occurs in the interior western U.S. Stands occur in disturbed dry to mesic basins, alluvial fans, and foothills at elevations up to 2200 m. Climate is cool, semi-arid. Substrates are variable. It is an early-successional type that may occur in areas disturbed by fire, grazing or mining.

Dynamics:

DISTRIBUTION

Geographic Range: This ruderal herbaceous alliance occurs in lowland and foothill sites throughout the cool, interior western U.S. and Canada.

Nations: CA, US

States/Provinces: AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]: USFWS (Minidoka)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- < *Centaurea (solstitialis, meletensis)* (Yellow star-thistle fields) Semi-natural Stands (Sawyer et al. 2009) [42.042.00]

LOWER LEVEL UNITS

Associations:

- CEGL004004 *Salsola* spp. Ruderal Grassland
- CEGL002085 *Erodium cicutarium* Ruderal Annual Grassland

AUTHORSHIP

Primary Concept Source: K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: K.A. Schulz

Acknowledgments:

Version Date: 2014/12/18

REFERENCES

References: Bentley and Talbot 1948, Faber-Langendoen et al. 2017b, Sawyer et al. 2009, USFS 1937, Wagner et al. 1978, Whitson et al. 2000

6. OPEN ROCK VEGETATION

Tropical, temperate, and boreal habitats are characterized or dominated by plant growth forms, such as *lichen*, *bryophyte*, *alga*, or *fern*, that have structural adaptations for living on stable rock surfaces or on unstable rocky substrates, such as cliffs, talus, scree, pavement, cobble, lava or boulderfields, and with associated mesomorphic grass, shrub and tree growth forms.

6.B. Temperate & Boreal Open Rock Vegetation

Rocky habitats (such as cliffs, talus, scree, pavement, cobbles, recent lava flows, or large rock outcrops) characterized by temperate, including Mediterranean, and boreal lithomorphic and lithophilic growth forms, including saxicolous *lichens*, *bryophytes*, *algae*, and/or *ferns* and other pteridophytes. Tree growth forms typically have <10% cover, are very sparse; woody growth forms, when present, include cold-deciduous broad-leaved and needle-leaved trees and shrubs. Vegetation found on temperate and boreal rocky habitats (such as cliffs, talus, recent lava flows, or rock outcrops) at low to moderate elevations at mid-latitudes from 23° to 70°N or S latitude around the globe that are characterized by nonvascular plant growth forms that have structural adaptations for living on these habitats.

6.B.1. Temperate & Boreal Cliff, Scree & Other Rock Vegetation

Vegetation in temperate and boreal habitats found in rocky or rocklike habitats (such as cliffs, talus, scree, pavement, cobbles, lava, boulderfields, or badlands) at low elevations at mid-latitudes around the globe characterized by nonvascular plant growth forms that have structural adaptations for living on stable rock surfaces or in unstable rocky substrates. A sparse cover of vascular mesomorphic growth forms, including needle-leaved and cold-deciduous broad-leaved woody plants, may be present.

6.B.1.Nb. Western North American Temperate & Boreal Cliff, Scree & Rock Vegetation

This division is characterized by the vegetation of rocky or rock-like habitats, including outcrops, cliffs, talus, or scree, in low- to mid-elevation, temperate and boreal climatic areas of western North America. Cryptogam vegetation tends to dominate, with vascular plants species of low cover.

M887. Western North American Cliff, Scree & Rock Vegetation

This sparsely vegetated rock outcrop and cliff face macrogroup is found in temperate and boreal climates, on the Alaska peninsula and Aleutian Islands, boreal Alaska and Yukon Territory, the Coast Mountains of British Columbia, in Washington and northwestern Oregon. Stands include patchy vegetated fractures in the rock surface and less steep or more stable slopes that are composed of scattered trees and/or shrubs. Mosses or lichens may be very dense, well-developed and display cover well over 10%.

6. Open Rock Vegetation

6.B.1.Nb. Western North American Temperate & Boreal Cliff, Scree & Rock Vegetation

6.B.1.Nb.1.a. M887 Western North American Cliff, Scree & Rock Vegetation

G563. Californian Cliff, Scree & Rock Vegetation

Type Concept Sentence: This cliff, scree and rock vegetation is scattered across California's Coast, Transverse, and Peninsular ranges, Klamath Mountains, southern Sierra Nevada, and the northern coast of Baja California.

OVERVIEW

Scientific Name: *Pinus contorta* var. *murrayana* / *Ceanothus megacarpus* - *Cercocarpus montanus* var. *minutiflorus* Cliff, Scree & Rock Vegetation Group

Common Name (Translated Scientific Name): Sierra Lodgepole Pine / Bigpod Ceanothus - Smooth Mountain-mahogany Cliff, Scree & Rock Vegetation Group

Colloquial Name: Jeffrey Pine / Bigberry Manzanita - Chaparral Whitethorn Sparse Shrubland

Type Concept: This group is scattered across California's Coast, Transverse, and Peninsular ranges, Klamath Mountains, southern Sierra Nevada, and the northern coast of Baja California. Sites include barren and sparsely vegetated areas of steep cliff faces, narrow canyons, smaller rock outcrops of various igneous, sedimentary, serpentinite, and metamorphic bedrock. This group also includes unstable scree and talus slopes typically occurring below cliff faces. Scattered vegetation may include trees such as *Pseudotsuga menziesii*, *Pinus contorta* var. *murrayana*, *Pinus ponderosa*, and *Pinus jeffreyi*. Shrubs may include *Ceanothus megacarpus*, *Ceanothus leucodermis*, *Cercocarpus montanus* var. *glaber* (= *Cercocarpus betuloides*), *Cercocarpus montanus* var. *minutiflorus* (= *Cercocarpus minutiflorus*), *Arctostaphylos glauca*, and *Xylococcus bicolor*. Soil development is limited as is herbaceous cover, but may include *Allium falcifolium*, *Allium cratericola*, *Streptanthus* spp., *Hesperolinon* spp., *Asclepias solanoana*, *Eriogonum ursinum*, *Eriogonum nudum*, *Eriogonum luteolum*, *Erigeron* spp., *Dudleya cymosa*, *Dudleya lanceolata*, *Lewisia rediviva*, *Pentagramma triangularis*, *Selaginella bigelovii*, *Bromus rubens*, *Vulpia* spp., and others. Moss and lichen can be well-developed, and needs better characterization.

Classification Comments: This type may overlap with Western North American Cliff, Scree & Rock Vegetation Macrogroup (M887), especially Southern Vancouverian Cliff, Scree & Rock Vegetation Group (G573). Further review is needed.

Similar NVC Types:

- G573 Southern Vancouverian Cliff, Scree & Rock Vegetation

Diagnostic Characteristics: This is a sparsely vegetated and barren group characterized by patchy vegetation that does not exceed 10% total cover. Species occupying these sites may be opportunistic and/or adapted to such conditions. Woody species may include *Pseudotsuga menziesii*, *Pinus contorta* var. *murrayana*, *Pinus ponderosa*, *Pinus jeffreyi*, *Ceanothus megacarpus*, *Ceanothus leucodermis*, *Cercocarpus montanus* var. *minutiflorus*, *Arctostaphylos glauca*, and *Xylococcus bicolor*. Soil development is limited as is herbaceous cover, but may include *Allium falcifolium*, *Allium cratericola*, *Streptanthus* spp., *Hesperolinon* spp., *Asclepias solanoana*, *Eriogonum ursinum*, *Eriogonum nudum*, *Eriogonum luteolum*, *Erigeron* spp., *Dudleya cymosa*, *Dudleya lanceolata*, *Lewisia rediviva*, *Pentagramma triangularis*, *Selaginella bigelovii*, *Bromus rubens*, *Vulpia* spp., and others. Moss and lichen can be well-developed.

VEGETATION

Physiognomy and Structure: Vegetation of the group is variable in physiognomy and structure due to harsh substrate conditions and exposure, but is composed of a patchy assemblage of needleleaf trees, broadleaf deciduous shrubs, and sporadic herbaceous cover.

Floristics: Scattered vegetation may include trees such as *Pseudotsuga menziesii*, *Pinus contorta* var. *murrayana*, *Pinus ponderosa*, and *Pinus jeffreyi*. Shrubs may include *Ceanothus megacarpus*, *Ceanothus leucodermis*, *Cercocarpus montanus* var. *minutiflorus* (= *Cercocarpus minutiflorus*), *Arctostaphylos glauca*, and *Xylococcus bicolor*. Herbaceous cover is limited but may include *Streptanthus* spp., *Hesperolinon* spp., *Allium falcifolium*, *Allium cratericola*, *Asclepias solanoana*, *Eriogonum ursinum*, *Eriogonum nudum*, *Eriogonum luteolum*, *Erigeron* spp., *Dudleya cymosa*, *Dudleya lanceolata*, *Lewisia rediviva*, *Pentagramma triangularis*, *Selaginella bigelovii*, *Bromus rubens*, *Vulpia* spp., and others. Moss and lichen can be well-developed, and needs better characterization.

ENVIRONMENT & DYNAMICS

Environmental Description: This group is known from California's Coast, Transverse, and Peninsular ranges, Klamath Mountains, southern Sierra Nevada, and the northern coast of Baja California. Sites include barren and sparsely vegetated areas of steep cliff faces, narrow canyons, smaller rock outcrops of various igneous, sedimentary, serpentinite, and metamorphic bedrock. This group also includes unstable scree and talus slopes typically occurring below cliff faces. *Soil/substrate/hydrology:* Soils are poorly developed, rocky, and loosely consolidated. Parent materials include igneous, sedimentary, serpentinite, and metamorphic bedrock and scree.

Dynamics: Poor, rocky, loosely consolidated soils help maintain stands of this group by limiting the establishment of species from adjacent communities. Not all serpentinite outcrops support distinct vegetation. Only those with very low Ca:Mg ratio impact biotic composition.

DISTRIBUTION

Geographic Range: This group is known from California's Coast, Transverse, and Peninsular ranges, Klamath Mountains, southern Sierra Nevada, and the northern coast of Baja California.

Spatial Scale & Pattern [optional]: Large patch, Small patch

Nations: MX, US

States/Provinces: CA, MXBC

TNC Ecoregions [optional]: 5:C, 12:C, 14:C, 15:C, 16:C

USFS Ecoregions (2007): 261B:PP, 262A:PP, 322C:PP, M261A:CC, M261B:CC, M261C:CC, M261D:CC, M261E:CC

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate.

SYNONYMY

LOWER LEVEL UNITS

Alliances:

- A3784 *Sedum spathulifolium* Sparse Rock Vegetation Alliance
- A3785 *Selaginella bigelovii* Rock Alliance
- A3782 *Pinus jeffreyi* / *Arctostaphylos glauca* - *Ceanothus leucodermis* Sparse Shrubland Alliance
- A4073 *Dudleya cymosa* - *Dudleya lanceolata* - Lichen/Moss Sparse Rock Vegetation Alliance
- A3783 *Allium* spp. - *Streptanthus* spp. - *Hesperolinon* spp. Serpentinite Sparse Rock Vegetation Alliance

AUTHORSHIP

Primary Concept Source: P. Comer and T. Keeler-Wolf, in Faber-Langendoen et al. (2011)

Author of Description: M.E. Hall and J. Evens

Acknowledgments: J. Evens

Version Date: 10/08/2014

Classif Resp Region: West

Internal Author: MEH 11-10, mod. DFL/JE 10-13, mod. DFL 10-14

REFERENCES

References: Barbour and Major 1988, Comer et al. 2003, Faber-Langendoen et al. 2017a, Holland and Keil 1995, Kittel et al. 2012a, Rodriguez et al. 2017, Sawyer and Keeler-Wolf 1995

6. Open Rock Vegetation

6.B.1.Nb. Western North American Temperate & Boreal Cliff, Scree & Rock Vegetation

G565. Rocky Mountain Cliff, Scree & Rock Vegetation

Type Concept Sentence: This group consists of dry barren and sparsely vegetated rock outcrops and cliff faces of the Rocky Mountains and Cascade Range in North America, where there is often very high cover of nonvascular lichens and, in wetter places, mosses.

OVERVIEW

Scientific Name: Nonvascular Rocky Mountain Cliff, Scree & Rock Vegetation Group

Common Name (Translated Scientific Name): Nonvascular Rocky Mountain Cliff, Scree & Rock Vegetation Group

Colloquial Name: Rocky Mountain Indian-parsley - Rockspirea - Raspberry Cliff, Scree & Rock

Type Concept: This group consists of barren and sparsely vegetated rock outcrops and cliff faces located throughout the Rocky Mountains and northeastern Cascade Range in North America. These sparsely vegetated surfaces (generally <10% plant cover) are found from foothill to subalpine elevations on steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous (intrusives), sedimentary, and metamorphic bedrock types. It also occurs on unstable scree and talus slopes that can occur below cliff faces. In general these are the dry, sparsely vegetated places. The biota reflects what is surrounding them, unless it is an extreme parent material. There is often very high cover of nonvascular lichens and, in wetter places, mosses. There may be small patches of dense vascular vegetation and can include scattered trees and/or shrubs. Characteristic trees include species from the surrounding landscape, such as *Pseudotsuga menziesii*, *Pinus ponderosa*, *Pinus flexilis*, *Populus tremuloides*, *Abies concolor*, *Abies lasiocarpa*, or *Pinus edulis* and *Juniperus* spp. at lower elevations. There may be scattered shrubs present, such as species of *Holodiscus*, *Ribes*, *Physocarpus*, *Rosa*, *Juniperus*, and *Jamesia americana*, *Mahonia repens*, *Rhus trilobata*, or *Amelanchier alnifolia*. Soil development is limited, as is herbaceous cover. Characteristic nonvascular species information is not available

Classification Comments: Need moss and other nonvascular species information. Cliff, scree and rock vegetation in Alaska is placed into North Vancouverian Montane Bedrock, Cliff & Talus Vegetation Group (G318), Western North American Boreal Cliff & Rock Vegetation Group (G822), or North American Arctic Cliff, Scree & Rock Vegetation Group (G375).

Similar NVC Types:

- G569 North American Warm Semi-Desert Cliff, Scree & Pavement Sparse Vegetation
- G570 Intermountain Basins Cliff, Scree & Badland Sparse Vegetation
- G571 Rocky Mountain & Sierran Alpine Bedrock & Scree: occurs above treeline.
- G319 North Pacific Alpine-Subalpine Bedrock & Scree: occurs above treeline in the Pacific Northwest mountains.
- G567 Great Plains Cliff, Scree & Rock Vegetation
- G318 North Vancouverian Montane Bedrock, Cliff & Talus Vegetation: occurs in the Pacific Northwest mountains.

Diagnostic Characteristics: Dense covering of mosses and/or nonvasculars and sparse cover of herbaceous and woody vascular plants on exposed bedrock or talus.

VEGETATION

Physiognomy and Structure: Nonvascular, woody and herbaceous vascular plants.

Floristics: Herbaceous cover is limited. Characteristic trees include species from the surrounding landscape, such as *Pseudotsuga menziesii*, *Pinus ponderosa*, *Pinus flexilis*, *Populus tremuloides*, *Abies concolor*, *Abies lasiocarpa*, or *Pinus edulis* and *Juniperus* spp. at lower elevations. There may be scattered shrubs present, such as species of *Holodiscus*, *Ribes*, *Physocarpus*, *Rosa*, *Juniperus*, and *Jamesia americana*, *Mahonia repens*, *Rhus trilobata*, or *Amelanchier alnifolia*. Characteristic nonvascular species information is not available. Floristic information compiled from Hess and Wasser (1982), Andrews and Righter (1992), Ecosystem Working Group (1998), and Larson et al. (2000).

ENVIRONMENT & DYNAMICS

Environmental Description: *Climate:* Temperate. *Soil/substrate/hydrology:* Foothill to subalpine elevations on steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous (intrusives), sedimentary, and metamorphic bedrock types. Also included are unstable scree and talus slopes that typically occur below cliff faces. In general these are the dry, sparsely vegetated places. Soil development is limited. Environmental information compiled from Hess and Wasser (1982), Andrews and Righter (1992), Ecosystem Working Group (1998), and Larson et al. (2000).

Dynamics:

DISTRIBUTION

Geographic Range: This group is located throughout the Rocky Mountain, including the isolated island ranges of central Montana, and northeastern Cascade Ranges in North America.

Spatial Scale & Pattern [optional]: Large patch

Nations: CA, US

States/Provinces: AB, AZ, BC, CO, ID, MT, NM, NV, OR, SD, UT, WA, WY

TNC Ecoregions [optional]: 7:C, 8:C, 9:C, 11:C, 20:C, 21:C, 25:C, 26:C, 68:C

USFS Ecoregions (2007): 313A:CC, 313B:CC, 313D:CC, 315A:CC, 315H:CC, 321A:CC, 331A:C?, 331B:CC, 331D:C?, 331G:CC, 331H:CC, 331I:CP, 331J:CC, 331K:CP, 331N:CP, 341A:CC, 341B:CC, 341C:CC, 341F:CC, 341G:CC, 342A:CP, 342B:CC, 342C:CC, 342D:CP, 342E:CC, 342F:CP, 342G:CP, 342H:CP, 342J:CP, 342J:CC, M242B:CP, M242C:CC, M242D:CC, M313A:CC, M313B:CC, M331A:CC, M331B:CC, M331D:CC, M331E:CC, M331F:CC, M331G:CC, M331H:CC, M331I:CC, M331J:CC, M332A:CC, M332B:CC, M332D:CC, M332E:CC, M332F:CC, M332G:CC, M333A:CC, M333B:CC, M333C:CC, M333D:CC, M334A:CC, M341A:CC, M341B:CC, M341C:CC

Omernik Ecoregions:

Federal Lands [optional]: NPS (Great Basin)

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Moderate. Need moss and other nonvascular species information.

SYNONYMY

- < CL Cliff (Ecosystems Working Group 1998)
- < RO Rock (Ecosystems Working Group 1998)
- < TA Talus (Ecosystems Working Group 1998)

LOWER LEVEL UNITS

Alliances:

- A3742 Black Hills Cliff, Scree & Rock Alliance
- A0556 *Picea engelmannii* Rock Alliance
- A3740 *Aletes anisatus* - *Holodiscus dumosus* - *Rubus idaeus* Cliff, Scree & Rock Alliance
- A4146 *Sullivantia hapemanii* - *Mimulus* spp. Wet Rock Alliance
- A3741 *Aquilegia flavescens* - *Phacelia hastata* Cliff, Scree & Rock Alliance

AUTHORSHIP

Primary Concept Source: G. Kittel, in Faber-Langendoen et al. (2011)

Author of Description: G. Kittel and M.S. Reid

Acknowledgments:

Version Date: 12/21/2010

Classif Resp Region: West

Internal Author: GK 10-10, 12-15, mod. MSR 3-17

REFERENCES

References: Andrews and Righter 1992, Comer et al. 2003, Ecosystems Working Group 1998, Faber-Langendoen et al. 2017a, Hess and Wasser 1982, Larson et al. 2000a, NCC 2002, Neely et al. 2001, Peet 1981

6. Open Rock Vegetation

6.B.1.Nb. Western North American Temperate & Boreal Cliff, Scree & Rock Vegetation

G565. Rocky Mountain Cliff, Scree & Rock Vegetation

A3740. *Aletes anisatus* - *Holodiscus dumosus* - *Rubus idaeus* Cliff, Scree & Rock Alliance

Type Concept Sentence: Sparsely vegetated areas dominated by various forbs and graminoids occupying cliffs, outcrops and scree areas of the Colorado and Wyoming Rocky Mountains in subalpine to alpine settings.

OVERVIEW

Scientific Name: *Aletes anisatus* - *Holodiscus dumosus* - *Rubus idaeus* Cliff, Scree & Rock Alliance

Common Name (Translated Scientific Name): Rocky Mountain Indian-parsley - Rockspirea - American Red Raspberry Cliff, Scree & Rock Alliance

Colloquial Name: Rocky Mountain Indian-parsley - Rockspirea - Raspberry Cliff, Scree & Rock

Type Concept: Associations within this alliance include sparsely vegetated areas of the Colorado and Wyoming Rocky Mountains in subalpine to alpine settings. Stands are typically herbaceous-dominated, although some are shrub-dominated. Due to the rocky substrate, total vegetation cover is typically sparse. Characteristic shrubs may include *Artemisia frigida*, *Chrysothamnus viscidiflorus*, *Holodiscus dumosus*, *Purshia tridentata*, *Rhus trilobata*, and *Ribes cereum*. The most consistent dominant herbaceous species

CBR alliances

include *Aletes anisatus*, *Aquilegia coerulea*, *Cirsium scopulorum*, *Claytonia megarhiza*, *Heuchera bracteata*, *Heuchera parvifolia*, and *Scutellaria brittonii*. Elevations range from 1800 to >3900 m. Stands occur in patches on rock ledges, scree and other steep slopes (20-100%). Substrates are shallow, rocky, rapidly drained, coarse-textured soils derived from various parent materials. Sites include windblown summits and ridges, scree and talus slopes, outcrops, and cliffs.

Classification Comments: The associations attributed here are done so based on geographic proximity and may not have much floristic overlap. More information is needed to fully describe and classify stands in this and other scree, gravel slide, and talus vegetation.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Characteristic of this alliance is perennial forb, shrub and graminoid vegetation of rock, scree and cliff areas of the Colorado and Wyoming Rocky Mountains. Sites have little to no soil development which promotes sparse vegetation cover. Most of the unvegetated surface is barren rock.

VEGETATION

Physiognomy and Structure: This alliance is characterized by a moderate cover of low-growing shrubs, perennial forbs and graminoids that grow in the crevices of rocks. Scattered trees are occasionally present as saplings from 1.5-3 m tall. The moss layer is sparse.

Floristics: Stands are typically herbaceous-dominated, although some are shrub-dominated. Due to the rocky substrate, total vegetation cover is typically sparse. Characteristic shrubs may include *Artemisia frigida*, *Chrysothamnus viscidiflorus*, *Holodiscus dumosus*, *Purshia tridentata*, *Rhus trilobata*, and *Ribes cereum*. The most consistent dominant herbaceous species include *Aletes anisatus*, *Aquilegia coerulea*, *Cirsium scopulorum*, *Claytonia megarhiza*, *Heuchera bracteata*, *Heuchera parvifolia*, and *Scutellaria brittonii*. Other herbaceous associates present may include *Aquilegia saximontana*, *Bouteloua gracilis*, *Bromus inermis* var. *pumpellianus* (= *Bromus pumpellianus*), *Carex geophila*, *Carex heteroneura*, *Cryptogramma acrostichoides*, *Cystopteris fragilis*, *Deschampsia cespitosa*, *Elymus elymoides*, *Elymus trachycaulus*, *Festuca arizonica*, *Festuca brachyphylla*, *Mertensia lanceolata*, *Muhlenbergia montana*, *Oreoxis alpina*, *Trisetum spicatum*, and *Viola biflora*. Scattered trees, such as *Juniperus scopulorum*, *Pinus contorta*, *Pinus edulis*, *Pinus flexilis*, *Pinus ponderosa*, and *Pseudotsuga menziesii*, are occasionally present as saplings from 1.5-3 m tall.

ENVIRONMENT & DYNAMICS

Environmental Description: Vegetation of this alliance occurs at elevations ranging from 1800 to >3900 m in the subalpine and alpine zones of the mountains of Colorado and Wyoming. The climate regime is continental, with long, cold winters and short summers with frequent afternoon thunderstorms. Strong westerly winds are common in the winter. Stands occur in patches on rock ledges, scree and other steep slopes (20-100%). Substrates are shallow, rocky, rapidly drained, coarse-textured soils derived from various parent materials. Sites include windblown summits and ridges, scree and talus slopes, outcrops, and cliffs. Soils are young and poorly developed due to low soil temperature, low soil moisture during the summer, and a short growing season.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is known from the Colorado and Wyoming Rocky Mountains.

Nations: US

States/Provinces: CO, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- ? *Claytonia megarhiza*-*Silene acaulis* ssp. *subacaulescens* habitat type (Komarkova 1986)
- ? *Heucheretum bracteato-parvifoliae* Association (Komarkova 1976)
- >< *Pseudocymopterus-Mentzelia-Chalicodium* Formation (Clements 1904)

- ? *Sagino saginoidis-Claytonietum megarhizae* Association (Komarkova 1976)

LOWER LEVEL UNITS

Associations:

- CEG001971 *Heuchera bracteata* - *Heuchera parvifolia* var. *nivalis* Rock Vegetation
- CEG001938 *Aquilegia coerulea* - *Cirsium scopulorum* Scree Sparse Vegetation
- CEG001878 *Claytonia megarhiza* Rock Vegetation
- CEG009605 *Petrophyton caespitosum* Sparse Vegetation
- CEG001134 *Rubus idaeus* Scree Shrubland
- CEG002801 *Holodiscus dumosus* Rock Outcrop Sparse Vegetation
- CEG001948 *Aletes anisatus* - *Scutellaria brittonii* Scree Vegetation

AUTHORSHIP

Primary Concept Source: M. Damm and K.A. Schulz, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Clements 1904, Faber-Langendoen et al. 2017b, Komarkova 1976, Komarkova 1986

6. Open Rock Vegetation

6.B.1.Nb. Western North American Temperate & Boreal Cliff, Scree & Rock Vegetation

G565. Rocky Mountain Cliff, Scree & Rock Vegetation

A3741. *Aquilegia flavescens* - *Phacelia hastata* Cliff, Scree & Rock Alliance

Type Concept Sentence: Sparse cliff, scree and rock outcrop vegetation of the northern Rocky Mountains. The most common dominants include *Aquilegia flavescens*, *Penstemon ellipticus*, *Phacelia hastata* and *Senecio megacephalus*.

OVERVIEW

Scientific Name: *Aquilegia flavescens* - *Phacelia hastata* Cliff, Scree & Rock Alliance

Common Name (Translated Scientific Name): Yellow Columbine - Silverleaf Phacelia Cliff, Scree & Rock Alliance

Colloquial Name: Yellow Columbine - Silverleaf Phacelia Cliff, Scree & Rock

Type Concept: Sparse cliff, scree and rock outcrop vegetation of the northern Rocky Mountains. Structurally, vegetation is very open and characterized by the dominance of forbs, the most important species including *Aquilegia flavescens*, *Phacelia hastata*, *Penstemon ellipticus*, and *Senecio megacephalus*. Associated herbaceous species may include *Achillea millefolium*, *Aquilegia flavescens*, *Arenaria capillaris*, *Arnica x diversifolia*, *Castilleja miniata*, *Chamerion angustifolium* (= *Epilobium angustifolium*), *Cirsium hookerianum*, *Epilobium anagallidifolium* (= *Epilobium alpinum*), *Galium boreale*, *Minuartia nuttallii* (= *Arenaria nuttallii*), *Phacelia sericea*, *Potentilla diversifolia*, *Sedum lanceolatum*, *Senecio megacephalus*, *Stellaria americana*, *Symphyotrichum foliaceum* (= *Aster foliaceus*), and *Valeriana sitchensis*. This subalpine to alpine community occurs from 1800 to 2400 m on steep to very steep (45-80%) talus slopes and scree fields spanning a range of exposures from east to primarily southwest (facing prevailing winds).

Classification Comments: The associations attributed here are done so based on geographic proximity and may not have much floristic overlap.

Internal Comments: MSR 11-14: alpine? Need to move out of here.

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Sparse perennial forb-dominated vegetation of the subalpine and alpine zones of the northern Rocky Mountains occupying cliff, scree and rock outcrop areas. Sites have little to no soil development which promotes sparse vegetation cover. Most of the unvegetated surface is barren rock.

VEGETATION

Physiognomy and Structure: This alliance is characterized by a rock-dominated substrate and a sparse cover of moderately tall (<1 m) perennial herbs that grow in patches between the rocks. Moss cover is sparse.

Floristics: Structurally, vegetation is very open and characterized by the dominance of forbs, the most important species including *Aquilegia flavescens*, *Phacelia hastata*, *Penstemon ellipticus*, and *Senecio megacephalus*. Associated herbaceous species may include

Achillea millefolium, *Aquilegia flavescens*, *Arenaria capillaris*, *Arnica x diversifolia*, *Castilleja miniata*, *Chamerion angustifolium* (= *Epilobium angustifolium*), *Cirsium hookerianum*, *Epilobium anagallidifolium* (= *Epilobium alpinum*), *Galium boreale*, *Minuartia nuttallii* (= *Arenaria nuttallii*), *Phacelia sericea*, *Potentilla diversifolia*, *Sedum lanceolatum*, *Senecio megacephalus*, *Stellaria americana*, *Symphotrichum foliaceum* (= *Aster foliaceus*), and *Valeriana sitchensis*. *Elymus alaskanus ssp. latiglumis* (= *Agropyron latiglume*) is the only characteristic graminoid. Mosses and lichens usually comprise less than 1% canopy cover.

ENVIRONMENT & DYNAMICS

Environmental Description: The climate regime of this alliance is continental, with long, cold winters and short summers with frequent afternoon thunderstorms. Strong westerly winds are common in the winter. Stands occur between 1800 and 2400 m elevation on all aspects of gentle to very steep (45-80%) talus slopes and scree fields. The ground is covered with small- to large-sized boulders that are snow-covered in winter. The boulders provide protection from the wind and an increased moisture supply to the vegetation. Precipitation that falls on the boulders concentrates in the crevices between the rocks creating mesic microsites suitable for the vegetation in the alliance. Stands also occur among the krummholz, where the stunted trees may provide similar sheltered sites. Soils are young and poorly developed due to low soil temperature, low soil moisture during the summer, and a short growing season.

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is currently only known from Waterton - Glacier National International Peace Park in Alberta and Montana.

Nations: CA, US

States/Provinces: AB, MT

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- C EGL005901 *Phacelia hastata* - (*Penstemon ellipticus*) Sparse Vegetation
- C EGL005899 *Aquilegia flavescens* - *Senecio megacephalus* Sparse Vegetation

AUTHORSHIP

Primary Concept Source: M. Damm, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: Faber-Langendoen et al. 2017b

6. Open Rock Vegetation

6.B.1.Nb. Western North American Temperate & Boreal Cliff, Scree & Rock Vegetation

G565. Rocky Mountain Cliff, Scree & Rock Vegetation

A0556. *Picea engelmannii* Rock Alliance

Type Concept Sentence: These wooded scree communities are characterized by *Picea engelmannii* as the dominant mature tree species and occur on steep slopes of any exposure in the southern Rocky Mountains of southern Colorado and northern New Mexico.

OVERVIEW

Scientific Name: *Picea engelmannii* Rock Alliance

Common Name (Translated Scientific Name): Engelmann Spruce Rock Alliance

Colloquial Name: Engelmann Spruce Wooded Scree

Type Concept: These wooded scree communities are characterized by *Picea engelmannii* as the dominant mature tree species. The trees are typically widely spaced and rarely reach over 20% cover. A few other trees can occur, usually as seedlings and saplings, including *Abies lasiocarpa*, *Pinus flexilis*, or *Populus tremuloides*. The shrub layer, also very sparse, can include *Jamesia americana*, *Juniperus communis*, *Ribes montigenum*, and *Ribes wolfii*. The herbaceous component is nearly unnoticeable, as plants typically are found only in crevices in the talus where small amounts of soil may have accumulated. Species can include *Carex rossii*, *Festuca brachyphylla*, *Koeleria macrantha*, *Saxifraga bronchialis*, *Sedum lanceolatum*, and *Senecio atratus*. These wooded scree communities occur on steep slopes of any exposure in the southern Rocky Mountains of southern Colorado and northern New Mexico. Differences in rock size and rates of movement cause heterogeneity in the development of vegetation. Elevations are upper montane to subalpine, ranging from about 3000 to 3600 m. Winter snowfall comprises the major portion of annual precipitation in this region. Melting snow can be held within the rocky matrix of these scree slopes, providing greater moisture-holding capacity than at first appearance. Slopes of these scree communities are typically greater than 50%. Greater than 80% of the substrate is composed of coarse rock fragments, with mineral soils confined to pockets.

Classification Comments: Scree and talus slopes with sparse vegetation have been poorly sampled and classified in the West. Undoubtedly there are coniferous tree-dominated communities in mountainous areas throughout the West occurring on talus, such as in this alliance. Also, several other wooded scree associations (e.g., dominated by *Abies lasiocarpa*, *Abies concolor*, *Pinus aristata*, *Pinus ponderosa*, and *Pseudotsuga menziesii*, and others) have been mentioned in the literature (Pfister et al. 1977, DeVelice et al. 1986, Fitzhugh et al. 1987), and are currently placed into their respective woodland alliances. Without more quantitative data for these scree communities, it is difficult to judge their proper classification and placement in the hierarchy. Wooded scree communities should be reviewed, and most probably belong in the Sparse Vegetation Class in the USNVC.

Internal Comments:

Other Comments:

Similar NVC Types:

Diagnostic Characteristics: Needle-leaved evergreen sparsely vegetated scree slopes of the southern Rocky Mountains where *Picea engelmannii* is the dominant species but typically not exceeding 20% cover.

VEGETATION

Physiognomy and Structure: The primary feature of this alliance is its occurrence on semi-stabilized talus slopes. These are very open woodlands dominated by needle-leaved evergreen trees up to 30 m in height and of only sparse cover (5-20%). There is a very sparse layer of short shrubs, primarily of scale-leaved evergreen species, although some cold-deciduous species may be present. There are very few forbs or graminoids present in most stands, typically found in crevices in the rocks where small amounts of soil may have accumulated. Total cover is characteristically less than 10%, although some stands may be somewhat higher.

Floristics: These wooded scree communities are characterized by *Picea engelmannii* as the dominant mature tree species. The trees are typically widely spaced and rarely reach over 20% cover. A few other trees can occur, usually as seedlings and saplings, including *Abies lasiocarpa*, *Pinus flexilis*, or *Populus tremuloides*. The shrub layer, also very sparse, can include *Jamesia americana*, *Juniperus communis*, *Ribes montigenum*, and *Ribes wolfii*. The herbaceous component is nearly unnoticeable, as plants typically are found only in crevices in the talus where small amounts of soil may have accumulated. Species can include *Carex rossii*, *Festuca brachyphylla*, *Koeleria macrantha*, *Saxifraga bronchialis*, *Sedum lanceolatum*, and *Senecio atratus*.

ENVIRONMENT & DYNAMICS

Environmental Description: These wooded scree communities occur on steep slopes of any exposure in the southern Rocky Mountains of southern Colorado and northern New Mexico. Elevations are upper montane to subalpine, ranging from about 3000 to 3600 m. Winter snowfall comprises the major portion of annual precipitation in this region, although summer monsoon rain events contribute as well. Maximum snowfall accumulations range from 5 m in northern New Mexico to over 13 m in the San Juan Mountains. Melting snow can be held within the rocky matrix of these scree slopes, providing greater moisture-holding capacity than at first appearance. Slopes of these scree communities are typically greater than 50% (24°). Greater than 80% of the substrate is composed of coarse rock fragments, with mineral soils confined to pockets (DeVelice et al. 1986). Differences in rock size and rates of movement cause heterogeneity in the development of vegetation (Pfister et al. 1977).

Dynamics: Vegetation on scree slopes reaches a quasi-equilibrium with the shifting substrate. Differences in rock size and rates of movement cause heterogeneity in the development of vegetation (Pfister et al. 1977), and there is a corresponding variability in species composition from one slope to another. The instability of the substrate leads to lack of soil development and slow regeneration of trees. Why some scree communities are dominated by *Picea engelmannii* and others by *Abies lasiocarpa* (or other conifers) is not documented in the literature.

DISTRIBUTION

Geographic Range: This woodland alliance is presently known only from the mountains of southern Colorado and northern New Mexico. It is probable that it occurs elsewhere in the Rocky Mountain cordillera.

Nations: US

States/Provinces: CO, NM

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low.

SYNONYMY

- ? *Picea engelmannii* Series (DeVelice et al. 1986) [Scree Forests and Habitat Types]

LOWER LEVEL UNITS**Associations:**

- CEGL000893 *Picea engelmannii* / *Saxifraga bronchialis* Scree Sparse Vegetation

AUTHORSHIP

Primary Concept Source: M.S. Reid, in Faber-Langendoen et al. (2013)

Author of Description: M.E. Hall

Acknowledgments:

Version Date: 2014/09/26

REFERENCES

References: DeVelice et al. 1986, Faber-Langendoen et al. 2017b, Fitzhugh et al. 1987, Pfister et al. 1977

6. Open Rock Vegetation

6.B.1.Nb. Western North American Temperate & Boreal Cliff, Scree & Rock Vegetation

G565. Rocky Mountain Cliff, Scree & Rock Vegetation

A4146. *Sullivantia hapemanii* - *Mimulus* spp. Wet Rock Alliance [Low - Poorly Documented]

Type Concept Sentence: These are seepage areas along vertical rockfaces, vertical to sloped rockwalls at the base of waterfalls, and large rocks and boulders kept wet by spray from nearby turbulent waterflow (e.g., cascading streamflow or churning of plunge pools at the base of waterfalls). They have a water regime ranging from seasonally to perennially wet but a minimum duration of wetness is needed to maintain these communities. This alliance is found in montane to alpine regions of the Rocky Mountain cordillera, from southern New Mexico north into Montana, Idaho, northeast Washington, Alberta and British Columbia, and west into the lower elevations and mountain ranges within the Intermountain West region.

OVERVIEW

Scientific Name: *Sullivantia hapemanii* - *Mimulus* spp. Wet Rock Alliance

Common Name (Translated Scientific Name): Hapeman's Coolwort - Monkeyflower species Wet Rock Alliance

Colloquial Name: Rocky Mountain-Great Basin Wet Cliff & Spray Zone

Type Concept: These are seepage areas along vertical rockfaces, vertical to sloped rockwalls at the base of waterfalls, and large rocks and boulders kept wet by spray from nearby turbulent waterflow (e.g., cascading streamflow or churning of plunge pools at the base of waterfalls). They have a water regime ranging from seasonally to perennially wet but a minimum duration of wetness is needed to maintain these communities. Generally they are freshwater but water chemistry and pH can vary according to local bedrock. These are wet surfaces that range from nearly unvegetated to supporting mats of mosses and liverworts that in turn may support vascular plants and invertebrates. These areas are sometimes called "hanging gardens," or "vertical wetlands." This alliance is found in montane to alpine regions of the Rocky Mountain cordillera, from southern New Mexico north into Montana, Idaho, northeast Washington, Alberta and British Columbia, and west into the lower elevations and mountain ranges within the Intermountain West region.

Classification Comments: These habitats have not been well-studied. The types and diversity of nonvascular and vascular plant communities are not well-known. Abiotic variation such as pH, water chemistry, shading effects, microclimatic effects, etc. are also understudied.

Internal Comments:

CBR alliances

Other Comments:

Similar NVC Types:

Diagnostic Characteristics:

VEGETATION

Physiognomy and Structure:

Floristics:

ENVIRONMENT & DYNAMICS

Environmental Description:

Dynamics:

DISTRIBUTION

Geographic Range: This alliance is found in montane to alpine regions of the Rocky Mountain cordillera, from southern New Mexico north into Montana, Idaho, northeast Washington, Alberta and British Columbia, and west into the lower elevations and mountain ranges within the Intermountain West region.

Nations: CA, US

States/Provinces: AB, BC, CO, ID, MT, NM, NV, UT, WA, WY

TNC Ecoregions [optional]:

USFS Ecoregions (2007):

Omernik Ecoregions:

Federal Lands [optional]:

CONFIDENCE LEVEL

USNVC Confidence Level with Comments: Low - Poorly Documented.

SYNONYMY

LOWER LEVEL UNITS

Associations:

- CEGL005509 *Sullivantia hapemanii* - *Mimulus* spp. Wet Rock Vegetation

AUTHORSHIP

Primary Concept Source: J. Rocchio, in Faber-Langendoen et al. (2014)

Author of Description: J. Rocchio

Acknowledgments:

Version Date: 2014/12/13

REFERENCES

References: Christy 2012, Faber-Langendoen et al. 2017b

Bibliography for CBR alliances (Alliance and Group references)

- Adams, D. B. 1979. Vegetation-environment relationships in Palo Duro Canyon, West Texas. Ph.D. dissertation, University of Oklahoma, Norman. 123 pp.
- Airphoto Analysis Associates. 1979. Integrated resource survey, Wood Buffalo National Park. Wood Buffalo National Park, Fort Smith, NWT. 613 pp. plus appendices plus maps.
- AIS [Aerial Information Systems, Inc.]. 2007. Santa Cruz Island photo interpretation and mapping classification report. Unpublished report to The Nature Conservancy, Redlands, CA.
- Aldous, A. E., and H. L. Shantz. 1924. Types of vegetation in the semiarid portion of the United States and their economic significance. *Journal of Agricultural Research* 28(2):99-128.
- Alexander, B. G., Jr. 1981. A preliminary forest habitat classification for the Lincoln National Forest, New Mexico. Unpublished thesis, Northern Arizona University, Flagstaff. 94 pp.
- Alexander, B. G., Jr., E. L. Fitzhugh, F. Ronco, Jr., and J. A. Ludwig. 1987. A classification of forest habitat types of the northern portion of the Cibola National Forest, NM. General Technical Report RM-143. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 35 pp.
- Alexander, B. G., Jr., F. Ronco, Jr., A. S. White, and J. A. Ludwig. 1984b. Douglas-fir habitat types of northern Arizona. General Technical Report RM-108. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 13 pp.
- Alexander, B. G., Jr., F. Ronco, Jr., E. L. Fitzhugh, and J. A. Ludwig. 1984a. A classification of forest habitat types of the Lincoln National Forest, New Mexico. General Technical Report RM-104. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 29 pp.
- Alexander, E. B., R. G. Coleman, T. Keeler-Wolf, and S. Harrison. 2007. *Serpentine geocology of western North America: Geology, soils, and vegetation*. Oxford University Press, New York, NY.
- Alexander, R. R., and F. Ronco, Jr. 1987. Classification of the forest vegetation on the national forests of Arizona and New Mexico. Research Note RM-469. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
- Allard, D. J. 1990. Southeastern United States ecological community classification. Interim report, Version 1.2. The Nature Conservancy, Southeast Regional Office, Chapel Hill, NC. 96 pp.
- Allen-Diaz, B. H. 1994. Montane meadows--SRM 216. Page 25 in: T. N. Shiflet, editor. *Rangeland cover types of the United States*. Society for Range Management, Denver, CO.
- Allen-Diaz, B. H., and J. W. Bartolome. 1998. Sagebrush-grass vegetation dynamics: Comparing classical and state-transition models. *Ecological Applications* 8:795-804.
- Anderson, L. S., P. L. Warren, and F. W. Riechenbacher. 1985. Vegetation associations of the Muleshoe Ranch Preserve. Unpublished report prepared for The Arizona Nature Conservancy, Tucson. 15 pp.
- Anderson, M. D. 2001a. *Ceanothus velutinus*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [http://www.fs.fed.us/database/feis/] (accessed 26 April 2011).
- Anderson, M. D. 2001b. *Ephedra viridis*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [http://www.fs.fed.us/database/feis/] (accessed 15 October 2007 and 19 June 2011).
- Anderson, M. D. 2004b. *Sarcobatus vermiculatus*. In: Fire Effects Information System. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Online. Available: www.fs.fed.us/database/feis/ (accessed 19 June 2011).
- Anderson, M. D. 2004c. *Ephedra nevadensis*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [http://www.fs.fed.us/database/feis/]
- Anderson, R. C. 1983. The eastern prairie-forest transition: An overview. Pages 86-92 in: R. Brewer, editor. *Proceedings of the 8th North American Prairie Conference*. Western Michigan University, Kalamazoo.
- Anderson, W. E. 1956. Some soil-plant relationships in eastern Oregon. *Journal of Range Management* 9:171-175.
- Andrews, R. R., and R. R. Righter. 1992. *Colorado birds*. Denver Museum of Natural History, Denver.
- Andrews, T. 1983. Subalpine meadow and alpine vegetation of the upper Pecos River. Report RM-51. USDA Forest Service, Southwestern Region, Albuquerque, NM.
- Anhold, J. 2005. Piñon pine mortality event in the Southwest: An update for 2005. Poster abstract. *Ecological Restoration of Southwest Ponderosa Pine and Pinyon-Juniper Ecosystems*, May 11 and 12, 2005, St. George, UT.
- Annable, C. R. 1985. Vegetation and flora of the Funeral Mountains, Death Valley National Monument. California-Nevada Cooperative National Park Resources Studies Unit, National Park Service/University of Nevada Contribution 016/07. Las Vegas, NV. 188 pp.
- AOU [American Ornithologists' Union]. 1983. Check-list of North American Birds, sixth edition. Allen Press, Inc., Lawrence, KS. 877 pp.
- Apfelbaum, S. I. 1985. Cattail (*Typha* spp.) management. *Natural Areas Journal* 5(3):9-17.
- Armstrong, J. D. 1969. Vegetation of the Virgin Mountains, Clark County, Nevada. Unpublished thesis, University of Nevada, Las Vegas. 104 pp.
- Asay, K. H., and R. P. Knowles. 1985. Current status and future of introduced wheatgrasses and wildrye for rangeland improvement. Pages 1-8 in: J. R. Carlson and E. D. McArthur, editors. *Range plant improvement in western North America*. Proceedings of a symposium at the annual meeting of the Society for Range Management. Society for Range Management, Denver, CO.

- Atzet, T. A., D. E. White, L. A. McCrimmon, P. A. Martinez, P. R. Fong, and V. D. Randall. 1996. Field guide to the forested plant associations of southwestern Oregon. Technical Paper R6-NR-ECOL-TP-17-96. USDA Forest Service, Pacific Northwest Region, Portland, OR.
- Atzet, T., and L. A. McCrimmon. 1990. Preliminary plant associations of the southern Oregon Cascade Mountain Province. USDA Forest Service, Pacific Northwest Region, Siskiyou National Forest, Grants Pass, OR. 330 pp.
- AZGAP [Arizona GAP]. 2004. Unpublished data. USGS Southwest Biological Science Center Colorado Plateau Research Station. Flagstaff, AZ.
- Baker, W. L. 1980a. Alpine vegetation of the Sangre De Cristo Mountains, New Mexico: Gradient analysis and classification. Unpublished thesis, University of North Carolina, Chapel Hill. 55 pp.
- Baker, W. L. 1982b. Natural vegetation of the Piceance Basin, Colorado. Appendix D, pages 1-113 in: J. S. Peterson and W. L. Baker, editors. Inventory of the Piceance Basin, Colorado. Unpublished report for the Bureau Land Management, Craig, CO.
- Baker, W. L. 1983a. Alpine vegetation of Wheeler Peak, New Mexico, USA: Gradient analysis, classification, and biogeography. *Arctic and Alpine Research* 15(2):223-240.
- Baker, W. L. 1983b. Some aspects of the presettlement vegetation of the Piceance Basin, Colorado. *Great Basin Naturalist* 43(4):687-699.
- Baker, W. L. 1983c. Natural vegetation of part of northwestern Moffat County, Colorado. Unpublished report prepared for the State of Colorado Natural Areas Program, Department of Natural Resources, Denver by Colorado Natural Heritage Inventory, Denver.
- Baker, W. L. 1983d. A preliminary classification of the natural vegetation of Colorado. Unpublished report prepared for the Colorado Natural Heritage Inventory, Denver. 17 pp.
- Baker, W. L. 1984a. A preliminary classification of the natural vegetation of Colorado. *Great Basin Naturalist* 44(4):647-676.
- Baker, W. L. 1986a. Riparian vegetation of the montane and subalpine zones in west-central and southwestern Colorado: Final report prepared for The Nature Conservancy and Colorado Natural Areas Program, Boulder.
- Baker, W. L. 1988. Size-class structure of contiguous riparian woodlands along a Rocky Mountain river. *Physical Geography* 9(1):1-14.
- Baker, W. L. 1989a. Macro- and micro-scale influences on riparian vegetation in western Colorado. *Annals of the Association of American Geographers* 79(1):65-78.
- Baker, W. L. 1989b. Classification of the riparian vegetation of the montane and subalpine zones in western Colorado. *Great Basin Naturalist* 49(2):214-228.
- Baker, W. L. 1990. Climatic and hydrologic effects on the regeneration of *Populus angustifolia* James along the Animas River, Colorado. *Journal of Biogeography* 17:59-73.
- Baker, W. L., and S. C. Kennedy. 1985. Presettlement vegetation of part of northwestern Moffat County, Colorado, described from remnants. *Great Basin Naturalist* 45(4):747-777.
- Bakker, J. D., S. D. Wilson, J. M. Christian, X. Li, L. G. Ambrose, and J. Waddington. 2003. Contingency of grassland restoration on year, site, and competition from introduced grasses. *Ecological Applications* 13:137-153.
- Ball, P. W., and A. A. Reznicek. 2002. *Flora of North America*. Volume 23. Magnoliophyta: Commelinidae (in part): Cyperaceae. Oxford University Press.
- Banner, A., J. Pojar, and R. Trowbridge. 1986. Representative wetland types of the northern part of the Pacific Oceanic Wetland Region. Internal report FF85008-PR. British Columbia Ministry of Forests Research Program. 45 pp.
- Banner, A., W. MacKenzie, S. Haeussler, S. Thomson, J. Pojar, and R. Trowbridge. 1993. A field guide to site identification and interpretation for the Prince Rupert Forest Region. Ministry of Forests Research Program. Victoria, BC. Parts 1 and 2. Land Management Handbook Number 26.
- Barbour, M. G., and R. A. Minnich. 2000. California upland forests and woodlands. Pages 161-202 in: M. G. Barbour and W. D. Billings, editors. *North American Terrestrial Vegetation*, second edition. Cambridge University Press.
- Barbour, M. G. 1988. Californian upland forests and woodlands. Pages 131-164 in: M. G. Barbour and W. D. Billings, editors. *North American terrestrial vegetation*. Cambridge University Press, New York, NY.
- Barbour, M. G., and J. Major, editors. 1977. *Terrestrial vegetation of California*. John Wiley and Sons, New York. 1002 pp.
- Barbour, M. G., and J. Major, editors. 1988. *Terrestrial vegetation of California: New expanded edition*. California Native Plant Society, Special Publication 9, Sacramento. 1030 pp.
- Barbour, M. G., and W. D. Billings, editors. 1988. *North American terrestrial vegetation*. Cambridge University Press, New York. 434 pp.
- Barbour, M. G., and W. D. Billings, editors. 2000. *North American terrestrial vegetation*. Second edition. Cambridge University Press, New York. 434 pp.
- Barbour, M. G., T. Keeler-Wolf, and A. A. Schoenherr, editors. 2007a. *Terrestrial vegetation of California*, third edition. University of California Press, Berkeley.
- Barnes, F. J. 1987. Carbon and water relations across a pinyon-juniper habitat gradient. Unpublished dissertation, New Mexico State University, Las Cruces.
- Barnes, P. W., and L. L. Tieszen. 1978. A phytosociological study of 14 selected communities at the Samuel H. Ordway Prairie. Unpublished Paper. Undergraduate Research Project, Augustana College, Sioux Falls, SD.
- Barney, C. W. 1980. Limber pine. Pages 98-99 in: F. H. Eyre, editor. *Forest cover types of the United States and Canada*. Society of American Foresters, Washington, DC.
- Barney, M. A., and N. C. Frischknecht. 1974. Vegetation changes following fire in the pinyon-juniper types of west-central Utah. *Journal of Range Management* 27(2):91-96.

- Barrows, J. S., E. W. Mogren, K. Rowdabaugh, and R. Yancik. 1977. The role of fire in ponderosa pine and mixed conifer ecosystems. Final report, Cooperative report between the National Park Service and Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 101 pp.
- Barrows, K. 1989. Operations and maintenance schedule for Baldwin Lake Ecological Reserve (and adjacent lands). Fourteen plant species (and animals and NC's). Unpublished report on file at California Natural Diversity Database.
- Bartolome, J. W. W. J. Barry, T. Griggs, and P. Hopkinson. 2007. Valley grassland. Pages 367-393 in: M. G. Barbour, T. Keeler-Wolf and A. A. Schoenherr. Terrestrial vegetation of California, 3rd ed. University of California Press, Berkeley.
- Bartos, D. L. 1979. Effects of burning on the aspen ecosystem. Pages 47-58 in: Wyoming shrublands. Proceedings of the eighth Wyoming shrub ecology workshop. Range Management Division, University of Wyoming, Laramie.
- Bartos, D. L., and R. B. Campbell, Jr. 1998. Decline of quaking aspen in the interior west-examples from Utah. *Rangelands* 20(1):17-24.
- Bartos, D. L., and W. F. Mueggler. 1979. Influence of fire on vegetation production in the aspen ecosystem in western Wyoming. Pages 75-78 in: M.S. Boyce, editor. North American elk: ecology, behavior and management. University of Wyoming, Laramie. 294 pp.
- Bassett, D., M. Larson, and W. Moir. 1987. Forest and woodland habitat types of Arizona south of the Mogollon Rim and southwestern New Mexico. Edition 2. USDA Forest Service, Southwestern Region, Albuquerque, NM.
- Bauer, K., E. L. Berlow, and C. M. D'Antonio. 2002. Shrub expansion in montane meadows: The relationship between climate and Rothrock sagebrush colonization patterns. *Journal of Range Management* 55:620-625.
- Baumann, T. G. 1978a. Winter ecology of bighorn sheep in the Mummy Range, Colorado. Unpublished thesis, Colorado State University, Fort Collins.
- Bear Creek Uranium Mine Application. No date. Unpublished report No. 399 prepared for Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne, WY.
- Beasley, R. S., and J. O. Klemmedson. 1980. Ecological relationships of bristlecone pine. *The American Midland Naturalist* 104(2):242-252.
- Beatley, J. C. 1975. Climates and vegetation pattern across the Mojave/Great Basin desert transition of southern Nevada. *The American Midland Naturalist* 93:53-70.
- Beatley, J. C. 1976. Vascular plants of the Nevada Test Site and central-southern Nevada: Ecological and geographic distributions. Technical Information Center, Energy Research and Development Administration. TID-26881. Prepared for Division of Biomedical and Environmental Research. 297 pp.
- Beatley, J. C. 1993. Climatic and vegetation pattern across the Mojave / Great Basin Desert Transition of southern Nevada. *The American Midland Naturalist* 93:53-70.
- Bedford, B. L., and K. S. Godwin. 2003. Fens of the United States: Distribution, characteristics, and scientific connection versus legal isolation. *Wetlands* 23(3):608-629.
- Beetle, A. A. 1955. Wheatgrasses of Wyoming. Bulletin 336. Wyoming Agricultural Experiment Station, Laramie, WY. 24 pp.
- Beetle, A. A., and K. L. Johnson. 1982. Sagebrush in Wyoming. Wyoming Agricultural Experiment Station Bulletin 779. University of Wyoming, Laramie.
- Beidleman, R. G. 1954. The cottonwood river-bottom community as a vertebrate habitat. Unpublished dissertation, University of Colorado, Boulder. 358 pp.
- Benedict, N. B. 1982. Mountain meadows: Stability and change. *Madroño* 29:148-153.
- Benedict, N. B. 1983. Plant associations of subalpine meadows, Sequoia National Park, California. *Arctic and Alpine Research* 15(3):383-396.
- Bennett, P. S. 1965. An investigation of the impact of grazing on ten meadows in Sequoia and Kings Canyon national parks. Master's thesis, San Jose State College, San Jose, CA.
- Bentley, J. R., and M. W. Talbot. 1948. Annual-plant vegetation of the California foothills as related to range management. *Ecology* 29:72-79.
- Betancourt, J. L. 1996. Long and short-term climatic influences on southwestern shrublands. Pages 5-9 in: J. R. Barrow, E. D. MacArthur, R. E. Sosebee, and R. J. Tausch, compilers. Proceedings: symposium on shrubland ecosystem dynamics in a changing climate; 1995 May 23-25; Las Cruces, NM. General Technical Report INT-GTR-338. USDA Forest Service, Intermountain Research Station, Ogden, UT.
- Betancourt, J. L., and T. R. Van Devender. 1981. Holocene vegetation in Chaco Canyon, New Mexico. *Science* 214:656-658.
- Bezanson, D. 2000. Natural vegetation types of Texas and their representation in conservation areas. M.A. thesis, University of Texas, Austin. [<http://tconr.home.texas.net/Vegetation/>]
- BIA [Bureau of Indian Affairs]. 1979. The secretarial land use plan for the addition to the Havasupai Indian Reservation. Unpublished draft Environmental Statement INT DES 79-42. Prepared by USDI Bureau of Indian Affairs, Phoenix Area Office with the assistance of Office of Arid Land Studies, University of Arizona, Tucson.
- Bighorn Coal Mine. No date. Application No. 213-T2, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.
- Billings, W. D. 1949. The shadscale vegetation zone of Nevada and eastern California in relation to climate and soils. *The American Midland Naturalist* 42(1):87-109.
- Billings, W. D. 1954. Temperature inversions in the pinyon-juniper zone of a Nevada mountain range. *Butler University Botanical Studies* 12:112-118.

- Billings, W. D., and J. H. Thompson. 1957. Composition of a stand of old bristlecone pines in the White Mountains of California. *Ecology* 38:158-160.
- Bissell, J. K. 1973. Geomorphological influence on vegetation in northwest Wyoming. Unpublished thesis, University of Wyoming, Laramie.
- Blackburn, W. H. 1967. Plant succession on selected habitat types in Nevada. Unpublished thesis, University of Nevada, Reno. 162 pp.
- Blackburn, W. H., and P. T. Tueller. 1970. Pinyon and juniper invasion in black sagebrush communities in east-central Nevada. *Ecology* 51:841-848.
- Blackburn, W. H., P. T. Tueller, and R. E. Eckert, Jr. 1968a. Vegetation and soils of the Mill Creek watershed. Nevada Agricultural Experiment Station Bulletin R-43. University of Nevada, Reno. 69 pp.
- Blackburn, W. H., P. T. Tueller, and R. E. Eckert, Jr. 1968b. Vegetation and soils of the Crowley Creek watershed. Nevada Agricultural Experiment Station Bulletin R-42. Reno. 60 pp.
- Blackburn, W. H., P. T. Tueller, and R. E. Eckert, Jr. 1968c. Vegetation and soils of the Duckwater watershed. Nevada Agricultural Experiment Station Bulletin R-40. University of Nevada, Reno. 76 pp.
- Blackburn, W. H., P. T. Tueller, and R. E. Eckert, Jr. 1969a. Vegetation and soils of the Cow Creek watershed. Vegetation and soils of the Mill Creek watershed. In cooperation with USDI Bureau of Land Management. University of Nevada, College of Agriculture, Reno. 71 pp.
- Blackburn, W. H., P. T. Tueller, and R. E. Eckert, Jr. 1969b. Vegetation and soils of the Coils Creek watershed. Nevada Agricultural Experiment Station Bulletin R-48. Reno. 81 pp.
- Blackburn, W. H., P. T. Tueller, and R. E. Eckert, Jr. 1969c. Vegetation and soils of the Churchill Canyon watershed. Nevada Agricultural Experiment Station Bulletin R-45. Reno. 157 pp.
- Blackburn, W. H., P. T. Tueller, and R. E. Eckert, Jr. 1969d. Vegetation and soils of the Pine and Mathews Canyon watersheds. Nevada Agricultural Experiment Station Bulletin R-46. Reno. 111 pp.
- Blackburn, W. H., P. T. Tueller, and R. E. Eckert, Jr. 1971. Vegetation and soils of the Rock Springs watershed. Nevada Agricultural Experiment Station Bulletin R-83. Reno. 116 pp.
- Blackburn, W. H., R. E. Eckert, Jr., and P. T. Tueller. 1969e. Vegetation and soils of the Crane Springs watershed. Nevada Agricultural Experiment Station Bulletin R-55. Reno. 63 pp.
- Blackhawk Coal Company. 1981. Vegetation resources. Chapter 9 Section 9.2, pages 9-1 through 9-27 in: Mining and Reclamation Plan for Willow Creek Mine, Blackhawk Coal Company. Utah Division of Oil, Gas & Mining Number ACT/007/002. Salt Lake City, UT.
- Blaissdell, J. P., and R. C. Holmgren. 1984. Managing intermountain rangelands-salt-desert shrub ranges. General Technical Report INT-163. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 52 pp.
- BLM [Bureau of Land Management]. 1979a. Pages 2-6 to 2-15 in: Grand Junction Resource Area grazing management-draft environmental statement.
- BLM [Bureau of Land Management]. 1979b. Final environmental impact statement, proposed development of coal resources in Eastern Powder River, WY. 67 pp.
- Bock, J. H., and C. E. Bock. 1984. Effect of fires on woody vegetation in the pine-grassland ecotone of the southern Black Hills. *The American Midland Naturalist* 112(1):35-42.
- Boggs, K. 2000. Classification of community types, successional sequences and landscapes of the Copper River Delta, Alaska. General Technical Report PNW-GTR-469. USDA Forest Service, Pacific Northwest Research Station, Portland, OR. March 2000. 244 pp.
- Boggs, K. 2002. Terrestrial ecological systems for the Cook Inlet, Bristol Bay, and Alaska Peninsula ecoregions. The Nature Conservancy, Anchorage, AK.
- Boggs, K. W., S. C. Klein, J. E. Grunblatt, and B. Koltun. 2003. Landcover classes, ecoregions and plant associations of Katmai National Park and Preserve. Natural Resource Technical Report NPS/KATM/NRTR--2003/001. National Park Service, Fort Collins, CO. 274 pp.
- Boggs, K., P. Hansen, R. Pfister, and J. Joy. 1990. Classification and management of riparian and wetland sites in northwestern Montana. Draft version I. Report prepared for the Montana Riparian Association and Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Missoula. 216 pp.
- Bolen, E. G. 1964. Plant ecology of spring-fed salt marshes in western Utah. *Ecological Monographs* 34(2):143-166.
- Boles, P. H., and W. A. Dick-Peddie. 1983. Woody riparian vegetation patterns on a segment of the Mimbres River in southwestern New Mexico. *Southwestern Naturalist* 28:81-87.
- Bolsinger, C. L. 1989. Shrubs of California's chaparral, timberland, and woodland: Area, ownership, and stand characteristics. Research Bulletin PNW-RB-160. USDA Forest Service, Pacific Northwest Experiment Station, Portland, OR.
- Borchert, M., A. Lopez, C. Bauer, and T. Knowd. 2004. Field guide to coastal sage scrub and chaparral series of Los Padres National Forest. Report R5-TP-019. USDA Forest Service, Pacific Southwest Region, San Francisco, CA.
- Borgais, D. 1990. Unpublished data from Roundtop Butte Preserve. Data on file at Oregon Natural Heritage Program, Portland, OR.
- Boucek, M. M. 1986. Vegetation survey at the Summit No.1 Coal Mine, Summit County, Utah. Volume 1, Section 783.19, Appendix 783.19. Pages 1-15 in Mining and Reclamation Plan. Summit Minerals Inc. Utah Division of Oil, Gas & Mining Number ACT/043/001. Salt Lake City.
- Bourgeron, P. S., and L. D. Engelking, editors. 1994. A preliminary vegetation classification of the western United States. Unpublished report. The Nature Conservancy, Western Heritage Task Force, Boulder, CO. 175 pp. plus appendix.

- Bourgeron, P. S., L. D. Engelking, H. C. Humphries, E. Muldavin, and W. H. Moir. 1993b. Assessing the conservation value of the Gray Ranch: Rarity, diversity and representativeness. Unpublished report prepared for The Nature Conservancy by the Western Heritage Task Force, Boulder, CO. (Volume I and II).
- Bourgeron, P. S., L. D. Engelking, H. C. Humphries, E. Muldavin, and W. H. Moir. 1995a. Assessing the conservation value of the Gray Ranch: Rarity, diversity and representativeness. *Desert Plants* 11(2-3):3-68.
- Bowers, J. E. 1982. The plant ecology of inland dunes in western North America. *Journal of Arid Environments* 5:199-220.
- Bowers, J. E. 1984. Plant geography of southwestern sand dunes. *Desert Plants* 6(1):31-42, 51-54.
- Bowers, J. E. 1986. Seasons of the wind: A naturalist's look at the plant life of southwestern sand dunes. Northland Press, Flagstaff, AZ. 156 pp.
- Bowns, J. E., and C. F. Bagley. 1986. Vegetation responses to long term sheep grazing on mountain ranges. *Journal of Range Management* 39:431-434.
- Bowns, J. E., and N. E. West. 1976. Blackbrush (*Coleogyne ramosissima* Torr.) on southwestern Utah rangelands. Utah Agricultural Experiment Station Research Report 27. Logan, UT. 27 pp.
- Boyce, D. A. 1977. Vegetation of the South Fork of the White River Valley, Colorado. Unpublished dissertation, University of Colorado, Boulder. 312 pp.
- Boyd, S. D. 1983. A flora of the Gavilan Hills, western Riverside County, California. Master's thesis, University of California, Riverside, CA.
- Bradley, A. F., N. V. Noste, and W. C. Fischer. 1992. Fire ecology of forests and woodlands in Utah. General Technical Report INT-287. USDA Forest Service, Intermountain Research Station, Ogden, UT. 128 pp.
- Bradley, W. G. 1964. The vegetation of the desert game range with special reference to the desert bighorn. Pages 43-67 in: *Transcripts of the Desert Bighorn Council*. Las Vegas, NV.
- Bradley, W. G. 1970. The vegetation of Saratoga Springs, Death Valley National Monument. *Southwest Naturalist* 15:111-129.
- Bramble-Brodahl, M. K. 1978. Classification of *Artemisia* vegetation in the Gros Ventre area, Wyoming. M.S. thesis, University of Idaho, Moscow.
- Brand, C. A., and J. Sanderson. 2002. Characterization of water resources at The Nature Conservancy's Medano-Zapata Ranch in the San Luis Valley, CO. Unpublished report prepared for The Nature Conservancy of Colorado.
- Branson, F. A., and J. B. Owen. 1970. Plant cover, runoff, and sediment yield relationships on Mancos shale in western Colorado. *Water Resources Research* 6:783-790.
- Branson, F. A., R. F. Miller, and I. S. McQueen. 1967. Geographic distribution and factors affecting the distribution of salt desert shrubs in the United States. *Journal of Range Management* 29(5):287-296.
- Branson, F. A., R. F. Miller, and I. S. McQueen. 1976. Moisture relationships in twelve northern desert shrub communities near Grand Junction, Colorado. *Ecology* 57:1104-1124.
- Britton, C. M., R. G. Clark, and F. A. Sneva. 1981. Will your sagebrush range burn? *Rangelands* 3(5):207-208.
- Brodo, I. M., S. D. Sharnoff, and S. Sharnoff. 2001. *Lichens of North America*. Yale University Press, New Haven. 795 pp.
- Brooks, M. 2000a. *Schismus arabicus* Nees, *Schismus barbatus* (L.). Pages 287-291 in: C. Bossard, M. Hoshovsky, and J. Randall, editors. *Invasive plants of California's wildlands*. University of California Press, Berkeley, CA.
- Brooks, M. 2000b. Competition between alien annual grasses and native annual plants in the Mojave Desert. *The American Midland Naturalist* 144:92-108.
- Brooks, M. L., and D. Pyke. 2001. Invasive plants and fire in the deserts of North America. Pages 1-14 in: K. E. M. Galley and T. P. Wilson, editors. *Proceedings of the Invasive Species Workshop: The role of fire in the control and spread of invasive species*. Held at Fire Conference 2000: The First National Congress on Fire, Ecology, Prevention and Management, Tall Timbers Research Station, Tallahassee, FL.
- Brooks, M. L., and R. A. Minnich. 2006. Southeastern deserts bioregion. Pages 391-414 in: N. G. Sugihara, J. W. van Wagtenonk, K. E. Shaffer, J. Fites-Kaufman, and A. E. Thode, editors. *Fire in California's ecosystems*. University of California Press, Berkeley.
- Brotherson, J. D. 1987. Plant community zonation in response to soil gradients in a saline meadow near Utah Lake, Utah County, Utah. *Great Basin Naturalist* 47(2):322-333.
- Brotherson, J. D., and D. Field. 1987. *Tamarix*: Impacts of a successful weed. *Rangelands* 9(3):110-112.
- Brotherson, J. D., and K. J. Brotherson. 1979. Ecological and community relationships of *Eriogonum corymbosum* (Polygonaceae) in the Uinta Basin, Utah. *Great Basin Naturalist* 39:177-191.
- Brotherson, J. D., and S. J. Barnes. 1984. Habitat relationships of *Glaux maritima* in central Utah. *Great Basin Naturalist* 44(2):299-309.
- Brotherson, J. D., and W. E. Evenson. 1982. Vegetation communities surrounding Utah Lake and its bays. *Utah Lake Vegetation Studies*. Unpublished report done for the Utah Division of Wildlife Resources and USDI Bureau of Reclamation, Provo, UT. 401 pp.
- Brotherson, J. D., and W. T. Brotherson. 1981. Grazing impacts on the sagebrush communities of central Utah. *Great Basin Naturalist* 41(3):335-340.
- Brotherson, J. D., L. L. Rasmussen, and R. D. Black. 1986. Comparative habitat and community relationships of *Atriplex confertifolia* and *Sarcobatus vermiculatus* in central Utah. *Great Basin Naturalist* 46(2):348-357.
- Brown, D. E. 1978. The vegetation and occurrence of chaparral and woodland flora on isolated mountains within the Sonoran and Mojave deserts in Arizona. *Arizona-Nevada Academy of Science* 13:7-12.
- Brown, D. E., and R. A. Minnich. 1986. Fire and changes in creosote bush scrub of the western Sonoran Desert, California. *American Midland Naturalist* 116:411-422.

- Brown, D. E., C. H. Lowe, and C. P. Pase. 1979. A digitized classification system for the biotic communities of North America with community (series) and association examples for the Southwest. *Journal of the Arizona-Nevada Academy of Science* 14:1-16.
- Brown, D. E., C. H. Lowe, and C. P. Pase. 1980. A digitized systematic classification for ecosystems with an illustrated summary of the natural vegetation of North America. General Technical Report RM-73. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 93 pp.
- Brown, D. E., editor. 1982a. Biotic communities of the American Southwest-United States and Mexico. *Desert Plants Special Issue* 4(1-4):1-342.
- Brown, J. R., and S. Archer. 1987. Woody plant seed dispersal and gap formation in a North American subtropical savanna woodland: The role of domestic herbivores. *Vegetatio* 73:73-80.
- Brown, J. R., and S. Archer. 1989. Woody plant invasion of grasslands: Establishment of honey mesquite (*Prosopis glandulosa* var. *glandulosa*) on sites differing in herbaceous biomass and grazing history. *Oecologia* 80:19-26.
- Brown, R. W. 1971. Distribution of plant communities in southeastern Montana badlands. *The American Midland Naturalist* 85(2):458-477.
- Buck-Diaz, J., and J. Evens. 2011b. Carrizo Plain National Monument vegetation classification and mapping project. Report to USDI, Bureau of Land Management, California Department of Fish and Game, and The Nature Conservancy. California Native Plant Society, Sacramento, CA.
- Buck-Diaz, J., J. Ratchford, and J. M. Evens. 2013. California rangeland monitoring and mapping: Focusing upon Great Valley and Carrizo Plain grassland habitats, California. Unpublished report submitted to the Natural Resources Conservation Service. California Native Society, Sacramento, CA. [http://cnps.org/cnps/vegetation/pdf/grassland_nrcs_report-2013c.pdf]
- Buck-Diaz, J., S. Batiuk, and J. M. Evens. 2012. Vegetation alliances and associations of the Great Valley ecoregion, California. California Native Society, Sacramento, CA. [http://cnps.org/cnps/vegetation/pdf/great_valley_eco-vegclass2012.pdf]
- Buckner, D. L. 1977. Ribbon forest development and maintenance in the central Rocky Mountains of Colorado. Unpublished dissertation, University of Colorado, Boulder. 224 pp.
- Buffington, L. C., and C. H. Herbel. 1965. Vegetational changes on a semidesert grassland range from 1858 to 1963. *Ecological Monographs* 35(2):139-164.
- Bundy, R. M., J. V. Baumgartner, M. S. Reid, P. S. Bourgeron, H. C. Humphries, and B. L. Donohue. 1996. Ecological classification of wetland plant associations in the Lahontan Valley, Nevada. Prepared for Stillwater National Wildlife Refuge and USDI Fish & Wildlife Service. 53 pp. not including inventories, tables and graphs.
- Bunin, J. E. 1975c. The vegetation of the west slope of the Park Range, Colorado. Unpublished dissertation, University of Colorado, Boulder. 235 pp.
- Bunin, J. E. 1985. Vegetation of the City of Boulder, Colorado open space lands. Report prepared for the City of Boulder, Real Estate/Open Space, Boulder, CO. 114 pp.
- Bunting, S. C. 1987. Use of prescribed burning in juniper and pinyon-juniper woodlands. Pages 141-144 in: R. L. Everett, compiler. *Proceedings--pinyon-juniper conference; 1986 January 13-16; Reno, NV.* General Technical Report INT-215. USDA Forest Service, Intermountain Research Station, Ogden, UT.
- Burgess, T. L. 1995. Desert grassland, mixed shrub savanna, shrub steppe, or semidesert scrub. Pages 31-67 in: M. P. McClaran and T. R. Van Devender, editors. *The Desert Grassland.* University of Arizona Press, Tucson.
- Burgess, T. L., and D. K. Northington. 1977. Desert vegetation of the Guadalupe Mountains region. Pages 229-243 in: R. H. Wauer and D. H. Riskind, editors. *Transactions of the symposium on the biological resources of the Chihuahuan Desert region, United States and Mexico.* USDI National Park Service. Transaction Proceedings Series No. 3. Washington, DC.
- Burgess, T. L., and R. D. Klein. No date. Vegetation of the northern salt basin, Hudspeth County, Texas. In: *Salt flats.* LBJ School of Public Affairs, Natural Areas Survey.
- Burk, J. H. 1977. Sonoran Desert vegetation. Pages 869-889 in: M. G. Barbour and J. Major, editors. *Terrestrial vegetation of California.* John Wiley and Sons, New York.
- Burke, M. T. 1982. The vegetation of Rae Lakes Basin, southern Sierra Nevada. *Madroño* 29:164-176.
- Burkhardt, J. W., and E. W. Tisdale. 1969. Nature and successional status of western juniper vegetation in Idaho. *Journal of Range Management* 22:264-270.
- Burkhardt, J. W., and E. W. Tisdale. 1976. Causes of juniper invasion in southwestern Idaho. *Ecology* 57:472-484.
- Burns, R. M., and B. H. Honkala, technical coordinators. 1990a. *Silvics of North America: Volume 1. Conifers.* Agriculture Handbook 654. USDA Forest Service, Washington, DC. 675 pp.
- Bursik, R. J., and R. K. Moseley. 1995. Ecosystem conservation strategy for Idaho Panhandle peatlands. Cooperative project between Idaho Panhandle National Forests and Idaho Department of Fish and Game, Conservation Data Center, Boise. 28 pp. plus appendix.
- Butler, D. R. 1979. Snow avalanche path terrain and vegetation, Glacier National Park, Montana. *Arctic and Alpine Research* 11:17-32.
- Butler, D. R. 1985. Vegetation and geomorphic change on snow avalanche paths, Glacier National Park, Montana, USA. *Great Basin Naturalist* 45(2):313-317.
- Buttery, R. F. 1955. Range conditions and trends resulting from winter concentrations of elk in Rocky Mountain National Park, Colorado. Unpublished thesis. Colorado Agricultural and Mechanical College, Fort Collins. 117 pp.
- Cable, D. R. 1967. Fire effects on semidesert grasses and shrubs. *Journal of Range Management* 20:170-176.
- Cable, D. R. 1969. Competition in the semidesert grass-shrub type as influenced by root systems, growth habits, and soil moisture extraction. *Ecology* 50:27-38.

- Cable, D. R. 1975a. Range management in the chaparral type and its ecological basis: The status of our knowledge. Research Paper RM-155. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 30 pp.
- Cable, D. R. 1975b. Influence of precipitation on perennial grass production in the semidesert southwest. *Ecology* 56:981-986.
- Caicco, S. L., and C. A. Wellner. 1983a. Research Natural Area recommendation for City of Rocks. Unpublished report prepared for USDI Bureau of Land Management, Burley District, Idaho by Idaho Natural Areas Coordinating Committee. On file at Idaho Conservation Data Center, Boise, ID. 12 pp.
- Caicco, S. L., and C. A. Wellner. 1983b. Research Natural Area recommendation for Jim Sage Canyon. Unpublished report prepared for USDI Bureau of Land Management, Burley District, Idaho by Idaho Natural Areas Coordinating Committee. On file at Idaho Conservation Data Center, Boise, ID.
- Caicco, S. L., and C. A. Wellner. 1983c. Research Natural Area recommendation for Southwest Lemhi Range. Unpublished report prepared for USDI Bureau of Land Management, Idaho Falls District, Idaho by Idaho Natural Areas Coordinating Committee. On file at Idaho Conservation Data Center, Boise, ID.
- Caicco, S. L., and C. A. Wellner. 1983e. Research Natural Area recommendation for St. Anthony Sand Dunes. Unpublished report prepared for USDI Bureau of Land Management, Idaho Falls District, Idaho by Idaho Natural Areas Coordinating Committee. 10 pp.
- Caicco, S. L., and C. A. Wellner. 1983f. Research Natural Area recommendation for Menan Buttes. Unpublished report prepared for USDI Bureau of Land Management, Idaho Falls District, Idaho by Idaho Natural Areas Coordinating Committee. 10 pp.
- Caicco, S. L., and C. A. Wellner. 1983g. Research Natural Area recommendation for Middle Canyon Alluvial Fan. Unpublished report prepared for USDI Bureau of Land Management, Idaho Falls District, Idaho by Idaho Natural Areas Coordinating Committee.
- Caicco, S. L., and C. A. Wellner. 1983h. Research Natural Area recommendation for Brass Cap Kipuka. Unpublished report prepared for USDI Bureau of Land Management, Shoshone District, Idaho by Idaho Natural Areas Coordinating Committee. 15 pp.
- Caicco, S. L., and C. A. Wellner. 1983i. Research Natural Area recommendation for Substation Tract. Unpublished report prepared for USDI Bureau of Land Management, Shoshone District, Idaho by Idaho Natural Areas Coordinating Committee. 11 pp.
- Caicco, S. L., and C. A. Wellner. 1983j. Research Natural Area recommendation for Big Juniper Kipuka. Unpublished report prepared for USDI Bureau of Land Management, Shoshone District, Idaho by Idaho Natural Areas Coordinating Committee.
- Caicco, S. L., and C. A. Wellner. 1983k. Research Natural Area recommendation for East Fork Salmon River Bench. Unpublished report prepared for USDI Bureau of Land Management, Salmon District, Idaho by Idaho Natural Areas Coordinating Committee. 14 pp.
- Caicco, S. L., and C. A. Wellner. 1983l. Research Natural Area recommendation for Antelope Flat. Unpublished report prepared for USDI, Bureau of Land Management, Salmon District, Idaho by Idaho Natural Areas Coordinating Committee. 12 pp.
- Callison, J., Jr., J. D. Brotherson, and J. E. Bowns. 1985. The effects of fire on the blackbrush (*Coleogyne ramosissima*) community of southwestern Utah. *Journal of Range Management* 38(6):535-538.
- Campbell, C. J., and W. A. Dick-Peddie. 1964. Comparison of phreatophyte communities on the Rio Grande in New Mexico. *Ecology* 45:492-501.
- Campbell, C. J., and W. Green. 1968. Perpetual succession of stream-channel vegetation in a semiarid region. *Journal of the Arizona Academy of Science* 5(2):86-98.
- Campbell, V. O. 1977. Certain edaphic and biotic factors affecting vegetation in the shadscale community of the Kaiparowitz area. Unpublished thesis, Brigham Young University, Provo, UT. 59 pp.
- Canalossi, J. 1979. Biological evaluation for Coal Creek and Crescent damsites, Colorado. Unpublished report prepared for USDI Bureau of Reclamation, Denver, CO.
- Carey, J. H. 1995. *Krascheninnikovia lanata*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 19 June 2011).
- Carmichael, R. S., O. D. Knipe, C. P. Pase, and W. W. Brady. 1978. Arizona chaparral: Plant associations and ecology. Research Paper RM-202. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 16 pp.
- Carpenter, A. T. 2005. Element stewardship abstract for *Tamarix* spp. [online]. The Nature Conservancy, Arlington, VA.
- Carr, W. R. 1991. Status report on *Cyperus onerosus*. Report prepared for U.S. Fish and Wildlife Service, Albuquerque, NM.
- Carr, W. R. 2004. An annotated list of the G3/T3 and rarer plant taxa of Texas. Texas Conservation Data Center, The Nature Conservancy of Texas, Austin.
- Carsey, K., D. Cooper, K. Decker, D. Culver, and G. Kittel. 2003b. Statewide wetlands classification and characterization: Wetland plant associations of Colorado. Prepared for Colorado Department of Natural Resources, Denver, by Colorado Natural Heritage Program, College of Natural Resources, Colorado State University, Fort Collins. 79 pp. [http://www.cnhp.colostate.edu/documents/2003/wetland_classification_final_report_2003.pdf]
- Carsey, K., G. Kittel, K. Decker, D. J. Cooper, and D. Culver. 2003a. Field guide to the wetland and riparian plant associations of Colorado. Colorado Natural Heritage Program, Fort Collins, CO.
- Castle, E. S. 1954. The vegetation and its relationship to the dune soils of Kane County, Utah. Unpublished thesis, Brigham Young University, Provo, UT.
- Cedar Creek Associates, Inc. 1987. Draft vegetation in formation for the Alton Coal Mining Project. Volume 6, Chapter 3, Appendix 3.6-B, pages 1-41 in: Mining & Reclamation Plan for Alton Mine, Utah International, Inc., Utah Division of Oil, Gas & Mining ACT/025/003.
- Chadwick, H. W., and P. D. Dalke. 1965. Plant succession on dune sands in Fremont County, Idaho. *Ecology* 46:765-780.

- Chambers, B. A., B. J. Naylor, J. Nieppola, B. Merchant, and P. Uhlig. 1997. Field guide to forest ecosystems of central Ontario. Southcentral Science Section (SCSS) Field Guide FG-01, Ontario Ministry of Natural Resources, North Bay, Ontario, Canada. 200 pp.
- Chappell, C., and J. Christy. 2004. Willamette Valley-Puget Trough-Georgia Basin Ecoregion Terrestrial Ecological System EO Specs and EO Rank Specs. Appendix 11 in: J. Floberg, M. Goering, G. Wilhere, C. MacDonald, C. Chappell, C. Rumsey, Z. Ferdana, A. Holt, P. Skidmore, T. Horsman, E. Alverson, C. Tanner, M. Bryer, P. Lachetti, A. Harcombe, B. McDonald, T. Cook, M. Summers, and D. Rolph. Willamette Valley-Puget Trough-Georgia Basin Ecoregional Assessment, Volume One: Report prepared by The Nature Conservancy with support from The Nature Conservancy of Canada, Washington Department of Fish and Wildlife, Washington Department of Natural Resources (Natural Heritage and Nearshore Habitat programs), Oregon State Natural Heritage Information Center and the British Columbia Conservation Data Centre.
- Chappell, C., R. Crawford, J. Kagan, and P. J. Doran. 1997. A vegetation, land use, and habitat classification system for the terrestrial and aquatic ecosystems of Oregon and Washington. Unpublished report prepared for Wildlife habitat and species associations within Oregon and Washington landscapes: Building a common understanding for management. Prepared by Washington and Oregon Natural Heritage Programs, Olympia, WA, and Portland, OR. 177 pp.
- Charlton, D. 2000a. Lowland plant communities and associations at Pleistocene Lake Thompson Playa, Edwards Air Force Base, California. Unpublished report. U.S. Army Corps of Engineers, Engineer Research and Development Center, Edwards Air Force Base, CA.
- Charlton, D. 2000b. Report on the vegetation of the Superior Valley area of the proposed Fort Irwin expansion. Unpublished report shared by the author in 2003. U.S. Army Corps of Engineers, Engineer Research and Development Center, Edwards Air Force Base, CA.
- Cheatham, N. H., and J. R. Haller. 1975. An annotated list of California habitat types. Unpublished report. University of California, Natural Land and Water Reserves System.
- Cheng, S. 2004. Forest Service research natural areas in California. General Technical Paper PSW-GTR-188. USDA Forest Service, Pacific Southwest Research Station, Albany, CA.
- Christensen, E. M. 1949. The ecology and geographic distribution of oak (*Quercus gambelii*) in Utah. Unpublished thesis, University of Utah, Salt Lake City. 70 pp.
- Christensen, E. M. 1955. Ecological notes on the mountain brush in Utah. Proceedings of the Utah Academy of Science, Arts, and Letters 32:107-111.
- Christensen, E. M. 1963. The foothill bunchgrass vegetation of central Utah. Ecology 44(1):156-158.
- Christy, J. A. 1991. Draft classification of native wetland plant communities in Oregon. Unpublished report prepared for the Oregon Natural Heritage Program, Portland, OR. 69 pp.
- Christy, J. A. 2012. Spray zones. Oregon Wetlands Explorer, Natural Resources Digital Library. Oregon Biodiversity Information Center. [<http://oregonexplorer.info/wetlands/SprayZones>]
- Christy, S. 1973. An analysis of the woody vegetation on the South Platte River flood plain in northeastern Colorado. Unpublished thesis, University of Northern Colorado, Greeley. 82 pp.
- Clagg, H. B. 1975. Fire ecology in high-elevation forests in Colorado. Unpublished M.S. thesis, Colorado State University, Fort Collins. 137 pp.
- Clary, W. P. 1978. Arizona fescue mountain rangelands. Pages 205-207 in: D. N. Hyder, editor. Proceedings of the First International Rangeland Congress, Denver, CO, 14-18 August 1978. Society for Range Management, Denver.
- Clary, W. P. 1992. Ecology and values of Gambel oak woodlands. Pages 87-95 in: Ecology and management of oak and associated woodlands. General Technical Report RM-218. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 224 pp.
- Clary, W. P., M. B. Baker, Jr., P. F. O'Connell, T. N. Johnsen, Jr., and R. E. Campbell. 1974. Effects of pinyon-juniper removal on natural resource products and uses in Arizona. Research Paper RM-128. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 28 pp.
- Clausnitzer, R. R., and B. A. Zamora. 1987. Forest habitat types of the Colville Indian Reservation. Unpublished report prepared for the Department of Forest and Range Management, Washington State University, Pullman. 110 pp.
- Clements, F. E. 1904. Formation and succession herbaria. University of Nebraska, University Studies IV(4):329-355.
- CNPS [California Native Plant Society]. 2005. Unpublished transect and relevé survey data collected from 1991-2005. California Native Plant Society, Sacramento, CA.
- CNPS [California Native Plant Society]. 2015-2017. A manual of California vegetation [online]. California Native Plant Society, Sacramento, CA. [<http://vegetation.cnps.org/>].
- Coffin, D. P., W. K. Lauenroth, and I. C. Burke. 1996. Recovery of vegetation in a semiarid grassland 53 years after disturbance. Ecological Applications 6:538-555.
- Cogan, D., M. Reid, K. Schulz, and M. Pucherelli. 2004. Zion National Park, Utah 1999-2003. Vegetation Mapping Project. Technical Memorandum 8260-03-01. Remote Sensing and GIS Group Technical Service Center, Bureau of Reclamation, Denver, CO. Appendix F: Vegetation Association Descriptions for Zion.
- Coles, J., A. Tendick, G. Manis, A. Wight, G. Wakefield, J. Von Loh, and A. Evenden. 2009a. Vegetation classification and mapping project report, Arches National Park. Natural Resource Technical Report NPS/NCPN/NRTR--2009/253. National Park Service, Fort Collins, CO. 544 pp.
- Comer, P. (editor), L. Allen, S. Cooper, D. Faber-Langendoen, and G. Jones. 1999. Selected shrubland and grassland communities of the northern Great Plains. Report to the Nebraska National Forest. The Nature Conservancy.

- Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, C. Nordman, M. Pyne, M. Reid, M. Russo, K. Schulz, K. Snow, J. Teague, and R. White. 2003-present. Ecological systems of the United States: A working classification of U.S. terrestrial systems. NatureServe, Arlington, VA.
- Comer, P., editor. 1999. Selected shrubland and grassland communities of the Northern Great Plains. A report to the Nebraska National Forest from The Nature Conservancy, Western Conservation Science Department, Boulder CO. 119 pp.
- Conard, S. G., and S. R. Radosevich. 1982. Post-fire succession in white fir (*Abies concolor*) vegetation of the northern Sierra Nevada. *Madrono* 29(1):42-56.
- Cooper, D. J. 1986a. Ecological studies of wetland vegetation, Cross Creek Valley, Holy Cross Wilderness Area, Sawatch Range, Colorado. Holy Cross Wilderness Defense Fund, Technical Report No. 2. 24 pp.
- Cooper, D. J. 1986b. Community structure and classification of Rocky Mountain wetland ecosystems. Pages 66-147 in: J. T. Windell, et al. An ecological characterization of Rocky Mountain montane and subalpine wetlands. USDI Fish & Wildlife Service Biological Report 86(11). 298 pp.
- Cooper, D. J. 1988. Advanced identification of wetlands in the City of Boulder Comprehensive Planning Area. Unpublished technical report prepared for U.S. Environmental Protection Agency, Region VIII and the City of Boulder, CO.
- Cooper, D. J. No date. Ecological studies of wetlands in South Park, Colorado: Classification, functional analysis, rare species inventory, and the effects of removing irrigation. Unpublished report prepared for Park County and the U.S. Environmental Protection Agency Region VIII.
- Cooper, D. J., and C. Severn. 1992. Wetlands of the San Luis Valley, Colorado: An ecological study and analysis of the hydrologic regime, soil chemistry, vegetation and the potential effects of a water table drawdown. Report submitted to the State of Colorado Division of Wildlife, the USDI Fish & Wildlife Service and the Rio Grande Water Conservation District.
- Cooper, D. J., and J. S. Sanderson. 1997. A montane *Kobresia myosuroides* fen community type in the southern Rocky Mountains of Colorado, U.S.A. *Arctic and Alpine Research*, 29(3):300-303.
- Cooper, D. J., and T. R. Cottrell. 1990. Classification of riparian vegetation in the northern Colorado Front Range. Unpublished report prepared for The Nature Conservancy, Colorado Field Office, Boulder. 115 pp.
- Cooper, S. V. 1975. Forest habitat types of northwestern Wyoming and contiguous portion of Montana and Idaho. Unpublished dissertation, Washington State University, Pullman. 190 pp.
- Cooper, S. V., and B. L. Heidel. 1997. Population status and ecology of trembling aspen and black cottonwood communities on the Blackfeet Indian Reservation. Prepared for the Blackfeet Nation-Fish and Wildlife Department and the USDI Fish & Wildlife Service by Montana Natural Heritage Program, Helena, MT.
- Cooper, S. V., C. Jean, and B. L. Heidel. 1999. Plant associations and related botanical inventory of the Beaverhead Mountains Section, Montana. Unpublished report to the Bureau of Land Management. Montana Natural Heritage Program, Helena. 235 pp.
- Cooper, S. V., K. E. Neiman, R. Steele, and D. W. Roberts. 1987. Forest habitat types of northern Idaho: A second approximation. General Technical Report INT-236. USDA Forest Service, Intermountain Research Station, Ogden, UT. 135 pp. [reprinted in 1991]
- Cooper, S. V., P. Lesica, and D. Page-Dumroese. 1997. Plant community classification for alpine vegetation on Beaverhead National Forest, Montana. Report INT-GTR-362. USDA Forest Service, Intermountain Research Station, Ogden, UT. 61 pp.
- Cooper, S. V., P. Lesica, R. L. DeVelice, and T. McGarvey. 1995. Classification of southwestern Montana plant communities with emphasis on those of Dillon Resource Area, Bureau of Land Management. Montana Natural Heritage Program, Helena, MT. 154 pp.
- Cooper, S., and R. Pfister. 1981. Forest habitat types of the Blackfeet Indian Reservation. Review Draft, 5/21/81, for Bureau of Indian Affairs, Wind River Agency, Fort Washakie, WY.
- Cope, A. B. 1992b. *Juniperus californica*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 29 July 2011).
- Copeland, W. N. 1978. Botanical survey of Eight Dollar Mountain, May 6-9, 1978. Oregon Natural Heritage Data Base, Portland, OR.
- Copeland, W. N. 1979. Harney Lake RNA Guidebook, Supplement #9. USDA Forest Service Experiment Station, Portland, OR.
- Copeland, W. N. 1980a. The Lawrence Memorial Grassland Preserve, a biophysical inventory with management recommendations. June 1980. Unpublished report prepared by The Nature Conservancy Field Office, Portland, Oregon. 161 pp.
- Copeland, W. N., and S. E. Greene. 1982. Stinking Lake Research Natural Area. Supplement #12 to Franklin, J. F., F. C. Hall, C. T. Dyrness and C. Maser. 1972. Federal research natural areas in Oregon and Washington: A guidebook for scientists and educators. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR.
- Costello, D. F. 1944b. Important species of the major forage types in Colorado and Wyoming. *Ecological Monographs* 14:107-134.
- Cotter-Ferguson Project. No date. Application No. 490, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.
- Crawford, R. C. 2001. Initial riparian and wetland classification and characterization of the Columbia Basin in Washington. Prepared for Environmental Protection Agency and Bureau of Land Management, Spokane District. Washington Natural Heritage Program, Washington Department of Natural Resources, Olympia. 83 pp.
- Cronquist, A., A. H. Holmgren, N. H. Holmgren, and J. A. Reveal. 1972. Intermountain flora. Volume 1. Hafner Publishing Co., Inc., NY. 269 pp.
- Cronquist, A., A. H. Holmgren, N. H. Holmgren, J. L. Reveal, and P. K. Holmgren. 1977. Intermountain flora: Vascular plants of the Intermountain West, U.S.A. Volume 6: The Monocotyledons. Columbia University Press, New York. 584 pp.
- Cronquist, A., N. H. Holmgren, and P. K. Holmgren. 1997. Intermountain flora: Vascular plants of the Intermountain West, USA. Volume 3, Part A, subclass Rosidae (except Fabeles). New York Botanical Garden, Bronx, NY. 446 pp.

- Cross, A. F. 1991. Vegetation of two southeastern Arizona desert marshes. *Madrono* 38(3):185-194.
- Crouch, G. L. 1961a. Wildlife populations and habitat conditions on grazed and ungrazed bottomlands in Logan County, Colorado. Unpublished thesis, Colorado State University, Fort Collins.
- Crouch, G. L. 1961b. Inventory and analysis of wildlife populations and habitat, South Platte River Valley. Final report, Federal Aid in Wildlife Restoration, Project W-104-R-1-2, Colorado Game and Fish Department. 68 pp.
- Crouch, G. L. 1978. Effects of protection from livestock grazing on a bottomland wildlife habitat in northeastern Colorado. Pages 118-125 in: *Lowland river and stream habitat in Colorado: A symposium*. Greeley, CO. 4-5 October 1978.
- Crouch, G. L. 1979a. Long-term changes in cottonwoods on a grazed and an ungrazed plains bottomland in northeastern Colorado. Research Note RM-370. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 4 pp.
- Crouch, G. L. 1979b. Changes in the vegetation complex of a cottonwood ecosystem on the South Platte River. Pages 19-22 in: *Riparian and wetland habitats of the Great Plains: Proceedings of the 31st annual meeting*. Great Plains Agricultural Council Publication 91. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
- Crowe, E. A., and R. R. Clausnitzer. 1997. Mid-montane wetland plant associations of the Malheur, Umatilla, and Wallowa-Whitman national forests. Technical Paper R6-NR-ECOL-TP-22-97. USDA Forest Service, Pacific Northwest Region, Portland, OR.
- Crowe, E. A., B. L. Kovalchik, and M. J. Kerr. 2004. Riparian and wetland vegetation of central and eastern Oregon. Oregon Natural Heritage Information Center, Institute for Natural Resources, Oregon State University, Portland. 473 pp. [<http://oregonstate.edu/ornhic/publications.html>]
- Culver, D. R., M. A. March, S. M. Kettler, and C. A. Pague. 1996. Natural Heritage Inventory of significant animals and plants and classification of riparian plant associations: Timpas Grazing District and Kim Grazing Association. Report prepared for USDA Forest Service, Pike-San Isabel National Forest, La Junta, CO, by Colorado Natural Heritage Program, Fort Collins.
- Cunningham, H. 1971. Soil-vegetation relationships of a bitterbrush-sagebrush association in northwestern Colorado. Unpublished thesis, Colorado State University, Fort Collins. 94 pp.
- Current, F. B. 1984. The distribution and description of the vegetation of Battle Mountain as explained by abiotic factors. Unpublished dissertation, University of Wyoming, Laramie.
- Currie, P. O. 1975. Grazing management of ponderosa pine - bunchgrass ranges of the central Rocky Mountains: The status of our knowledge. Research Paper RM-159. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 24 pp.
- Czarapata, E. J. 2005. Crack Willow *Salix fragilis* L. Pages 94-96 in: *Invasive plants of the Upper Midwest, an illustrated guide to their identification and control*. Produced by the USDA Forest Service, Forest Health Staff, Newtown Square, PA. [http://www.na.fs.fed.us/fhp/invasive_plants] [http://www.na.fs.fed.us/fhp/invasive_plants/weeds/crack-willow.pdf]
- Dale, E. E., and P. M. Kuroda. 1979. Vegetation map and natural areas survey. Pages 77-82 of unspecified report [incomplete citation]. Includes USDI National Park Service memo and tables.
- Dalen, R. S., and W. R. Snyder. 1987. Economic and social aspects of pinyon-juniper treatment - then and now. Pages 343-350 in: R. L. Everett, editor. *Proceedings - Pinyon-Juniper Conference*, Reno, NV, 13-16 January 1986. General Technical Report INT-215. USDA Forest Service.
- Daniels, F. P. 1911. The flora of Boulder, Colorado and vicinity. University of Missouri Studies, Science Series II(2):8-48.
- Dastrup, B. C. 1963. Vegetational changes of the Uinta Basin since settlement. Unpublished thesis, Brigham Young University, Provo, UT. 118 pp.
- Daubenmire, R. 1952. Forest vegetation of northern Idaho and adjacent Washington, and its bearing on concepts of vegetation classification. *Ecological Monographs* 22(4):301-330.
- Daubenmire, R. 1975. Floristic plant geography of eastern Washington and northern Idaho. *Journal of Biogeography* 2:1-18.
- Daubenmire, R. F. 1970. Steppe vegetation of Washington. Washington State University Agricultural Experiment Station Technical Bulletin No. 62. 131 pp.
- Daubenmire, R. F. 1992. Palouse prairie. Pages 297-312 in: R. T. Coupland, editor. *Natural grasslands introduction and Western Hemisphere. Ecosystems of the world, Volume 8A*. Elsevier Publishing Company, Amsterdam.
- Daubenmire, R. F., and J. B. Daubenmire. 1968. Forest vegetation of eastern Washington and northern Idaho. Washington State University Agricultural Experiment Station Technical Bulletin No. 60. 104 pp.
- Day, T. A. 1985. Plant association and soil factors in primary succession on cinder cones in Idaho. Unpublished thesis, University of Idaho, Moscow. 62 pp.
- Day, T. A., and R. G. Wright. 1985. The vegetation types of Craters of the Moon National Monument. *Forestry, Wildlife, and Range Experiment Station Bulletin No. 38*. University of Idaho, Moscow. 6 pp.
- Dealy, J. E. 1971. Habitat characteristics of the Silver Lake mule deer range. Research Paper PNW-125. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR. 99 pp.
- Dealy, J. E. 1975. Ecology of curl-leaf mahogany (*Cercocarpus ledifolius* Nutt.) in Oregon and adjacent areas. Unpublished dissertation, Oregon State University, Corvallis. 168 pp.
- Dealy, J. E. 1978. Autecology of curlleaf mountain mahogany (*Cercocarpus ledifolius*). Pages 398-400 in: *Proceedings of the First International Rangeland Congress*. Society of Range Management, Denver, CO.
- DeBano, L. F. 1999. Chaparral shrublands in the southwestern United States. Chapter 7. Pages 83-94 in: P. F. Ffolliott and A. Ortega-Rubio, editors. *Ecology and Management of Forests, Woodlands, and Shrublands in Dryland Regions of the United States and Mexico: Perspectives for the 21st Century*. Co-edition number 1. University of Arizona-Centro de Investigacione.

- DeByle, N. V. 1985. Managing wildlife habitat with fire in the aspen ecosystem. Pages 73-82 in: Fire's effects on wildlife habitat-Symposium proceedings. General Technical Report INT-186. USDA Forest Service, Intermountain Research Station, Ogden, UT.
- DeByle, N. V., and R. P. Winokur, editors. 1985. Aspen: Ecology and management in the western United States. General Technical Report RM-119. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 283 pp.
- Degenhardt, W. G., C. W. Painter, and A. H. Price. 1996. Amphibians and reptiles of New Mexico. University of New Mexico Press, Albuquerque. xix + 431 pp.
- DeLeuw, Cather & Company. 1977. Vegetation sampling (Glenwood Canyon). Unpublished report prepared by DeLeuw, Cather & Company, Consulting Engineers and Planners, Chicago, Illinois for Colorado Division of Highways, Glenwood Springs, CO.
- DeLong, C. 2003. A field guide to site identification and interpretation for the southeast portion of the Prince George Forest Region. Land Manage. Handbook No. 51. Province of British Columbia, Research Branch, Ministry of Forestry, Victoria, BC. [<http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh51.htm>]
- DeLong, C., A. MacKinnon, and L. Jang. 1990. A field guide for identification and interpretation of ecosystems of the northeast portion of the Prince George Forest Region. Land Management Handbook No. 22. Province of British Columbia, Research Branch, Ministry of Forests, Victoria, BC.
- DeLong, C., D. Tanner, and M. J. Jull. 1993. A field guide for site identification and interpretation for the southwest portion of the Prince George Forest Region. Land Management Handbook No. 24. British Columbia Ministry of Forests Research Branch, Victoria, British Columbia.
- DePuit, E. J. 1986. The role of crested wheatgrass in reclamation of drastically disturbed lands. Pages 323-330 in: K. D. Johnson, editor. Crested wheatgrass: Its values, problems and myths. Symposium proceedings; 1983 October 3-7; Logan, UT. Utah State University, Logan.
- Derby, J. A., and R. C. Wilson. 1978. Floristics of pavement plains of the San Bernardino Mountains. *Aliso* 9:374-378.
- Derby, J. A., and R. C. Wilson. 1979. Phytosociology of pavement plains of the San Bernardino Mountains. *Aliso* 9:463-474.
- Despain, D. G. 1973a. Vegetation of the Big Horn Mountains, Wyoming, in relation to substrate and climate. *Ecological Monographs* 43(3):329-354.
- DeVelice, R. L. 1992. Classification of the plant communities of Beaverhead, Silver Bow, and Madison counties, Montana. Volume I (text). Prepared for the Montana Natural Heritage Program, Helena, MT. 35 pp.
- DeVelice, R. L., and J. A. Ludwig. 1983a. Climax forest series of northern New Mexico and southern Colorado. Pages 45-53 in: Proceedings of the Workshop on Southwestern Habitat Types, 6-8 April 1983, Albuquerque, NM. USDA Forest Service, Southwest Region, Albuquerque, NM.
- DeVelice, R. L., and P. Lesica. 1993. Plant community classification for vegetation on BLM lands, Pryor Mountains, Carbon County, Montana. Unpublished report by Montana Natural Heritage Program, Helena, MT. 78 pp.
- DeVelice, R. L., J. A. Ludwig, W. H. Moir, and F. Ronco, Jr. 1986. A classification of forest habitat types of northern New Mexico and southern Colorado. General Technical Report RM-131. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 59 pp.
- DeVelice, R. L., J. Lichthardt, and P. S. Bourgeron. 1991. A preliminary classification of the plant communities of northeastern Montana. Prepared for the Montana Natural Heritage Program. Helena, MT. 144 pp.
- DeVelice, R. L., S. V. Cooper, J. T. McGarvey, J. Lichthardt, and P. S. Bourgeron. 1995. Plant communities of northeastern Montana: A first approximation. Montana Natural Heritage Program, Helena, MT. 116 pp.
- Diamond, D. D. 1993. Classification of the plant communities of Texas (series level). Unpublished document. Texas Natural Heritage Program, Austin. 25 pp.
- Diamond, D., B. Amos, T. Cook, R. Edwards, W. Elliot, R. Evans, and K. Kennedy. 1992. Endangered, threatened, and watchlist of natural communities of Texas. Texas Organization for Endangered Species. Austin, TX. 14 pp.
- Dick-Peddie, W. A. 1993. New Mexico vegetation: Past, present, and future. University of New Mexico Press, Albuquerque. 244 pp.
- Dick-Peddie, W. A., J. K. Meents, and R. Spellenberg. 1984. Vegetation resource analysis for the Velarde Community Ditch Project, Rio Arriba and Santa Fe counties, New Mexico. Unpublished final report prepared for the USDI Bureau of Reclamation, Southwestern Region, Amarillo, TX. 251 pp.
- Dillinger, K. C. 1970. Evaluation of mule deer habitat in Mesa Verde National Park. Unpublished thesis, Colorado State University, Fort Collins. 40 pp.
- Dillman, A. C. 1946. The beginnings of crested wheat grass in North America. *Journal of the American Society of Agronomy* 38:237-250.
- Dilts, T., and P. Weisberg. 2010. Death Valley springs monitoring dataset. Great Basin Landscape Ecology Lab, University of Nevada Reno, NV.
- DiTomaso, J. M., and E. A. Healy. 2007. Weeds of California and other western States. Two volumes. Publication 3488. University of California, Agriculture and Natural Resources, Oakland, CA. 1808 pp.
- DiTomaso, J. M., E. Healy, C. Bell, J. Drewitz, and A. Tschohl. 1999. Pampas grass and jubata grass threaten California coastal habitats. Leaflet 99-1, University of California Extension, WeedRIC, and California Exotic Pest Plant Council, Davis, CA.
- Dodd, J. D., and R. T. Coupland. 1966. Vegetation of saline areas in Saskatchewan. *Ecology* 47(6):958-968.
- Doescher, P. S., R. F. Miller, S. R. Swanson, and A. H. Winward. 1986. Identification of the *Artemisia tridentata* ssp. *wyomingensis*/*Festuca idahoensis* habitat type in eastern Oregon. *Northwest Science* 60(1):55-60.
- Donart, G. B., D. D. Sylvester, and W. C. Hickey. 1978b. Potential natural vegetation-New Mexico. New Mexico Interagency Range Commission Report 11.

- Donart, G. B., D. Sylvester, and W. Hickey. 1978a. A vegetation classification system for New Mexico, USA. Pages 488-490 in: Rangeland Congress, Denver, CO, 14-18 August 1978. Society for Range Management, Denver.
- Dorn, R. D. 1984. Vascular plants of Montana. Mountain West Publishing, Cheyenne, WY. 276 pp.
- Dorn, R. D. 1997. Rocky Mountain region willow identification field guide. Renewable Resources R2-RR-97-01. USDA Forest Service, Rocky Mountain Region, Denver, CO. 107 pp.
- Douglas, G. W. 1971. An ecological survey of potential natural areas in the North Cascades National Park complex. Unpublished report prepared for Intercampus Education and Science Preserves Commission, State of Washington. 137 pp.
- Driese, K. L., W. A. Reiners, E. H. Merrill, and K. G. Gerow. 1997. A digital land cover map of Wyoming, USA: A tool for vegetation analysis. *Journal of Vegetation Science* 8:133-146.
- Driscoll, R. S. 1964a. Vegetation-soil units in the central Oregon juniper zone. Research Paper PNW-19. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR. 60 pp.
- Durkin, P., M. Bradley, E. Muldavin, and P. Mehlhop. 1994b. A riparian/wetland vegetation community classification of New Mexico: Pecos River Basin. Unpublished report for New Mexico Environment Department Surface Water Quality Bureau.
- Durkin, P., M. Bradley, E. Muldavin, and P. Mehlhop. 1995a. Riparian/wetland vegetation community classification of Rio Grande: A classification and site evaluation. Unpublished report for New Mexico Environment Department Surface Water Quality Bureau. New Mexico Natural Heritage Program, Albuquerque.
- Dwyer, D. D., and R. D. Pieper. 1967. Fire effects on blue gramma-pinyon-juniper rangeland in New Mexico. *Journal of Range Management* 20:359-362.
- Earth Resource Technology. No date. Vanguard II Mine Application No. 334-T2, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.
- Easterday, J. C., and M. S. Mamone. 1980. Vegetation of Warner Valley. Pages 3-66 in: C. Gilman, project director. Analysis of the aquatic habitats of Warner Valley with relation to land use patterns. Final report. National Science Foundation Grant SPI-78-03490. Department of Fisheries and Wildlife, Oregon State University, Corvallis. 175 pp.
- Eckert, R. E., A. T. Bleak, J. H. Robertson, and E. A. Naphan. 1961. Responses of *Agropyron cristatum*, *A. desertorum*, and other range grasses to three different sites in eastern Nevada. *Ecology* 42:775-783.
- Ecosystems Working Group. 1998. Standards for broad terrestrial ecosystem classification and mapping for British Columbia. Prepared by the Ecosystems Working Group, Terrestrial Ecosystem Task Force, Resources Inventory Committee, for the Province of British Columbia. 174 pp. plus appendices. [<http://srmwww.gov.bc.ca/risc/pubs/teecolo/tem/indextem.htm>]
- Eddleman, L. E. 1967. A study of phyto-edaphic relationships in alpine tundra of northern Colorado. Unpublished dissertation, Colorado State University, Fort Collins. 148 pp.
- Eddleman, L. E., and R. Jandl. 1994. Great Basin National Park vegetation analysis. Technical Report NPS/PNROSU/NRTR-94/02. National Park Service, Pacific Northwest Region, Seattle, WA. 110 pp.
- Eggler, W. A. 1941. Primary succession on volcanic deposits in southern Idaho. *Ecological Monographs* 11(3):278-298.
- El-Hage, A., and D. W. Moulton. 1998. Area study: Parts of the Trans-Pecos, Texas. Evaluation of selected natural resources in parts of Loving, Pecos, Reeves, Ward, and Winkler counties, Texas. Texas Parks and Wildlife, Resource Protection Division: Water Resources Team, Austin.
- Elias, T. S. 1987. The complete trees of North America: A field guide and natural history. Gramercy Publishing Company, New York. 948 pp.
- Ellis, S. L., T. Shoemaker, and R. Sanz. 1979. Inventories of plants, birds, mammals, reptiles, and amphibians of the Unaweep Canyon Springs, Mesa County, Colorado. Unpublished report prepared for Colorado Natural Areas Program, Department of Natural Resources, Denver.
- Ellis, S., and P. Hackney. 1981. Vegetation baseline report: Clear Creek property. Unpublished report prepared for Chevron Shale Oil Co., Denver, CO, by Environmental Research and Technology Inc., Fort Collins, CO.
- Ellison, L. 1954. Subalpine vegetation of the Wasatch Plateau, Utah. *Ecological Monographs* 24(2):89-104.
- Empire Engineering and Land Surveying. 1986. Vegetation resources, Volume 2, Chapter 9, Sections 9.0-9.3, pages 9-1 through 9-19 and 9-38 through 9-41 in: Mining and Reclamation Plan for Black Jack Mine Number 1. Report for New Tech Mining Corporation. Utah Division of Oil, Gas, and Mining Act/019/004. Salt Lake City, UT.
- Englund, S. R. 2004. *Bromus tectorum* impacts soil carbon storage in semiarid grasslands of Canyonlands National Park. M.S. thesis, University of Utah, Salt Lake City.
- ENTRIX, Inc. 2007. Landscape analysis [of the Spring Mountains National Recreational Area]. Chapter 3 & 4: Current & Reference conditions. Project No. 3138801. An unpublished report to the Humboldt-Toiyabe National Forest, Las Vegas, NV.
- Erdman, J. A. 1962. Ecology of the pinyon-juniper woodland of Wetherill Mesa, Mesa Verde National Park, Colorado. Unpublished thesis, University of Colorado, Boulder. 109 pp.
- Erdman, J. A. 1969. Pinyon-juniper succession after fires on residual soils of the Mesa Verde, Colorado. Unpublished dissertation, University of Colorado, Boulder. 81 pp.
- Erdman, J. A. 1970. Pinyon-juniper succession after natural fires on residual soils of Mesa Verde, Colorado. *Brigham Young University Science Bulletin, Biological Series* 11(2):1-26.
- Erdman, J. A., C. L. Douglas, and J. W. Marr. 1969. Wetherill Mesa Studies, environment of Mesa Verde, Colorado. USDI National Park Service. Archeological Research Series 7-B. Washington, DC. 72 pp.
- Ernst, C. H., and E. M. Ernst. 2003. Snakes of the United States and Canada. Smithsonian Books, Washington, DC.
- Evans, F. R. 1936. A comparative study of the vegetation of a grazed and an ungrazed canyon of the Wasatch Range. Unpublished thesis, University of Utah, Salt Lake City.

- Evans, P. A. 1926. An ecological study in Utah. *Botanical Gazette* 82:253-285.
- Evans, R. D., R. Rimer, L. Sperry, and J. Belnap. 2001. Exotic plant invasion alters nitrogen dynamics in an arid grassland. *Ecological Applications* 11(5):1301-1310.
- Evans, S. 1989a. Riparian survey of Washington's Columbia Basin. Unpublished report prepared for The Nature Conservancy Washington Natural Heritage Program, Olympia, Washington.
- Evenden, A. G. 1990. Ecology and distribution of riparian vegetation in the Trout Creek Mountains of southeastern Oregon. Ph.D. dissertation, Oregon State University, Corvallis. 156 pp.
- Evens, J. M. 2000. Water course vegetation on granite and calcareous substrates in the eastern Mojave Desert, California. Master's thesis, Humboldt State University, Arcata, CA.
- Evens, J. M., and E. Kentner. 2006. Classification of vegetation associations from the Mount Tamalpais Watershed, Nicasio Reservoir, and Soulajule Reservoir in Marin County, California. Report for the Marin Municipal Water District. California Native Plant Society, Sacramento.
- Evens, J. M., and S. Hartman. 2007. Vegetation survey and classification for the Northern and Eastern Colorado Desert Coordinated Management Plan (NECO). CNPS Vegetation Program, Sacramento, CA.
- Evens, J. M., D. Roach-McIntosh, and D. Stout. 2012. Vegetation descriptions for Joshua Tree National Park. Unpublished report submitted to USDI, National Park Service, Mojave Desert Inventory and Monitoring Network. California Native Plant Society, Sacramento, CA.
- Evens, J. M., K. Sikes, D. Hastings, and J. Ratchford. 2014. Vegetation alliance descriptions for Lake Mead National Recreation Area, Death Valley National Park and Mojave National Preserve. Unpublished report submitted to USDI National Park Service, Mojave Desert Network Inventory and Monitoring Program. California Native Plant Society, Sacramento, CA. [http://science.nature.nps.gov/im/units/MOJN/rpts_pubs/rpts_pubs_main.cfm]
- Evens, J. M., S. San, and J. Taylor. 2004. Vegetation classification and mapping of Peoria Wildlife Area, south of New Melones Lake, Tuolumne County, California. Prepared by California Native Plant Society, Sacramento, CA, in collaboration with J. Menke of Aerial Information Systems, Redlands, CA. 175 pp.
- Evens, J., A. Klein, J. Taylor, T. Keeler-Wolf, and D. Hickson, principal investigators. 2006. Vegetation classification, descriptions, and mapping of the Clear Creek Management Area, Joaquin Ridge, Monocline Ridge, and Environs in San Benito and western Fresno counties, California. Final report prepared by California Native Plant Society and California Department of Fish and Game, Sacramento, CA. 273 pp.
- Evens, J., and S. San. 2004. Vegetation associations of a serpentine area: Coyote Ridge, Santa Clara County, California. Unpublished report. California Native Plant Society, Sacramento, CA.
- Evens, J., and S. San. 2006. Vegetation alliances of the San Dieguito River Park region, San Diego County, California. Final report (August 2005) Version 2 (revised May 2006). Prepared by California Native Plant Society in cooperation with the California Natural Heritage Program of the California Department of Fish and Game and San Diego Chapter of the California Native Plant Society. Sacramento, CA. 271 pp.
- Everett, R. L., compiler. 1986. Proceedings pinyon-juniper conference: 1986 January 13-16, Reno, NV. General Technical Report INT-215. USDA Forest Service, Intermountain Research Station, Ogden, UT. 581 pp.
- Eyre, F. H., editor. 1980. Forest cover types of the United States and Canada. Society of American Foresters, Washington, DC. 148 pp.
- Faber-Langendoen, D., and Midwest State Natural Heritage Program Ecologists. 1996. Terrestrial vegetation of the midwest United States. International classification of ecological communities: Terrestrial vegetation of the United States. The Nature Conservancy, Arlington, VA.
- Faber-Langendoen, D., J. Drake, M. Hall, G. Kittel, S. Menard, C. Nordman, M. Pyne, M. Reid, M. Russo, K. Schulz, L. Sneddon, K. Snow, and J. Teague. 2013-2017b. Screening alliances for induction into the U.S. National Vegetation Classification: Part 1 - Alliance concept review. NatureServe, Arlington, VA.
- Faber-Langendoen, D., J. Drake, S. Gawler, M. Hall, C. Josse, G. Kittel, S. Menard, C. Nordman, M. Pyne, M. Reid, L. Sneddon, K. Schulz, J. Teague, M. Russo, K. Snow, and P. Comer, editors. 2010-2017a. Divisions, Macrogroups and Groups for the Revised U.S. National Vegetation Classification. NatureServe, Arlington, VA. plus appendices. [in preparation]
- Faber-Langendoen, D., J. Rocchio, P. Comer, G. Kudray, L. Vance, E. Byers, M. Schafale, C. Nordman, E. Muldavin, G. Kittel, L. Sneddon, M. Pyne, and S. Menard. 2008a. Overview of Natural Heritage methodology for ecological Element Occurrence ranking based on ecological integrity assessment methods. Draft for Network review. NatureServe, Arlington, VA.
- Faden, A. O. 1977. Vegetation zonation of a Mohave Desert playa. Unpublished thesis, University of Nevada, Las Vegas.
- Fautin, R. W. 1946. Biotic communities of the Northern Desert Shrub Biome in western Utah. *Ecological Monographs* 16(4):251-310.
- FEIS [Fire Effects Information System]. 1998. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. [<http://www.fs.fed.us/database/feis/>]
- FEIS [Fire Effects Information System]. 2001. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2001, May). [<http://www.fs.fed.us/database/feis/>] (accessed 20 July 2001).
- Fenimore, R. M., Jr. 1970. Plant succession in a receding lake bed in the western Great Basin. Unpublished thesis, University of Nevada, Reno.
- Ferchau, H. A. 1973. Vegetation inventory analysis & impact study of the Parachute Creek area, Garfield County, Colorado. Part II, Volume 1, Chapter VI:1-77 in: Unpublished Colony Environmental Report for Colony Develop. Operation, Denver, prepared by Thorne Ecological Institute, Boulder.

- Ferren, W. R., and F. W. Davis. 1991. Biotic inventory and ecosystem characterization of Fish Slough in Inyo and Mono counties. Unpublished report. California Department of Fish and Game, Sacramento, CA.
- Ferren, W. R., P. L. Fiedler, and R. A. Leidy. 1996b. Wetlands of California. *Madroño* 43:105-125.
- Fish, E. B. 1966. Secondary succession on upper Kiowa Creek watershed. Unpublished thesis, Colorado State University, Fort Collins. 102 pp.
- Fisser, H. G. 1962. An ecological study of the *Artemisia tripartita* subsp. *rupicola* and related shrub communities in Wyoming. Unpublished dissertation, University of Wyoming, Laramie.
- Fisser, H. G. 1964. Range survey in Wyoming's Big Horn Basin of Wyoming. Wyoming Agricultural Experiment Station Bulletin 424.
- Fisser, H. G. 1970. Exclosure studies with transects of permanent plots, 1969 results. University of Wyoming Cooperative Research Report to the USDI Bureau of Land Management, sections I-IV. Wyoming Agricultural Experiment Station. Science Report 240. Laramie, WY. 128 pp.
- Fisser, H. G., J. R. Wight, J. R. Flesland, and L. D. Robinson. 1965. *Halogeton* research, 1964 results. University of Wyoming Cooperative Research Report to the USDI Bureau of Land Management, Sections I-VI. Wyoming Agricultural Experiment Station. Mimeographed Circular pages 1-82. University of Wyoming, Laramie.
- Fites-Kaufman, J. A., P. Rundel, N. Stephenson, and D. A. Weixelman. 2007. Montane and subalpine vegetation of the Sierra Nevada and Cascade ranges. Pages 456-501 in: M. Barbour, T. Keeler-Wolf, and A. A. Schoenherr, editors. *Terrestrial Vegetation of California*, third edition. University of California Press, Berkeley.
- Fitzgerald, J. P. 1978. Vertebrate associations in plant communities along the South Platte River in northeastern Colorado. Pages 73-88 in: W. D. Graul and J. Bissell, editors. *Lowland River and Stream Habitat in Colorado: A symposium*, Greeley, Colorado, October 4-5, 1978. Colorado Chapter of the Wildlife Society and Colorado Audubon Council.
- Fitzhugh, E. L., W. H. Moir, J. A. Ludwig, and F. Ronco, Jr. 1987. Forest habitat types in the Apache, Gila, and part of the Cibola national forests. General Technical Report RM-145. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 116 pp.
- Fleming, M. D., and P. Spencer. 2007. Kodiak Archipelago land cover classification users guide. SAIC at USGS Alaska Science Center, Anchorage, AK. 77 pp.
- Flowers, S. 1962. Vegetation of Morrow Point and Blue Mesa Reservoir basins of the upper Gunnison River, Colorado. Pages 47-102 in: A. M. Woodbury, editor. *Ecological studies of the flora and fauna of the Curecanti Reservoir Basins, western Colorado*. University of Utah, Anthropological Papers No. 59 (Upper Colo. Series No. 8).
- FNA Editorial Committee [Flora of North America Editorial Committee], editors. 1993. *Flora of North America, north of Mexico*. Volume 2. Pteridophytes and gymnosperms. Oxford University Press, New York. xvi plus 475 pp.
- FNA Editorial Committee [Flora of North America Editorial Committee], editors. 2003. *Flora of North America, north of Mexico*. Volume 4. Magnoliophyta: Caryophyllidae, part 1. Oxford University Press, New York. 559 pp.
- Forsling, C. L., and E. V. Storm. 1929. The utilization of browse forage as summer range for cattle in southwestern Utah. USDA Circular 62. Washington, DC. 29 pp.
- Fowells, H. A., compiler. 1965. *Silvics of the forest trees of the United States*. Agriculture Handbook No. 271. USDA Forest Service, Washington, DC. 762 pp.
- Francis, R. E. 1983. Sagebrush-steppe habitat types in northern Colorado: A first approximation. Pages 67-71 in: *Proceedings of the Workshop on Southwestern habitat types*. USDA Forest Service, Southwestern Region, Albuquerque, NM.
- Francis, R. E. 1986. Phyto-edaphic communities of the Upper Rio Puerco Watershed, New Mexico. Research Paper RM-272. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 73 pp.
- Francis, R. E., and E. F. Aldon. 1983. Preliminary habitat types of a semiarid grassland. Pages 62-66 in: W. H. Moir and L. Hendzel, technical coordinators. *Proceedings of the workshop on southwestern habitat types, 6-8 April 1983, Albuquerque, NM*. USDA Forest Service, Southwestern Region, Albuquerque, NM.
- Franklin, J. F. 1966. Vegetation and soils in the subalpine forests of the southern Washington Cascade Range. Ph.D. dissertation, Washington State University, Pullman. 132 pp.
- Franklin, J. F. 1988. Pacific Northwest forests. Pages 104-130 in: M. G. Barbour and W. D. Billings, editors. *North American terrestrial vegetation*. Cambridge University Press, New York.
- Franklin, J. F., and C. T. Dyrness. 1973. Natural vegetation of Oregon and Washington. General Technical Report PNW-8. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR. 417 pp.
- Freeman, C. E., and W. A. Dick-Peddie. 1970. Woody riparian vegetation in the Black and Sacramento Mountain ranges, southern New Mexico. *The Southwestern Naturalist* 15(2):145-164.
- Fritz, R. J. 1981. Alpine vegetational patterns around isolated tree islands on the eastern and western slopes of the Tenmile Range, Summit County, Colorado. Unpublished thesis, University of Colorado, Boulder, CO. 233 pp.
- Fross, D., and D. Wilken. 2006. *Ceanothus*. Timber Press, Portland, OR. 272 pp.
- Fuller, T. C. 1976. Pampas grass: Its history as a weed. *Fremontia* 4:16.
- Ganskopp, D. C. 1979. Plant communities and habitat types of the Meadow Creek Experimental Watershed. Unpublished thesis, Oregon State University, Corvallis. 162 pp.
- Gardner, J. L. 1951. Vegetation of the creosotebush area of the Rio Grande Valley in New Mexico. *Ecological Monographs* 21:379-403.
- Garrison, G. A., A. J. Bjugstad, D. A. Duncan, M. E. Lewis, and D. R. Smith. 1977. Vegetation and environmental features of forest and range ecosystems. USDA Forest Service. Agriculture Handbook 475. Washington, DC.

- Gibbens, R. P., J. M. Tromble, J. T. Hennessy, and M. Cardenas. 1983. Soil movement in mesquite dunelands and former grasslands of southern New Mexico. *Journal of Range Management* 36(2):145-148.
- Giese, T. G. 1975. The ecology of the Middle Blue River Valley, Summit County, Colorado, with an analysis of modifications due to powerline construction. Unpublished thesis, University of Colorado, Boulder. 109 pp.
- Girard, M. M., H. Goetz, and A. J. Bjugstad. 1989. Native woodland habitat types of southwestern North Dakota. Research Paper RM-281. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 36 pp.
- Girard, M., D. L. Wheeler, and S. B. Mills. 1997. Classification of riparian communities on the Bighorn National Forest. R2-RR-97-02. USDA Forest Service, Rocky Mountain Region, Sheridan, WY. 308 pp.
- Glad, J. B., R. Mishaga, and R. R. Halse. 1987. Habitat characteristics of *Sidalcea nelsoniana* Piper (Malvaceae) at Walker Flat, Yamhill County, Oregon. *Northwest Science* 61:257-263.
- Gom, L. A., and S. B. Rood. 1999. Patterns of clonal occurrence in a mature cottonwood grove along the Oldman River, Alberta. *Canadian Journal of Botany* 77:1095-1105.
- Goodrich, S., E. D. MacArthur, and A. Winward. 1985. A new combination and a new variety in *Artemisia tridentata*. *Great Basin Naturalist* 45:99-104.
- Gordon, D. T. 1980. White fir. Pages 92-93 in: F. H. Eyre, editor. *Forest cover types of the United States and Canada*. Society of American Foresters, Washington, DC.
- Gordon, H. J., and T. C. White. 1994. Ecological guide to the southern California chaparral plant series. Technical Report R5-ECOL-TP-005. USDA Forest Service, Pacific Southwest Region, San Francisco, CA.
- Grace, J. B., and R. G. Wetzel. 1981. Habitat partitioning and competitive displacement in cattail (*Typha*): Experimental field studies. *The American Midland Naturalist* 118:463-474.
- Gracz, M., K. Noyes, P. North, and G. Tande. 2005. Wetland mapping and classification of the Kenai Lowland, Alaska. [<http://www.kenaiwetlands.net/>]
- Graham, E. H. 1937. Botanical studies in the Uinta Basin of Utah and Colorado. *Annals of the Carnegie Museum* 26:28-432.
- Graybosch, R. A., and H. Buchanan. 1983. Vegetative types and endemic plants of the Bryce Canyon Breaks. *Great Basin Naturalist* 43:701-712.
- Great Plains Flora Association. 1986. *Flora of the Great Plains*. University Press of Kansas, Lawrence. 1402 pp.
- Green, R. N., and K. Klinka. 1994. A field guide to site interpretation for the Vancouver Forest Region. British Columbia Ministry of Forests. ISSN 0229-1622 Land Management Handbook 28. 285 pp.
- Greenwood, L. R., and J. D. Brotherson. 1978. Ecological relationships between pinyon-juniper and true mountain mahogany stands in the Uintah Basin, Utah. *Journal of Range Management* 31(3):164-167.
- Gregory, S. 1983. Subalpine forb community types of the Bridger-Teton National Forest, Wyoming. Unpublished completion report #36 for USDA Forest Service Cooperative Education Agreement (contract 40-8555-3-115). Bozeman, MT 63 pp.
- Griffin, J. R., and W. B. Critchfield. 1972. The distribution of forest trees in California. Research Paper PSW-82/1972. USDA Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, CA. 114 pp.
- Griffiths, D. 1902. Forage conditions in the northern border of the Great Basin. USDA Bureau of Plant Industry Bulletin 15.
- Gross, J. E. 1955. A vegetation survey of the Poudre bighorn sheep range. Unpublished paper prepared for Big Game Management, WM-190D, Colorado State University, Fort Collins. 65 pp.
- Gross, K. L., and P. A. Werner. 1982. Colonizing abilities of "biennial" plant species in relation to ground cover: Implications for their distributions in a successional sere. *Ecology* 63(4):921-931.
- Gruell, G. E., S. Bunting, and L. Neuenschwander. 1985. Influence of fire on curlleaf mountain-mahogany in the Intermountain West. Pages 58-72 in: J. E. Lotan and J. K. Brown, compilers. *Fire's effects on wildlife habitat-symposium proceedings*. USDA Forest Service Technical Report INT-186, Intermountain Forest and Range Experiment Station, Ogden, UT.
- Gucker, C. L. 2006a. *Yucca brevifolia*. In: *Fire Effects Information System* [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 2 January 2011).
- Haase, E. F. 1972. Survey of floodplain vegetation along the lower Gila River in southwestern Arizona. *Journal of the Arizona Academy of Science* 7:75-81.
- Hall, F. C. 1967. Vegetation-soil relations as a basis for resource management on the Ochoco National Forest of central Oregon. Unpublished dissertation, Oregon State University, Corvallis. 207 pp.
- Hall, F. C. 1973. Plant communities of the Blue Mountains in eastern Oregon and southeastern Washington. R6 Area Guide 3-1. USDA Forest Service, Pacific Northwest Region, Portland, OR. 62 pp.
- Hall, H. H. 1971. Ecology of a subalpine meadow of the Aquarius Plateau, Garfield and Wayne counties, Utah. Unpublished dissertation, Brigham Young University, Provo, UT.
- Hall, J. B., and P. L. Hansen. 1997. A preliminary riparian habitat type classification system for the Bureau of Land Management districts in southern and eastern Idaho. Riparian and Wetland Research Program, School of Forestry, University of Montana. Idaho Bureau of Land Management, Technical Bulletin No. 97-11. 381 pp.
- Hallock, D., N. Lederer, and M. Figgs. 1986. Ecology, status and avifauna of willow carrs in Boulder County. Boulder County Nature Association Publication No. 4. Boulder, CO. 38 pp.
- Hamilton, J. G. 1997. Changing perceptions of pre-European grasslands in California. *Madroño* 44(4):311-333.
- Hammond, D. J. 1998. Measuring changes in aerial extent of historic wetlands at Great Sand Dunes National Monument, Colorado, 1936-1995. M.S. thesis, Colorado State University, Fort Collins.
- Hamner, R. W. 1964. An ecological study of *Sarcobatus vermiculatus* communities of the Big Horn Basin, Wyoming. Unpublished thesis, University of Wyoming, Laramie.

- Hanes, T. L. 1976. Vegetation types of the San Gabriel Mountains. Pages 65-76 in: J. Latting, editor. Plant communities of southern California. Symposium proceedings. Special Publication No. 2. California Native Plant Society, Sacramento, CA.
- Hanes, T. L. 1977. Chaparral. Pages 417-469 in: M. G. Barbour and J. Major, editors. Terrestrial vegetation of California. Wiley-Interscience, reprinted 1988 by the California Native Plant Society, Sacramento, CA.
- Hansen, M., J. Coles, K. A. Thomas, D. Cogan, M. Reid, J. Von Loh, and K. Schulz. 2004b. USGS-NPS Vegetation Mapping Program: Wupatki National Monument, Arizona, vegetation classification and distribution. U.S. Geological Survey Technical Report. Southwest Biological Science Center, Flagstaff, AZ. 229 pp.
- Hansen, M., J. Coles, K. A. Thomas, D. Cogan, M. Reid, J. Von Loh, and K. Schulz. 2004c. USGS-NPS Vegetation Mapping Program: Sunset Crater National Monument, Arizona, vegetation classification and distribution. U.S. Geological Survey Technical Report. Southwest Biological Science Center, Flagstaff, AZ. 188 pp.
- Hansen, P. L. 1985. An ecological study of the vegetation of the Grand River/Cedar River, Sioux, and Ashland districts of the Custer National Forest. Unpublished dissertation, South Dakota State University. 257 pp.
- Hansen, P. L., and G. R. Hoffman. 1988. The vegetation of the Grand River/Cedar River, Sioux, and Ashland districts of the Custer National Forest: A habitat type classification. General Technical Report RM-157. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 68 pp.
- Hansen, P. L., G. R. Hoffman, and A. J. Bjugstad. 1984. The vegetation of Theodore Roosevelt National Park, North Dakota: A habitat type classification. General Technical Report RM-113. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 35 pp.
- Hansen, P. L., K. Bogs, R. Pfister, and J. Joy. 1990. Classification and management of riparian and wetland sites in central and eastern Montana. Draft version 2. Montana Riparian Association, Montana Forest and Conservation Experiment Station, School of Forestry. University of Montana, Missoula, MT. 279 pp.
- Hansen, P. L., R. D. Pfister, K. Boggs, B. J. Cook, J. Joy, and D. K. Hinckley. 1995. Classification and management of Montana's riparian and wetland sites. Miscellaneous Publication No. 54. Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana. 646 pp. plus posters.
- Hansen, P. L., S. W. Chadde, and R. D. Pfister. 1988b. Riparian dominance types of Montana. University of Montana Miscellaneous Publication 49. Montana Forest and Conservation Experiment Station, Missoula. 411 pp.
- Hansen, P., K. Boggs, and R. Pfister. 1991. Classification and management of riparian and wetland sites in Montana. Unpublished draft version prepared for Montana Riparian Association, Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Missoula. 478 pp.
- Hansen, P., R. Pfister, J. Joy, D. Svoboda, K. Boggs, L. Myers, S. Chadde, and J. Pierce. 1989. Classification and management of riparian sites in southwestern Montana. Unpublished draft prepared for the Montana Riparian Association, School of Forestry, University of Montana, Missoula. 292 pp.
- Hanson, H. C. 1929. Range resources of the San Luis Valley. Pages 5-61 in: Range resources of the San Luis Valley. Bulletin 335. Colorado Experiment Station, Fort Collins, CO.
- Hanson, H. C., and W. S. Ball. 1928. An application of Raunkiaer's law of frequency to grazing studies. *Ecology* 9:467-473.
- Hanson, H. C., and W. Whitman. 1938. Characteristics of major grassland types in western North Dakota. *Ecological Monographs* 8:58-114.
- Harper, K. T., and R. A. Jaynes. 1986. Some edaphic and compositional characteristics of *Artemisia tridentata* and associated plant communities in southeastern Utah. Pages 265-272 in: E. D. McArthur and B. L. Welch, compilers. Proceedings-Symposium on the Biology of *Artemisia* and *Chrysothamnus*, 9-13 July, Provo, UT. General Technical Report INT-200. USDA Forest Service, Intermountain Research Station, Ogden, UT.
- Harrington, F. A., Jr. 1978. Ecological segregation of ungulates in alpine and subalpine communities. Unpublished dissertation, Colorado State University, Fort Collins. 142 pp.
- Harrington, M. G., and S. S. Sackett. 1992. Past and present fire influences on southwestern ponderosa pine old growth. Pages 44-50 in: M. R. Kaufmann, W. H. Moir, and R. L. Bassett. Old-growth forests in the southwest and Rocky Mountain regions. Proceedings of a workshop, March 9-13, 1992, Portal, AZ. General Technical Report RM-213. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
- Harrington, T. C., and F. W. Cobb, Jr., editors. 1988. *Leptographium* root diseases on conifers. The American Phytopathological Society Press, St. Paul, MN. 149 pp.
- Harris, A. G., S. C. McMurray, P. W. C. Uhlig, J. K. Jeglum, R. F. Foster, and G. D. Racey. 1996. Field guide to the wetland ecosystem classification for northwestern Ontario. Ontario Ministry of Natural Resources, Northwest Science and Technology, Thunder Bay, Ontario. Field guide FG-01. 74 pp. plus appendix.
- Harvey, S. J. 1980. The potential and current vegetation of the Sun River Game Range. Montana Department of Fish, Wildlife and Parks. Helena, MT. 85 pp.
- Hauke, R. L. 1993. Equisetaceae Michaux ex DeCandolle: Horsetail Family. Pages 76-84 in: Flora of North America Editorial Committee, editors. Flora of North America, North of Mexico. Volume 2. Oxford University Press, New York.
- Hauser, A. S. 2006b. *Carex filifolia*. In Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>]
- Hawksworth, F. G., and D. K. Bailey. 1980. Bristlecone pine. Pages 89-90 in: F. H. Eyre, editor. Forest cover types of the United States and Canada. Society of American Foresters, Washington, DC.
- Hayward, H. E. 1928. Studies of plants in the Black Hills of South Dakota. *Botanical Gazette* 85(4):353-412.

- HDR. 2014. Vegetation classification and mapping, Naval Base Ventura County, San Nicolas Island, California. Unpublished report prepared by HDR for Naval Facilities Engineering Command Southwest, San Diego, CA.
- Hefley, H. M. 1937. Ecological studies on the Canadian River floodplain in Cleveland County, Oklahoma. *Ecological Monographs* 7:347-402.
- Heifner, M. A. 1974. Ecological studies in Colorado alpine willow marshes. Unpublished thesis, Colorado State University, Fort Collins. 66 pp.
- Heinze, D. H., R. E. Eckert, and P. T. Tueller. 1962. The vegetation and soils of the Steptoe Watershed. Unpublished report prepared for the USDI Bureau of Land Management. 40 pp.
- Henderson, J. A., D. A. Peter, and R. Leshner. 1986. Preliminary plant associations of the Olympic National Forest. USDA Forest Service, Pacific Northwest Region. 136 pp.
- Henderson, J. A., S. A. Simon, and S. B. Hartvigsen. 1977. Plant community types and habitat types of the Price District Manti-La Sal National Forest. Unpublished report prepared for Utah State University, Department of Forestry and Outdoor Recreation, Logan.
- Hendrickson, D. A., and W. L. Minckley. 1984. Cienegas - Vanishing climax communities of the American Southwest. *Desert Plants* 6(3):131-175.
- Hendrickson, J., and B. Prigge. 1975. White fir in the mountains of eastern Mojave Desert of California. *Madroño* 23:164-168.
- Hennessy, J. T., R. P. Gibbens, J. M. Tromble, and M. Cardenas. 1983. Vegetation changes from 1935 to 1980 in mesquite dunelands and former grasslands of southern New Mexico. *Journal of Range Management* 36(3):370-374.
- Henrickson, J. 1974. Saline habitats and halophytic vegetation of the Chihuahuan Desert region. Pages 249-272 in: R. H. Wauer and D. H. Riskind, editors. Transactions of the symposium on the biological resources of the Chihuahuan Desert region, United States and Mexico. USDI National Park Service. Transactions of Proceedings Series No. 3. Washington, DC.
- Henry, R. J. 1981. Riparian vegetation of two mountain ranges in southwestern New Mexico. Unpublished thesis, New Mexico State University, Las Cruces.
- Herbel, C. H., F. N. Ares, and R. Wright. 1972. Drought effects on a semidesert grassland range. *Ecology* 53:1084-1093.
- Hermann, F. J. 1970. Manual of the Carices of the Rocky Mountains and Colorado Basin. Agriculture Handbook No. 374. USDA Forest Service, Washington, DC. 397 pp.
- Hess, K. 1981. Phyto-edaphic study of habitat types of the Arapaho-Roosevelt National Forest, Colorado. Unpublished dissertation, Colorado State University, Fort Collins. 558 pp.
- Hess, K., and C. H. Wasser. 1982. Grassland, shrubland, and forest habitat types of the White River-Arapaho National Forest. Unpublished final report 53-82 FT-1-19. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 335 pp.
- Hess, K., and R. R. Alexander. 1986. Forest vegetation of the Arapaho and Roosevelt national forests in northcentral Colorado: A habitat type classification. Research Paper RM-266. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 48 pp.
- Hickman, J. C. 1993. The Jepson manual: Higher plants of California. University of California Press, Ltd., Berkeley, CA. 1400 pp.
- Hickson, D., and T. Keeler-Wolf. 2007. Vegetation and land use classification and map of the Sacramento-San Joaquin River Delta. Prepared for the Bay Delta Region, California Department of Fish and Game by the Vegetation Classification and Mapping Program, California Department of Fish and Game, Sacramento. 152 pp. plus appendices.
- Hinckley, L. C. 1944. The vegetation of the Mount Livermore area in Texas. *The American Midland Naturalist* 32:236-250.
- Hironaka, M. 1978. Basic synecological relationships of the Columbia River sagebrush type. University of Idaho, Forest Wildlife and Range Experiment Station Contribution Number 124:27-31.
- Hironaka, M., M. A. Fosberg, and A. H. Winward. 1983. Sagebrush-grass habitat types of southern Idaho. Forestry, Wildlife, and Range Experiment Station Bulletin No. 15, University of Idaho, Moscow. 44 pp.
- Hirsch, K. J. 1985. Habitat type classification of grasslands and shrublands of southwestern North Dakota. Ph.D. thesis, North Dakota State University, Fargo.
- Hitchcock, C. L., A. Cronquist, M. Ownbey, and J. W. Thompson. 1964. Vascular plants of the Pacific Northwest. Part 2: Salicaceae to Saxifragaceae. University of Washington Press, Seattle. 597 pp.
- Hitchcock, C. L., A. Cronquist, M. Ownbey, and J. W. Thompson. 1977a. Vascular plants of the Pacific Northwest. Part 1: Vascular Cryptogams, Gymnosperms, and Monocotyledons. University of Washington Press, Seattle. 914 pp.
- Hoagland, B. W. 1998a. Classification of Oklahoma vegetation types. Working draft. University of Oklahoma, Oklahoma Natural Heritage Inventory, Norman. 43 pp.
- Hoffman, G. R., and R. R. Alexander. 1976. Forest vegetation of the Bighorn Mountains, Wyoming: A habitat type classification. Research Paper RM-170. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 38 pp.
- Hoffman, G. R., and R. R. Alexander. 1980. Forest vegetation of the Routt National Forest in northwestern Colorado: A habitat type classification. General Technical Report RM-221. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 41 pp.
- Hoffman, G. R., and R. R. Alexander. 1983. Forest vegetation of the White River National Forest in western Colorado: A habitat type classification. Research Paper RM-249. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 36 pp.
- Hoffman, G. R., and R. R. Alexander. 1987. Forest vegetation of the Black Hills National Forest of South Dakota and Wyoming: A habitat type classification. Research Paper RM-276. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 48 pp.

- Holecheck, J. L., and T. Stephenson. 1983. Comparison of big sagebrush in northcentral New Mexico under moderately grazed and grazing excluded conditions. *Journal of Range Management* 36:455-456.
- Holland, J. 1982. A floristic and vegetation analysis of the Newberry Mountains, Clark County, Nevada. Unpublished thesis, University of Nevada, Las Vegas. Reproduced in the Lake Mead Report Series by University of Nevada Cooperative National Park Resources Studies Unit, Las Vegas.
- Holland, R. F. 1986b. Preliminary descriptions of the terrestrial natural communities of California. Unpublished report prepared for the California Department of Fish and Game, Nongame-Heritage Program and Natural Diversity Database, Sacramento. 156 pp.
- Holland, V. L., and D. J. Keil. 1995. California vegetation. Kendall/Hunt Publishing Company, Dubuque, IA. 516 pp.
- Holm, L. G., D. L. Plucknett, J. V. Pancho, and J. P. Herberger. 1977. The world's worst weeds: Distribution and biology. University Press of Hawaii, Honolulu. 609 pp.
- Holm, T. 1927. The vegetation of the alpine region of the Rocky Mountains in Colorado. Pages 1-45 in: National Academy of Sciences 19. Third Memoir.
- Holstein, G. 2001. Pre-agricultural grassland in central California. *Madroño* 48(4):253-264.
- Holway, J. G. 1962a. Phenology of Colorado alpine plants. Unpublished dissertation, Colorado State University, Fort Collins. 154 pp.
- Hopkins, W. E. 1979a. Plant associations of the Fremont National Forest. Technical Report R6-ECOL-79-004. USDA Forest Service, Pacific Northwest Region, Portland.
- Hopkins, W. E. 1979b. Plant associations of South Chiloquin and Klamath Ranger Districts - Winema National Forest. Publication R6-ECOL-79-005. USDA Forest Service, Pacific Northwest Region, Portland, OR. 96 pp.
- Horton, L. E. 1971. Vegetation and ecological relationships, west slope of the Teton study area, Targhee National Forest. USDA Forest Service, Intermountain Region. Unpublished mimeographed report. 50 pp. plus appendices.
- Howard, J. L. 1995. *Purshia mexicana* var. *stansburiana*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 28 June 2011).
- Howard, J. L. 2003. *Atriplex canescens*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 13 July 2007).
- Howard, J. L. 2004c. *Pinus longaeva*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>]
- Hull, A. C., Jr., and M. K. Hull. 1974. Presettlement vegetation of Cache Valley, Utah and Idaho. *Journal of Range Management* 27(1):27-29.
- Humphrey, R. R. 1974. Fire in the deserts and desert grassland of North America. Pages 365-400 in: T. T. Kozlowski and C. E. Ahlgren, editors. *Fire and Ecosystems*. Academic Press, New York.
- Hurd, R. M. 1961. Grassland vegetation in the Big Horn Mountains, Wyoming. *Ecology* 42(3):459-467.
- Hyder, D. N., R. E. Bement, E. E. Remmenga, and C. Terwilliger, Jr. 1966. Vegetation-soils and vegetation-grazing relations from frequency data. *Journal of Range Management* 19:11-17.
- Ibrahim, K. M., N. E. West, and D. L. Goodwin. 1972. Phytosociological characteristics of perennial *Atriplex*-dominated vegetation of southeastern Utah. *Vegetatio* 24:13-22.
- Imper, D. K. 1988a. Ecological survey of the proposed Haypress Meadows Research Natural Area, SAF type 207, Klamath National Forest. Unpublished report. USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA.
- Isaacson, H. E. 1967. Ecological provinces within the pinyon-juniper type of the Great Basin and Colorado Plateau. Unpublished thesis, Utah State University, Logan. 44 pp.
- Jackson, J. R. 1972. Vegetation of the flood plain of the South Platte River in the proposed Narrows Reservoir site. Unpublished thesis, University of Northern Colorado, Greeley. 83 pp.
- Jackson, J. R., and I. E. Lindauer. 1978. Vegetation of the flood plain of the south Platte River in the proposed Narrows Reservoir site. *Transactions of the Mississippi Academy of Science* 12:37-46.
- Jahrsdoerfer, S. E., and D. M. Leslie. 1988. Tamaulipan brushland of the lower Rio Grande Valley of south Texas: Description, human impacts, and management options. USDI Fish & Wildlife Service. Biological Report 88(36). 63 pp.
- Jameson, D. A. 1962. Effects of burning on a galleta-black grama range invaded by juniper. *Ecology* 43:760-763.
- Jameson, D. A., and E. H. Reid. 1965. The pinyon-juniper type of Arizona. *Journal of Range Management* 18:152-154.
- Jameson, D. A., J. A. Williams, and E. W. Wilton. 1962. Vegetation and soils of Fishtail Mesa, Arizona. *Ecology* 43:403-410.
- Janes, E. B. 1969. Botanical composition and productivity in the California annual grassland in relation to rainfall. Master's thesis, University of California, Berkeley, CA.
- Jankovsky-Jones, M., C. J. Murphy, and C. L. Coulter. 2001. Riparian and wetland plant associations of southwestern Idaho in the Lower Snake River District, Bureau of Land Management. Idaho Conservation Data Center, Idaho Department of Fish and Game, Boise.
- Jensen, M. E., L. S. Peck, and M. V. Wilson. 1988a. A sagebrush community type classification for mountainous northeastern Nevada rangelands. *Great Basin Naturalist* 48(4):422-433.
- Jensen, S. E. 1990. Wetlands delineation, Moose Meadow Ranch, Fremont County, Idaho. White Horse Associates, Smithfield, UT. 17 pp.
- Jensen, S. E., and J. S. Tuhy. 1981. Soils investigation of riparian communities of East Smiths Fork and Henrys Fork drainages, North Slope Uinta Mountains, Utah. Unpublished report presented to USDA Forest Service, Ogden, UT. 35 pp.
- Jimerson, T. M. 1993. Preliminary plant associations of the Klamath province, Six Rivers and Klamath national forests. Unpublished report. USDA Forest Service, Eureka, CA.

- Jimerson, T. M., J. W. Menke, S. K. Carothers, M. P. Murray, V. VanSickle, and K. H. McClellan. 2000. Field guide to the rangeland vegetation types of the Northern Province. General Technical Report R5-ECOL-TP-014. USDA Forest Service, Pacific Southwest Region, Vallejo, CA.
- Johansen, A. D., and R. G. Latta. 2003. Mitochondrial haplotype distribution, seed dispersal and patterns of post glacial expansion of ponderosa pine. *Molecular Ecology* 12:293-298.
- Johnsen, T. N., Jr. 1962. One-seed juniper invasion of northern Arizona grasslands. *Ecological Monographs* 32:187-207.
- Johnson, C. G., and R. R. Clausnitzer. 1992. Plant associations of the Blue and Ochoco mountains. R6-ERW-TP-036-92. USDA Forest Service, Pacific Northwest Region, Wallowa-Whitman National Forest. 163 pp. plus appendices.
- Johnson, C. G., and S. A. Simon. 1985. Plant associations of the Wallowa Valley Ranger District, Part II: Steppe. USDA Forest Service, Pacific Northwest Region, Wallowa-Whitman National Forest. 258 pp.
- Johnson, C. G., Jr., and S. A. Simon. 1987. Plant associations of the Wallowa-Snake Province Wallowa-Whitman National Forest. Technical Paper R6-ECOL-TP-255A-86. USDA Forest Service, Pacific Northwest Region, Wallowa-Whitman National Forest. 399 pp. plus appendices.
- Johnson, D. A. 2000b. *Artemisia tridentata subsp. vaseyana*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 2 January 2011).
- Johnson, D. H., and T. A. O'Neil. 2000. Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press, Corvallis. 736 pp.
- Johnson, H. B. 1976. Vegetation and plant communities of southern California deserts. Pages 125-162 in: J. Latting, editor. Plant communities of southern California. Symposium proceedings. Special Publication No. 2. California Native Plant Society, Sacramento, CA.
- Johnson, J. L., and R. D. Pfister. 1982. A survey of potential ecological natural landmarks of the middle Rocky Mountains. USDA Forest Service Intermountain Forest and Range Experiment Station, Ogden, UT. Unpublished report prepared for USDI National Park Service. 197 pp.
- Johnson, J. R., and G. F. Payne. 1968. Sagebrush reinvasion as affected by some environmental influences. *Journal of Range Management* 21:209-213.
- Johnson, K. A. 2001. *Pinus flexilis*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>]
- Johnson, K. L. 1970a. Alpine vegetation and soils of Mesa Seco Plateau, San Juan Mountains, Colorado. Unpublished dissertation, University of Illinois, Urbana. 217 pp.
- Johnson, K. L. 1986c. The social values of crested wheat grass: Pros, cons and tradeoffs. Pages 331-335 in: K. L. Johnson, editor. Crested wheat grass: Its values, problems and myths. Symposium proceedings, October 3-7, 1983, Utah State University. Logan, UT.
- Johnson, K. R. 1939. Plant ecology of northwestern Colorado lakes and surrounding areas. Unpublished dissertation, University of Colorado, Boulder. 138 pp.
- Johnson, S. 1987b. Can tamarisk be controlled? *Fremontia* 15:19-20.
- Johnson, W. M. 1953. Effect of grazing intensity upon vegetation and cattle gains on ponderosa pine-bunchgrass ranges of the Front Range of Colorado. USDA Circular Number 929. 36 pp.
- Johnson, W. M. 1956a. The effect of grazing intensity on plant composition, vigor, and growth of pine-bunchgrass ranges in central Colorado. *Ecology* 37:790-798.
- Johnson, W. M., and C. H. Niederhof. 1941. Some relationships of plant cover to run-off, erosion, and infiltration on granitic soils. *Journal of Forestry*. 39:854-858.
- Johnson, W. M., and E. H. Reid. 1958. Herbage utilization on pine-bunchgrass ranges of Colorado. *Journal of Forestry* 56:647-651.
- Johnson, W. M., and E. H. Reid. 1964. Range condition classification of bunchgrass range at the Manitou Experimental Forest in Colorado. *Journal of Range Management* 17:137-141.
- Johnston, B. C. 1984. Plant associations of Region Two. Edition 3.5. USDA Forest Service, Rocky Mountain Region. Lakewood, CO.
- Johnston, B. C. 1987. Plant associations of Region Two: Potential plant communities of Wyoming, South Dakota, Nebraska, Colorado, and Kansas. R2-ECOL-87-2. USDA Forest Service, Rocky Mountain Region. Lakewood, CO. 429 pp.
- Johnston, B. C. 2001. Ecological types of the Upper Gunnison Basin. Technical Report R2-RR-2001-01. USDA Forest Service, Rocky Mountain Region. Denver, CO.
- Johnston, B. C., and L. Hendzel. 1985. Examples of aspen treatment, succession and management in western Colorado. USDA Forest Service, Range Wildlife Fisheries and Ecology. Denver, CO. 164 pp.
- Jones, G. 1992b. Wyoming plant community classification (Draft). Wyoming Natural Diversity Database, Laramie, WY. 183 pp.
- Jones, G. P. 1989b. Survey of plant species and communities of interest in the Beaver Rim Area of Critical Environmental Concern. Report submitted to the Bureau of Land Management, Rawlins District Office, under Work Effort No. WY030-09-4352-06-2512. Wyoming Natural Diversity Database, Laramie, WY.
- Jones, G. P., and G. M. Walford. 1995. Major riparian vegetation types of eastern Wyoming. Submitted to Wyoming Department of Environmental Quality, Water Quality Division. Wyoming Natural Diversity Database, Laramie, WY. 245 pp.
- Jones, S. L. 1998d. Pygmy nuthatch. Pages 360-361 in: H. E. Kingery, editor. Colorado breeding bird atlas. Colorado Bird Atlas Partnership and Colorado Division of Wildlife, Denver.
- Jorgensen, H. E. 1979. Vegetation of the Yellow Water Triangle, Montana. Montana Department of Fish and Game, in cooperation with the Bureau of Land Management. Helena, MT. 57 pp.

- Jorgenson, M. T. 1999. Ecological characteristics of wetlands near Nulato, Alaska and their potential for wastewater treatment. Final Report prepared for City of Nulato, by ABR, Inc., Fairbanks, AK. 12 pp.
- Junak, S., D. A. Knapp, J. R. Haller, R. Philbrick, A. Schoenherr and T. Keeler-Wolf. 2007. The Channel Islands. Chapter 9 in: M. G. Barbour, T. Keeler-Wolf and A. A. Schoenherr, editors. Terrestrial vegetation of California, third edition. University of California Press, Berkeley.
- Kagan, J. 1997. Draft of Oregon and Washington vegetation report. Oregon Natural Heritage Program, Portland.
- Kagan, J. S. 1985. Status report for *Thelypodium howellii* ssp. *spectabilis*. Unpublished report by Oregon Natural Heritage Program for U.S. Fish and Wildlife Service. On file at Oregon Natural Heritage Program, Portland, OR.
- Kagan, Jimmy. Personal communication. Coordinator, Oregon Natural Heritage Program, Portland.
- Karl, M. G., R. K. Heitschmidt, and M. R. Haferkamp. 1999. Vegetation biomass dynamics and patterns of sexual reproduction in a northern mixed-grass prairie. *The American Midland Naturalist* 141:227-237.
- Kartesz, J. T. 1994a. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. Second edition. Volume 1--Checklist. Timber Press, Portland, OR. 622 pp.
- Kartesz, J. T. 1999. A synonymized checklist and atlas with biological attributes for the vascular flora of the United States, Canada, and Greenland. First edition. In: J. T. Kartesz and C. A. Meacham. Synthesis of the North American Flora, Version 1.0. North Carolina Botanical Garden, Chapel Hill, NC.
- Kauffman, J. B., W. C. Krueger, and M. Vaura. 1983. Effects of late season cattle grazing on riparian plant communities. *Journal of Range Management* 37:685-691.
- Kauffman, J. B., W. C. Krueger, and M. Vaura. 1985. Ecology and plant communities of the riparian area associated with Catherine Creek in northeastern Oregon. Technical Bulletin 147. Eastern Oregon Agricultural Experiment Station, Oregon State University, Corvallis. 35 pp.
- Keammerer, W. R. 1974a. Vegetation of the Grand Valley area. Pages 73-117 in: Ecological inventory of the Grand Valley area Unpublished report prepared for the Colony Development Operation, Atlantic Richfield Company, Denver, CO.
- Keammerer, W. R. 1974b. Vegetation of Parachute Creek Valley. Pages 4-91 in: Environmental inventory and impact analysis of a proposed utilities corridor in Parachute Creek Valley, Co. Unpublished report prepared for Colony Development Operation, Denver, CO.
- Keammerer, W. R. 1977. Final report: Vegetation baseline studies, oil shale tract C-b. Unpublished report. Stoecker-Keammerer and Associates, Ecological Consultants, Boulder, CO. 183 pp.
- Keammerer, W. R. 1987. Bentonite regional vegetation study. Prepared for Crook County Bentonite Producers and Wyoming Department of Environmental Quality, Land Quality Division, by Stoecker-Keammerer and Associates, Boulder, CO.
- Keammerer, W. R., and R. E. Stoecker. 1980. Vegetation and wildlife studies for the Mount Emmons project. Unpublished report prepared for AMAX Environmental Services, Inc., by Stoecker-Keammerer and Associates, Ecological Consultants, Boulder, CO. 3 volumes.
- Keammerer, W. R., and S. J. Peterson. 1981. Vegetation studies on the Naval Oil Shale Reserve. Unpublished report prepared for TRW Energy Systems Group, McLean, Virginia, by Stoecker-Keammerer and Associates, Ecological Consultants, Boulder, CO. 77 pp.
- Kearney, T. H., and R. H. Peebles, and collaborators. 1969. Arizona flora. University of California, Berkeley, CA. 1085 pp.
- Kearsley, M. J. C., K. Green, M. Tukman, M. Reid, M. Hall, T. J. Ayers, and K. Christie. 2015. Grand Canyon National Park-Grand Canyon / Parashant National Monument vegetation classification and mapping project. Natural Resource Report NPS/GRCA/NRR--2015/913. National Park Service, Fort Collins, CO. 75 pp. plus appendices.
- Keeler-Wolf, T. 1990c. An ecological survey of the proposed Long Canyon Research Natural Area, Sequoia National Forest, Kern County, California. Unpublished report. USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA.
- Keeler-Wolf, T. 1997. Preliminary table of Mojave Desert ecosystem vegetation types.
- Keeler-Wolf, T. 2007. Mojave Desert scrub vegetation. Pages 609-656 in: M. G. Barbour, T. Keeler-Wolf, and A. A. Schoenherr, editors. Terrestrial vegetation of California. Third edition. University of California Press, Berkeley.
- Keeler-Wolf, T. Personal communication. Senior Vegetation Ecologist, Wildlife and Habitat Data Analysis Branch, California Department of Fish and Game, Sacramento, CA.
- Keeler-Wolf, T., and J. Evens. 2006. Vegetation classification of the Santa Monica Mountains National Recreation Area and environs in Ventura and Los Angeles counties, California. A report submitted to National Park Service, Santa Monica Mountains National Recreation Area by California Department of Fish and Game, Wildlife and Habitat Data Analysis Branch and The California Native Plant Society, Vegetation Program, Sacramento, CA.
- Keeler-Wolf, T., and K. Thomas. 2000. Draft descriptions of vegetation alliances for the Mojave Ecosystem Mapping project. California Natural Diversity Database, California Department of Fish and Game, Sacramento.
- Keeler-Wolf, T., and M. Vaghti. 2000. Vegetation mapping of Suisun Marsh, Solano County, California. A report to the California Department of Water Resources. California Department of Fish and Game, California Natural Diversity Database, Sacramento, CA.
- Keeler-Wolf, T., C. Roye, and K. Lewis. 1998a. Vegetation mapping and classification of the Anza-Borrego Desert State Park, California. Unpublished report on file at California Natural Diversity Database, California Department Fish and Game, Sacramento.

- Keeler-Wolf, T., D. Schirokauer, J. Meinke, and P. van der Leeden. 2003b. Classification of the vegetation of Point Reyes National Seashore, Golden Gate National Recreation area, Samuel P. Taylor, Mount Tamalpais, and Tomales state parks, Marin, San Francisco, and San Mateo counties, California. California Department of Fish and Game, Wildlife Habitat Data Analysis Branch, Sacramento, CA.
- Keeler-Wolf, T., J. M. Evens, A. I. Solomeshch, V. L. Holland, and M. G. Barbour. 2007. Community classification and nomenclature. Pages 21-36 in: M. R. Stromberg, J. D. Corbin, and C. M. D'Antonio, editors. California grasslands: Ecology and management. University of California Press, Berkeley. 390 pp.
- Keeler-Wolf, T., M. Schindel, and S. San. 2004. Point Reyes National Seashore, Golden Gate National Recreation Area, San Francisco Water Department Watershed Lands, Mount Tamalpais, Tomales Bay, and Samuel P. Taylor State Parks. Appendix B. Point Reyes National Seashore, Golden Gate National Recreation Area, and surrounding wildlands plant community classification and mapping project. Final report. California State Department of Fish and Game, Sacramento, CA.
- Keeler-Wolf, T., M. Schindel, S. San, P. Moore, and D. Hickson. 2003a. Classification of the vegetation of Yosemite National Park and surrounding environs in Tuolumne, Mariposa, Madera and Mono counties, California. Unpublished report by NatureServe in cooperation with the California Native Plant Society and California Department of Fish and Game, Wildlife and Habitat Data Analysis Branch, Sacramento, CA.
- Keeler-Wolf, T., P. E. Moore, E. T. Reyes, J. M. Menke, D. N. Johnson, and D. L. Karavidas. 2012. Yosemite National Park vegetation classification and mapping project report. Natural Resource Technical Report NPS/YOSE/NRTR--2012/598. National Park Service, Fort Collins, CO.
- Keeler-Wolf, T., S. San, and D. Hickson. 2005. Vegetation classification of Joshua Tree National Park, Riverside and San Bernardino counties, California. Unpublished report to the National Park Service. California Fish and Game and California Native Plant Society, Sacramento, CA.
- Keeley, J. E. 2006b. Fire severity and plant age of woody plants in sage scrub and chaparral. *Madroño* 53:373-379.
- Keeley, J. E., and P. H. Zedler. 1998a. Evolution of life histories in *Pinus*. Pages 219-250 in: D. M. Richardson, editor. Ecology and biogeography of *Pinus*. The Press Syndicate of the University of Cambridge, Cambridge, UK.
- Kemp, K. 1965. A study of litter and vegetation on the upper chaparral area of central Arizona. Unpublished thesis, University of Arizona, Tucson. 79 pp.
- Kennedy, K. L. 1983a. A habitat-type classification for the pinyon-juniper woodlands of the Lincoln National Forest. Unpublished thesis, New Mexico State University, Las Cruces. 87 pp.
- Kettler, S., and A. McMullen. 1996. Routt National Forest riparian vegetation classification. Report prepared for Routt National Forest by the Colorado Natural Heritage Program, Colorado State University, Fort Collins.
- Kittel, G. 1993. A preliminary classification of the riparian vegetation of the White River Basin. Unpublished report prepared for the Colorado Department of Natural Resources and the Environmental Protection Agency by the Colorado Natural Heritage Program. 106 pp.
- Kittel, G. M. 1994. Montane vegetation in relation to elevation and geomorphology along the Cache la Poudre River, Colorado. Unpublished thesis, University of Wyoming, Laramie.
- Kittel, G. M., and N. D. Lederer. 1993. A preliminary classification of the riparian vegetation of the Yampa and San Miguel/Dolores river basins. Unpublished report prepared for Colorado Department of Health and the Environmental Protection Agency by The Nature Conservancy, Colorado Field Office, Boulder.
- Kittel, G., E. Reyes, J. Evens, J. Buck, and D. Johnson. 2012a. Vegetation classification and mapping project report, Pinnacles National Monument. Natural Resource Report NPS/SFAN/NRR-2012/574. National Park Service, Fort Collins, CO. 428 pp.
- Kittel, G., E. Van Wie, and M. Damm. 1997a. A classification of the riparian vegetation of the South Platte Basin (and part of Republican River Basin), Colorado. Submitted to Colorado Department of Natural Resources and the Environmental Protection Agency, Region VIII. Prepared by Colorado Natural Heritage Program, Colorado State University, Fort Collins.
- Kittel, G., E. Van Wie, M. Damm, R. Rondeau, S. Kettler, A. McMullen, and J. Sanderson. 1999b. A classification of riparian and wetland plant associations of Colorado: A user's guide to the classification project. Colorado Natural Heritage Program, Colorado State University, Fort Collins CO. 70 pp. plus appendices.
- Kittel, G., E. Van Wie, M. Damm, R. Rondeau, S. Kettler, and J. Sanderson. 1999a. A classification of the riparian plant associations of the Rio Grande and Closed Basin watersheds, Colorado. Unpublished report prepared by the Colorado Natural Heritage Program, Colorado State University, Fort Collins.
- Kittel, G., R. Rondeau, and A. McMullen. 1996. A classification of the riparian vegetation of the Lower South Platte and parts of the Upper Arkansas River basins, Colorado. Submitted to Colorado Department of Natural Resources and the Environmental Protection Agency, Region VIII. Prepared by Colorado Natural Heritage Program, Fort Collins. 243 pp.
- Kittel, G., R. Rondeau, and S. Kettler. 1995. A classification of the riparian vegetation of the Gunnison River Basin, Colorado. Submitted to Colorado Department of Natural Resources and the Environmental Protection Agency. Prepared by Colorado Natural Heritage Program, Fort Collins. 114 pp.
- Kittel, G., R. Rondeau, N. Lederer, and D. Randolph. 1994. A classification of the riparian vegetation of the White and Colorado River basins, Colorado. Final report submitted to Colorado Department of Natural Resources and the Environmental Protection Agency. Colorado Natural Heritage Program, Boulder. 166 pp.
- Klein, A., and J. Evens. 2006. Vegetation alliances of western Riverside County, California. Contract Number: P0185404. Final report prepared for The California Department of Fish and Game, Habitat Conservation Division. California Native Plant Society, Sacramento, CA. 332 pp. [http://www.dfg.ca.gov/biogeodata/vegcamp/pdfs/VegMappingRpt_Western_Riverside.pdf]

- Klein, A., J. Crawford, J. Evens, T. Keeler-Wolf, and D. Hickson. 2007. Classification of the vegetation alliances and associations of the northern Sierra Nevada foothills, California. Volumes 1 and 2. Report prepared for California Department of Fish and Game, Habitat Conservation Division. California Native Plant Society, Sacramento, CA.
[<https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=18232&inline=1>]
- Klein, A., T. Keeler-Wolf, and J. Evens. 2015. Classification of the vegetation alliances and associations of Sonoma County, California. Volume 2 of 2. Vegetation descriptions. California Department of Fish and Wildlife Vegetation Classification and Mapping Program and the California Native Plant Society Vegetation Program. 690 pp.
- Kleiner, E. F. 1968. Comparative study of grasslands of Canyonlands National Park. Unpublished dissertation, University of Utah, Salt Lake City. 58 pp.
- Kleiner, E. F., and K. T. Harper. 1972. Environment and community organization in grasslands of Canyonlands National Park. *Ecology* 53(2):299-309.
- Kleiner, E. F., and K. T. Harper. 1977. Occurrence of four major perennial grasses in relation to edaphic factors in a pristine community. *Journal of Range Management* 30(4):286-289.
- Klemmedson, J. O. 1953. Interrelations of vegetation, soils, and range conditions induced by grazing. Unpublished thesis, Colorado State University, Fort Collins. 178 pp.
- Klikoff, L. G. 1965. Microenvironmental influence on vegetational pattern near timberline in the central Sierra Nevada. *Ecological Monographs* 35:187-211.
- Klimas, C. V. 1988a. River regulation effects on floodplain hydrology and ecology. Pages 40-49 in: D. D. Hook, W. H. McKee, Jr., H. K. Smith, J. Gregory, V. G. Burrell, Jr., M. R. DeVoe, R. E. Sojka, S. Gilbert, R. Banks, L. H. Stolzy, C. Brooks, T. D. Matthews and T. H. Shear, editors. 1988. The ecology and management of wetlands: I. Ecology of wetlands. Timber Press, Portland, OR.
- Kline, R. P. 1973. Establishment report for West Fork Mink Creek Research Natural Area within Caribou National Forest, Bannock County, Idaho. Unpublished report. 7 pp. plus maps.
- Klippel, G. E., and D. F. Costello. 1960. Vegetation and cattle responses to different intensities of grazing on short-grass ranges of the central Great Plains. Technical Bulletin 1216. USDA Forest Service. 82 pp.
- Klish, M. W. 1977. The vegetation of Summit County, Colorado Unpublished thesis, Colorado State University, Fort Collins. 103 pp.
- Knight, D. H. 1994. Mountains and plains: Ecology of Wyoming landscapes. Yale University Press, New Haven, MA. 338 pp.
- Knight, D. H., G. P. Jones, Y. Akashi, and R. W. Myers. 1987. Vegetation ecology in the Bighorn Canyon National Recreation Area. Unpublished report prepared for the USDI National Park Service and University of Wyoming-National Park Service Research.
- Knopf, F. L. 1985. Significance of riparian vegetation to breeding birds along an altitudinal cline. Pages 105-111 in: R. R. Johnson, et al., editors. Riparian ecosystems and their management. General Technical Report RM-120. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
- Kojima, S., and V. J. Krajina. 1975. Vegetation and environment of the coastal western hemlock zone in Strathcona Provincial Park, British Columbia, Canada. *Syesis* 8(suppl. 1):1-123.
- Komarkova, V. 1976. Alpine vegetation of the Indian Peaks Area, Front Range, Colorado Rocky Mountains. Unpublished dissertation, University of Colorado, Boulder. 655 pp.
- Komarkova, V. 1986. Habitat types on selected parts of the Gunnison and Uncompahgre national forests. Unpublished final report prepared for USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO. 270 pp. plus appendices.
- Komarkova, V. K., R. R. Alexander, and B. C. Johnston. 1988b. Forest vegetation of the Gunnison and parts of the Uncompahgre national forests: A preliminary habitat type classification. Research Paper RM-163. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 65 pp.
- Komarkova, V., A. Peters, G. Kamani, W. Jones, V. Howard, H. Gordon, and K. Southwick. 1988a. Natural recovery of plant communities on disturbance plots and history of land use in the Niwot Ridge/Green Lakes Valley, Front Range, Colorado. University of Colorado Longterm Ecological Research Working Paper 88/1. Boulder, CO. 46 pp.
- Komarkova, V., and H. Gordon. 1982. The recovery of plant communities after disturbance along the Front Range, Colorado. Unpublished report. Colorado Commission on Higher Education, Denver, CO. 271 pp.
- Komarkova, V., and P. J. Webber. 1978. An alpine vegetation map of Niwot Ridge, Colorado. *Arctic and Alpine Research* 10:1-29.
- Koniak, S. 1985. Succession in pinyon-juniper woodlands following wildfire in the Great Basin. *Great Basin Naturalist* 45:556-566.
- Kovalchik, B. L. 1987. Riparian zone associations - Deschutes, Ochoco, Fremont, and Winema national forests. Technical Paper 279-87. USDA Forest Service, Pacific Northwest Region, Portland, OR. 171 pp.
- Kovalchik, B. L. 1993. Riparian plant associations on the national forests of eastern Washington - Draft version 1. USDA Forest Service, Colville National Forest, Colville, WA. 203 pp.
- Kovalchik, B. L. 2001. Classification and management of aquatic, riparian and wetland sites on the national forests of eastern Washington. Part 1: The series descriptions. 429 pp. plus appendix.
[http://www.reo.gov/col/wetland_classification/wetland_classification.pdf]
- Krantz, T. 1983. The pebble plains of Baldwin Lake. *Fremontia* 10:9-13.
- Krantz, T. 1988. Limestone endemics of Big Bear Valley. *Fremontia* 16:20-21.
- Küchler, A. W. 1964. Potential natural vegetation of the conterminous United States. American Geographic Society Special Publication 36. New York, NY. 116 pp.
- Kunze, L. M. 1994. Preliminary classification of native, low elevation, freshwater wetland vegetation in western Washington. Washington State Department of Natural Resources, Natural Heritage Program. 120 pp.
- Kunzler, L. M., and K. T. Harper. 1980. Recovery of Gambel oak after fire in central Utah. *Great Basin Naturalist* 40:127-130.

- Kunzler, L. M., K. T. Harper, and D. B. Kunzler. 1981. Compositional similarity within the oakbrush type in central and northern Utah. *Great Basin Naturalist* 41(1):147-153.
- Kurzios, M. 1981. Vegetation and flora of the Grapevine Mountains, Death Valley National Monument, California - Nevada. Unpublished thesis, University of Nevada, Las Vegas.
- Laacke, R. J. 1990a. *Abies concolor* - white fir. Pages 36-46 in: R. M. Burns and B. H. Honkala, technical coordinators. *Silvics of North America, Volume 1. Conifers. Agriculture Handbook 654*. USDA Forest Service, Washington, DC.
- Laacke, R. J., and J. N. Fiske. 1983. Red fir and white fir. Pages 41-43 in: R. M. Burns, editor. *Silviculture systems for the major forest types of the United States. Agriculture Handbook No. 445*. USDA Forest Service, Washington, DC.
- Ladyman, J. A. R., and E. Muldavin. 1996. Terrestrial cryptograms of pinyon-juniper woodlands in the southwestern United States: A review. General Technical Report RM-GTR-280. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 33 pp.
- LaMarche, V. C., Jr., and H. A. Mooney. 1972. Recent climatic change and development of the bristlecone pine (*P. longaeva* (Bailey)) krummholz zone, Mount Washington, Nevada. *Arctic and Alpine Research* 4(1):61-72.
- Lambert, A., K. Saltonstall, R. Long, and T. L. Dudley. 2016. Biogeography of *Phragmites australis* lineages in the southwestern United States. *Biological Invasions* 18:2597-2617.
- Lambertini, C. 2016. Heteroplasmy due to chloroplast paternal leakage: Another insight into *Phragmites* haplotypic diversity in North America. *Biological Invasions* 18(9):2443-2455. [<http://dx.doi.org/10.1007/s10530-016-1193-3>]
- Lambrinos, J. G. 2000. The impact of the invasive alien grass *Cortaderia jubata* (Lemoine) Stapf on an endangered Mediterranean-type shrubland in California. *Diversity Distributions* 6:217-231.
- Lambrinos, J. G. 2001. The expansion history of a sexual and asexual species of *Cortaderia* in California, USA. *Journal of Ecology* 89:88-98.
- Lambrinos, J. G. 2002. The variable invasive success of *Cortaderia* species in a complex landscape. *Ecology* 83:518-529.
- Landfire [Landfire National Vegetation Dynamics Database]. 2007a. Landfire National Vegetation Dynamics Models. Landfire Project, USDA Forest Service, U.S. Department of Interior. (January - last update) [<http://www.LANDFIRE.gov/index.php>] (accessed 8 February 2007).
- Langenheim, J. H. 1956. Plant succession on a subalpine earthflow in Colorado. *Ecology* 37:301-317.
- Langenheim, J. H. 1962. Vegetation and environmental patterns in the Crested Butte area, Gunnison County, Colorado. *Ecological Monographs* 32:249-285.
- Lanner, Dr. Ronald. Personal communication. Professor Emeritus of Forest Resources, Utah State University, Logan.
- Lanner, R. M., and S. B. Vander Wall. 1980. Dispersal of limber pine seed by Clark's nutcracker. *Journal of Forestry* 78(10):637-639.
- Larson, D. W., U. Matthes, J. A. Gerrath, N. W. K. Larson, J. M. Gerrath, C. Nekola, G. L. Walker, S. Porembski, and A. Charlton. 2000a. Evidence for the widespread occurrence of ancient forest on cliffs. *Journal of Biogeography* 27(2):319-331.
- Larson, M., and W. H. Moir. 1986. Forest and woodland habitat types (plant associations) of southern New Mexico and central Arizona (north of the Mogollon Rim). USDA Forest Service, Southwestern Region, Albuquerque, NM. 76 pp.
- Larson, M., and W. H. Moir. 1987. Forest and woodland habitat types of northern New Mexico and northern Arizona. Edition 2. USDA Forest Service, Southwestern Region, Albuquerque, NM.
- Laurenzi, A. W., R. D. Ohmart, and N. C. Hink. 1983. Classification of mixed broadleaf riparian forests in Tonto National Forest. Pages 72-81 in: *Proceedings of the workshop on Southwestern habitat types*. USDA Forest Service, Southwestern Region.
- Lawrence, D., C. T. Lane, M. G. Willoughby, C. Hincz, D. Moisey, and C. Stone. 2005. Range plant community types and carrying capacity for the Lower Foothills subregion of Alberta: Fourth approximation. Alberta Sustainable Resource Development, Public Lands and Forests Division, Edmonton. 244 pp. ISBN. No. 0-7785-4098-7 [online edition].
- Leary, K. D., and P. M. Peterson. 1984. Soil analyses in relation to vegetation in the Cottonwood Mountains, Death Valley National Monument. University of Nevada Cooperative National Park Resources Studies Unit Report 036/01, Las Vegas.
- Lee, L. C., and C. J. Jonkel. 1980. The vegetation structure and ecology of grizzly bear habitat in the Pine and Antelope Butte Wetlands, Montana. Unpublished Border Grizzly Project Special Report 36. University of Montana, Missoula. 63 pp.
- Lesica, P., and R. L. DeVelice. 1992. Plant communities of the Pryor Mountains. Preliminary report prepared by the Montana Natural Heritage Program, Helena, MT.
- Leucite Hills Mine Application. No date. No. 520-T2, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.
- Lewis, M. E. 1970. Alpine rangelands of the Uinta Mountains, Ashley and Wasatch national forests, Region 4 of the USDA Forest Service. Unpublished report mimeographed for USDA Forest Service, Region IV, Ogden, UT. 75 pp.
- Lewis, M. E. 1971. Flora and major plant communities of the Ruby-East Humboldt Mountains with special emphasis on Lamoille Canyon. Unpublished report compiled for USDA Forest Service, Region IV, Ogden, UT. 62 pp.
- Lewis, M. E. 1975a. Plant communities of the Jarbidge Mountain Complex, Humboldt National Forest. Unpublished report compiled for USDA Forest Service, Region IV, Ogden, UT. 22 pp.
- Lewis, M. E. 1975b. Flora of the Santa Rosa Mountains, Humboldt National Forest. Unpublished report compiled for USDA Forest Service, Region IV, Ogden, UT. 19 pp.
- Lillybridge, T. R., B. L. Kovalchik, C. K. Williams, and B. G. Smith. 1995. Field guide for forested plant associations of the Wenatchee National Forest. General Technical Report PNW-GTR-359. USDA Forest Service, Pacific Northwest Research Station, Portland, OR. 335 pp.
- Lindauer, I. E. 1970. The vegetation of the flood plain of the Arkansas River in southeastern Colorado. Unpublished dissertation, Colorado State University, Fort Collins. 92 pp.

- Lindauer, I. E. 1978. A comparison of the vegetative communities of the South Platte and Arkansas River drainages in eastern Colorado. Pages 56-72 in: W. D. Gaul and S. J. Bissel, editors. Lowland River and Stream Habitat in Colorado: A Symposium, 4-5 October 1978. Colorado Chapter of Wildlife Society and Audubon Council.
- Lindauer, I. E., and J. P. Fitzgerald. 1974. Ecological survey and analysis of terrestrial communities at the Weld County (Hardin) proposed reservoir site. Unpublished report to U.S. Bureau of Reclamation, Denver, CO, by University of Northern Colorado, Greeley. 45 pp.
- Lindauer, I. E., and R. T. Ward. 1968. A survey of the woody phreatophytes in the lower Arkansas River Valley of Colorado. Unpublished report to U.S. Bureau of Reclamation, Denver, CO, by the Department of Botany, Colorado State University, Fort Collins. 46 pp.
- Lindauer, I. E., and S. J. Christy. 1972. An analysis of the woody vegetation on the South Platte River floodplain in northeastern Colorado. Unpublished report to the U.S. Bureau of Reclamation, Denver, CO, by the University of Northern Colorado, Biology Department, Greeley.
- Lindauer, I. E., J. P. Fitzgerald, and L. L. Lindauer. 1973. Ecological analyses of flood plain communities, Narrows Reservoir Site, Colorado. Unpublished report to U.S. Bureau of Reclamation, Denver, CO, by the University of Northern Colorado, Department of Biology, Greeley. 108 pp.
- Little, E. L. 1987. Pinyon trees (*Pinus edulis*) remeasured after 47 years. Pages 65-68 in: Proceedings - pinyon-juniper conference. General Technical Report INT-215. USDA Forest Service, Intermountain Research Station, Ogden, UT.
- Little, E. L., Jr. 1996. Forest trees of Oklahoma: How to know them. Oklahoma Forestry Services, State Department of Agriculture. Publication No. 1, Revised Edition No. 14. Oklahoma City. 205 pp.
- Livingston, R. B. 1947. An ecological study of the Black Forest region and adjacent plains. Unpublished dissertation, Duke University, Durham, NC. 134 pp.
- Livingston, R. B. 1949. An ecological study of the Black Forest, Colorado. Ecological Monographs 19:123-144.
- Lloyd, D. A., K. Angove, G. Hope, and C. Thompson. 1990. A guide for site identification and interpretation of the Kamloops Forest Region. 2 volumes. Land Management Handbook No. 23. British Columbia Ministry of Forests, Victoria, BC. [<http://www.for.gov.bc.ca/hfd/pubs/docs/lmh/lmh23.htm>]
- Lloyd, R. M., and R. S. Mitchell. 1973. A flora of the White Mountains, California and Nevada. University of California Press, Berkeley, CA.
- Logan Simpson Design. 2011. Lake Powell Pipeline Project vegetation resources studies: Draft vegetation communities report. Prepared for MWH Global, Inc., Boise, ID. 223 pp.
- Looman, J. 1981a. The vegetation of the Canadian prairie provinces. III. Aquatic and semi-aquatic vegetation. Phytocoenologia 9(4):473-497.
- Looman, J. 1982. The vegetation of the Canadian prairie provinces. III. Aquatic and semi-aquatic vegetation, Part 2. Freshwater marshes and bogs. Phytocoenologia 10(4):401-423.
- Loope, L. L. 1969. Subalpine and alpine vegetation of northeastern Nevada. Unpublished thesis, Duke University, Durham, NC.
- Loope, W. L. 1977. Relationships of vegetation to environment in Canyonlands National Park, Utah. Unpublished dissertation, Utah State University, Logan.
- Loope, W. L., and N. E. West. 1979. Vegetation in relation to environments of Canyonlands National Park. Pages 195-199 in: R. M. Linn, editor. Proceedings of the First Conference of Scientific Resources in the National Parks, Volume I. November 9-13, 1976, New Orleans. USDI National Park Service Transactions and Proceedings Series 5.
- Loveless, C. M. 1963. Ecological characteristics of a selected mule deer winter range. Unpublished dissertation, Colorado State University, Fort Collins. 318 pp.
- Loveless, C. M. 1967. Ecological characteristics of a mule deer winter range. Colorado Department of Game, Fish and Parks Technical Publication 20. 125 pp.
- Lovich, J. 2000. *Tamarix ramosissima/Tamarix chinensis/Tamarix gallica/Tamarix parviflora*. Pages 312-317 in: C. C. Bossard, J. M. Randall, and M. C. Hoshovsky, editors. Invasive plants of California's wildlands, University of California Press, Berkeley.
- Lucky McMine Application. No date. Nos. 356C and 356C-A2, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.
- Lundberg, C. E. 1977. The local composition and distribution of vegetation in the soda ash producing area of Sweetwater County, Wyoming. Unpublished thesis, University of Wyoming, Laramie.
- Lusby, G. C., G. T. Turner, J. R. Thompson, and V. H. Reid. 1963. Hydrologic and biotic characteristics of grazed and ungrazed watersheds of the Badger Wash Basin in western Colorado, 1953-1958. U.S. Geological Survey Water-Supply Paper 1532-B.
- Macdonald, K. B. 1977. Plant and animal communities of Pacific North American salt marshes. Pages 167-191 in: V. J. Chapman, editor. Ecosystems of the world. 1. Wet coastal ecosystems. Elsevier Scientific Publications Company, New York.
- MacDonald, K. B. 1988. Coastal salt marsh. Pages 263-294 in: M. G. Barbour and J. Major, editors. Terrestrial vegetation of California. California Native Plant Society, Special Publication No. 9.
- Mack, R. N. 1988. First comprehensive botanical survey of the Columbia Plateau, Washington, the Sandberg and Leiberger expedition of 1893. Northwest Science 62:118-127.
- MacKenzie, W. H., and J. R. Moran. 2004. Wetlands of British Columbia: A guide to identification. Land Management Handbook No. 52. Research Branch, British Columbia Ministry of Forests and Lands, Victoria, BC. 287 pp.
- MacKinnon, A., C. DeLong, and D. Meidinger. 1990. A field guide for identification and interpretation of ecosystems of the northwest portion of the Prince George Forest Region. Land Management Handbook No. 21. Province of British Columbia, Research Branch, Ministry of Forests, Victoria, BC.

- MacMahon, J. A. 1988. Warm deserts. Pages 232-264 in: M. G. Barbour and W. D. Billings, editors. North American terrestrial vegetation. Cambridge University Press, New York.
- MacMahon, J. A., and F. H. Wagner. 1985. The Mojave, Sonoran and Chihuahuan deserts of North America. Pages 105-202 in: M. Evenari and D. W. Goodall, editors. Ecosystems of the world 12A: Hot deserts and arid shrublands. Elsevier, New York.
- Major, J., and D. W. Taylor. 1977. Alpine. Pages 601-675 in: Barbour, M. G. and J. Major, eds. 1977. Terrestrial vegetation of California. John Wiley and Sons, New York.
- Malanson, G. P., and D. R. Butler. 1984. Transverse pattern vegetation on avalanche paths in the northern Rocky Mountains, Montana. *Great Basin Naturalist* 44(3):453-458.
- Manning, M. 1988. Ecology and rooting characteristics of four intermountain meadow community types. Unpublished thesis, University of Nevada, Reno.
- Manning, M. E., and W. G. Padgett. 1989. Preliminary riparian community type classification for Nevada. Draft report prepared for USDA Forest Service, Intermountain Region, Ogden, UT. 134 pp.
- Manning, M. E., and W. G. Padgett. 1991. Riparian community type classification for the Humboldt and Toiyabe national forests, Nevada and eastern California. Unpublished draft report prepared for USDA Forest Service, Intermountain Region Ecology and Classification Program, Ogden, UT. 490 pp.
- Manning, M. E., and W. G. Padgett. 1992. Riparian community type classification for the Humboldt and Toiyabe national forests, Nevada and eastern California. USDA Forest Service, Intermountain Region Ecology and Classification Program. 274 pp.
- Manning, M. E., and W. G. Padgett. 1995. Riparian community type classification for Humboldt and Toiyabe national forests, Nevada and eastern California. USDA Forest Service, Intermountain Region. 306 pp.
- Manning, S. J. 1994. Changes in Owens Valley vegetation due to groundwater pumping and six years of drought. *Crossosoma* 20:1-16.
- Mariah Associates. 1981. Vegetation baseline data analysis, Alton Coal lease study area. Volume 6, Chapter 3, Appendix 3.6-A in Mining and Reclamation Plan for Alton Mine, Utah International Inc. Utah Division of Oil, Gas and Mining Number ACT/025/003. Salt Lake City. Unpaginated.
- Marion, L. H. 1943. The distribution of *Adenostoma sparsifolium*. *The American Midland Naturalist* 29:106-116.
- Marks, M., B. Lapin, and J. Randall. 1994. *Phragmites australis* (*P. communis*): Threats, management, and monitoring. *Natural Areas Journal* 14(4):285-294.
- Marr, J. W. 1977a. The development and movement of tree islands near the upper limit of tree growth in the southern Rocky Mountains. *Ecology* 58:1159-1164.
- Marr, J. W., D. A. Boyce, and J. W. Todd. 1973b. Preliminary report on the Redcliff project, Eagle County, Colorado. Unpublished report to the D. E. Fleming Company, Denver, and the Colorado River Water Conservation District, Glenwood Springs, by University of Colorado, Boulder. 9 pp.
- Marr, J. W., D. L. Buckner, and D. L. Johnson. 1974. Ecological modification of alpine tundra by pipeline construction. Pages 10-17 in: Proceedings of a workshop on revegetation of high-altitude disturbed lands. Colorado State University, Environmental Resources Center Information. Series 10.
- Marr, J. W., D. M. Armstrong, H. Chronic, J. Chronic, R. W. Pennak, W. A. Weber, R. E. Marr, D. Steward, and J. C. Meyer. 1980. Natural landmarks of the southern Rocky Mountain region. Unpublished report prepared for USDI Heritage Conservation and Recreation Service, Denver, CO, by Thorne Ecological Institute, Boulder, CO. 736 pp.
- Marr, J. W., R. Fritz, J. Meyer, and P. Murphy. 1979. Final report-terrestrial plant ecology-stand ecosystem data tables, Juniper/Cross Mountain Project. Report prepared for Colorado River Water Conservation District, Glenwood Springs, CO, by University of Colorado, Boulder. 47 pp.
- Marriott, H. J., and D. Faber-Langendoen. 2000. The Black Hills community inventory. Volume 2: Plant community descriptions. The Nature Conservancy, Midwest Conservation Science Center and Association for Biodiversity Information, Minneapolis, MN. 326 pp.
- Marriott, H. J., and G. P. Jones. 1989. Special status plant surveys and plant community surveys in the Trapper Creek and Medicine Lodge Wilderness Study Areas and the Spanish Point Karst ACEC. Report submitted to the Bureau of Land Management, Worland District Office, under Cooperative Agreement Task Order No. WY910-CA9-001TQE1. Wyoming Natural Diversity Database, Laramie. 42 pp. plus appendices.
- Martin, R. E., J. E. Dealy, and D. L. Caraher, editors. 1978. Proceedings of the western juniper ecology/management workshop; January 1977; Bend, OR. General Technical Report PNW-74. USDA Forest Service, Pacific Northwest Range and Forest Experiment Station, Portland, OR.
- Martin, W. C., and C. R. Hutchins. 1980. Flora of New Mexico. Volume 1. A. R. Strauss and Cramer, Germany. 1276 pp.
- Masek, J. 1979. Vegetation community descriptions for the South Platte River in Colorado and Nebraska. Unpublished report prepared for the Water and Power Resources Service, Denver, CO. 23 pp.
- Maser, C., J. W. Thomas, and R. G. Anderson. 1984. Wildlife habitats in managed rangelands - the Great Basin of southeastern Oregon: The relationship of terrestrial vertebrates to plant communities and structural conditions. General Technical Report PNW-GTR-172. USDA Forest Service, Pacific Northwest Research Station, Portland, OR. 58 pp.
- Mason, L. R., H. M. Andrews, J. A. Carley, and E. D. Haacke. 1967. Vegetation and soils of No Man's Mesa relict area. *Journal of Range Management* 20:45-59.
- Mattson, D. J. 1984. Classification and environmental relationships of wetland vegetation in central Yellowstone National Park. Unpublished thesis, University of Idaho, Moscow. 409 pp.

- Mauk, R. L., and J. A. Henderson. 1984. Coniferous forest habitat types of northern Utah. General Technical Report INT-170. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 89 pp.
- Maxey, G. B., and T. E. Eakin. 1949. Ground water in White River Valley, White Pine, Nye and Lincoln counties, Nevada. Nevada Water Resources Bulletin No. 8. 54 pp., with map.
- Maxwell, E. L. 1975. Multispectral analysis of rangeland conditions. Unpublished dissertation, Colorado State University, Fort Collins. 198 pp.
- McArthur, E. D., and B. L. Welch, compilers. 1986. Proceedings-Symposium on the biology of *Artemisia* and *Chrysothamnus*. 1984 July 9-13, Provo, Utah. General Technical Report INT-200. USDA Forest Service, Intermountain Research Station, Ogden, UT. 398 pp.
- McAuliffe, J. R. 1995. Landscape evolution, soil formation, and Arizona's desert grasslands. Pages 100-129 in: M. P. McClaran and T. R. Van Devender, editors. The Desert Grassland. University of Arizona Press, Tucson.
- McClaran, M. P., and T. R. Van Devender. 1995. The desert grassland. The University of Arizona Press, Tucson, AZ. 346 pp.
- McEachern, K. 1979. Population biology of *Populus sargentii* in northeastern Colorado. Unpublished thesis, University of Northern Colorado, Greeley. 41 pp.
- McHargue, L. T. 1973. A vegetational analysis of the Coachella Valley, California. Dissertation, University of California, Irvine.
- McIntosh, A. C. 1923. Vegetation at different elevations in Boulder Canyon. Unpublished thesis, University of Colorado, Boulder. 35 pp.
- McKell, C. M. 1950. A study of plant succession in the oak brush (*Quercus gambelii*) zone after fire. Unpublished thesis, University of Utah, Salt Lake City. 79 pp.
- McLaughlin, S. P., and J. E. Bowers. 1982. Effects of wildfire on a Sonoran Desert plant community. Ecology 63(1):246-248.
- McLaughlin, S., and W. V. Asdall. 1980. Flora and vegetation of the Rosemont area. Pages 64-89 in: R. Davis and J. R. Callahan, editors. An environmental inventory of the Rosemont area in Southern Arizona, Volume 1: The Present Environment. Unpublished manuscript prepared for the Anamax Mining Company by the University of Arizona, Tucson.
- McLean, A. 1970. Plant communities of the Similkameen Valley, British Columbia, and their relationships to soils. Ecological Monographs 40(4):403-424.
- McPherson, G. R. 1995. The role of fire in the desert grasslands. Pages 130-151 in: M. P. McClaran and T. R. Van Devender, editors. The Desert Grassland. University of Arizona Press, Tucson.
- Medicine Bow Mine Application. No date. Application No. 331-T1, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.
- Meeuwig, R. O., and R. L. Bassett. 1983. Pinyon-juniper. Pages 84-86 in: R. M. Burns, compiler. Silvicultural systems for the major forest types of the United States. Agriculture Handbook No. 445. USDA Forest Service, Washington, DC.
- Mehl, M. S. 1992. Old-growth descriptions for the major forest cover types in the Rocky Mountain Region. Pages 106-120 in: M. R. Kaufmann, W. H. Moir, and R. L. Bassett. Old-growth forests in the southwest and Rocky Mountain regions. Proceedings of the old-growth forests in the Rocky Mountains and Southwest conference, Portal, AZ. March 9-13, 1992. General Technical Report RM-213. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
- Meidinger, D., A. McLeod, A. MacKinnon, C. DeLong, and G. Hope. 1988. A field guide for identification and interpretation of ecosystems of the Rocky Mountain Trench, Prince George Forest Region. Land Management Handbook No. 15. Province of British Columbia, Research Branch, Ministry of Forests and Lands, Victoria, BC.
- Meidinger, D., and J. Pojar, editors. 1991. Ecosystems of British Columbia. British Columbia Ministry of Forests Special Report Series No. 6. Victoria, BC. 330 pp.
- Merkle, J. 1962. Plant communities of the Grand Canyon area, Arizona. Ecology 43(4):698-711.
- Metcalfe, O. B. 1902. Flora of Mesilla Valley. Unpublished thesis, New Mexico State University, Las Cruces. 22 pp.
- Meyer, R. 2005. *Atriplex lentiformis*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 29 July 2011).
- Miller, D. A., D. A. Mouat, and B. D. Treadwell. 1977. Remote sensing analysis and literature survey pertaining to the vegetation of the Petrified Forest National Park. Report of work performed under NASA and the National Park Service. 48 pp.
- Miller, P. C. 1964. Factors influencing the vegetation pattern on the White River Plateau in northwestern Colorado. Unpublished dissertation, University of Colorado, Boulder. 208 pp.
- Miller, R. F., and J. A. Rose. 1995. Historic expansion of *Juniperus occidentalis* (western juniper) in southeastern Oregon. The Great Basin Naturalist 55(1):37-45.
- Milton, N. M., and T. L. Purdy. 1983. Plant and soil relationships in two hydrothermally altered areas of the Great Basin. Great Basin Naturalist 43(3):457-469.
- Mincemoyer, S. 2005. Range-wide status assessment of *Howellia aquatilis* (water howellia). Revised December 2005. Report to the U.S. Fish and Wildlife Service. Montana Natural Heritage Program, Helena. 21 pp. plus appendices.
- Minnich, R. A. 1987. The distribution of forest trees in northern Baja California, Mexico. Madroño 34:98-127.
- Minnich, R. A. 2007b. Southern California conifers. Pages 502-538 in: M. G. Barbour, T. Keeler-Wolf, and A. A. Schoenherr, editors. Terrestrial vegetation of California. Third edition. University of California Press, Berkeley.
- Mitsch, W. J., and J. G. Gosselink. 1993. Wetlands. Second edition. Van Nostrand Reinhold Company, New York. 722 pp.
- MNNHP [Minnesota Natural Heritage Program]. 1993. Minnesota's native vegetation: A key to natural communities. Version 1.5. Minnesota Department of Natural Resources, Natural Heritage Program, St. Paul, MN. 110 pp.
- Moir, W. H. 1963. Vegetational analysis of three southern New Mexico mountain ranges. Unpublished thesis, New Mexico State University, Las Cruces. 77 pp.

- Moir, W. H. 1967. The subalpine tall grass, *Festuca thurberi* community of Sierra Blanca, New Mexico. *Southwestern Naturalist* 12(3):321-328.
- Moir, W. H., and J. A. Ludwig. 1979. A classification of spruce-fir and mixed conifer habitat types of Arizona and New Mexico. Research Paper RM-207. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 47 pp.
- Moir, W. H., and J. H. Dieterich. 1988. Old-growth ponderosa pine from succession on pine-bunchgrass habitat types in Arizona and New Mexico. *Natural Areas Journal* 8:17-24.
- Moir, W. H., and J. O. Carleton. 1987. Classification of pinyon-juniper (P-J) sites on national forests in the Southwest. Pages 216-226 in: R. L. Everett, editor. *Proceedings of the Pinyon-Juniper Conference*, Reno, NV, 13-16 January 1986. General Technical Report. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 581 pp.
- Moir, W. H., B. Geils, M. A. Benoit, and D. Scurlock. 1997. Ecology of southwestern ponderosa pine forests. Pages 3-27 in: W. M. Block and D. M. Finch, technical editors. *Songbird ecology in southwestern ponderosa pine forests: A literature review*. General Technical Report RM-GTR-292. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 152 pp.
- Mooney, H. A. 1973. Plant communities and vegetation. In: R. M. Lloyd and R. S. Mitchell, editors. *A flora of the White Mountains, California and Nevada*. University of California Press, Berkeley, CA.
- Mooney, H. A., G. S. Andre, and R. D. Wright. 1962. Alpine and subalpine vegetation patterns in the White Mountains of California. *American Midland Naturalist* 68:257-273.
- Mooney, M. J. 1985. A preliminary classification of high elevation sagebrush-grass plant vegetation in northern and central Nevada. Unpublished thesis, University of Nevada, Reno. 118 pp.
- Moran, V. 2004a. Rare plant and vegetation surveys 2002 and 2003, Santa Ysabel Ranch Open Space Preserve. Unpublished report for the County of San Diego Department of Parks and Recreation and The Nature Conservancy, San Diego, CA.
- Moran, V. 2004b. Post-cedar ecosystem and rare plant impact survey 2004, Santa Ysabel Ranch Open Space Preserve. Unpublished report for The Nature Conservancy and the County of San Diego, Grass Valley, CA.
- Moretti, M. C. 1979. Vegetation and soil factors in relation to slope position: A study of plant communities on foothill knolls in the Uintah Basin of Utah. Unpublished thesis, Brigham Young University, Provo. 31 pp.
- Moretti, M. C., and J. D. Brotherson. 1982. Vegetation and soil factors in relation to slope position of foothill knolls in the Uinta Basin of Utah. *Great Basin Naturalist* 42(1):81-90.
- Morgan, M. D. 1969. Ecology of aspen in Gunnison County, Colorado. *The American Midland Naturalist* 82(1):204-228.
- Moseley, R. K. 1987a. Synecological relationships of alpine spike-fescue (*Leucopoa kingii* (Wats.) Weber) grasslands in eastcentral Idaho, U.S.A. Unpublished manuscript prepared for Arctic and Alpine Research. 33 pp.
- Moseley, R. K. 1987b. Area of Critical Environmental Concern and Research Natural Area proposal for the Malm Gulch and Germer Basin area, Bureau of Land Management, Salmon District, Idaho. Unpublished report prepared for USDI Bureau of Land Management, Salmon District, ID, by The Nature Conservancy, Moscow, ID. 18 pp.
- Moseley, R. K. 1987c. Idaho preserve design package: Formation Spring, Caribou County, Idaho. Unpublished report prepared by The Nature Conservancy, Idaho Field Office, Ketchum, ID. 9 pp.
- Moseley, R. K. 1998. Riparian and wetland community inventory of 14 reference areas in southwestern Idaho. Technical Bulletin 98-5. USDI Bureau of Land Management, Boise State Office, Boise, ID. 52 pp.
- Moseley, R. K., M. Mancuso, and C. Murphy. 1998. Field forms from riparian surveys in southwestern Idaho. Unpublished data on file at Idaho Conservation Data Center, Idaho Department of Fish and Game, Boise, ID.
- Moseley, R. K., M. Manusco, and J. Hiltly. 1992. Rare plant and riparian vegetation inventory of the Boise foothills, Ada County, Idaho. Unpublished report on file, Idaho Conservation Data Center (IDCDC), Department of Fish and Game, Boise, ID. 20 pp.
- Moseley, R. K., R. J. Bursik, and M. Manusco. 1991. Floristic inventory of wetlands in Fremont and Teton counties, Idaho. Unpublished report on file IDCDC Department of Fish & Game, Boise, ID. 60 pp.
- Moseley, R. K., R. J. Bursik, F. W. Rabe, and L. D. Cazier. 1994. Peatlands of the Sawtooth Valley, Custer, and Blaine counties, Idaho. Sawtooth NF/TNC/IdCDC Idaho Department of Fish & Game Cooperative Cost Share Project. SNF Purchase Order #40-0267-3-0233. 64 pp.
- Moulton, M. P., J. R. Choate, S. J. Bissell, and R. A. Nicholson. 1981. Associations of small mammals on the central high plains of eastern Colorado. *Southwestern Naturalist* 26(1):53-57.
- Mozingo, H. 1987. *Shrubs of the Great Basin: A natural history*. University of Nevada Press, Las Vegas. 342 pp.
- MTNHP [Montana Natural Heritage Program]. No date. Unpublished data on file. Montana Natural Heritage Program, Helena, MT.
- Mueggler, W. F. 1988. Aspen community types of the Intermountain Region. General Technical Report INT-250. USDA Forest Service, Intermountain Research Station, Ogden, UT. 135 pp.
- Mueggler, W. F., and R. B. Campbell, Jr. 1986. Aspen community types of Utah. Research Paper INT-362. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.
- Mueggler, W. F., and W. L. Stewart. 1980. Grassland and shrubland habitat types of western Montana. General Technical Report INT-66. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 154 pp.
- Muldavin, E. 1987. Gila Riparian Preserve Design. Unpublished report prepared for The Nature Conservancy, New Mexico Field Office by New Mexico Natural Heritage Program, Albuquerque.
- Muldavin, E. 1994. Organ Mountains sensitive species and plant community inventory. Unpublished report prepared by the New Mexico Natural Heritage Program, Albuquerque.

- Muldavin, E. H., R. L. DeVelice, and F. Ronco, Jr. 1996. A classification of forest habitat types of southern Arizona and portions of the Colorado Plateau. General Technical Report RM-GTR-287. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 130 pp.
- Muldavin, E., A. Kennedy, C. Jackson, P. Neville, T. Neville, K. Schulz, and M. Reid. 2011b. Vegetation classification and map: Bandelier National Monument. Natural Resource Technical Report NPS/SCPN/NRTR--2011/438. National Park Service, Fort Collins, CO.
- Muldavin, E., and P. Mehlhop. 1992. A preliminary classification and test vegetation map for White Sands Missile Range and San Andreas National Wildlife Refuge, New Mexico. University of New Mexico, New Mexico Natural Heritage Program.
- Muldavin, E., B. Sims, and L. Johnson. 1993b. Pecos Wild and Scenic River in stream flow report. Final report prepared for the USDA Forest Service, Santa Fe National Forest, Santa Fe, NM.
- Muldavin, E., et al. 1998c. Plant community inventory for Fort Bliss. Unpublished report in preparation by the New Mexico Natural Heritage Program, Albuquerque, NM.
- Muldavin, E., G. Harper, P. Neville, and Y. Chauvin. 1998b. The vegetation of White Sands Missile Range, New Mexico. Volume II. Vegetation map. Final report for Cooperative Agreement No. 14-16-00-91-233 White Sands Missile Range, U.S. Fish & Wildlife Service. The Nature Conservancy and the University of New Mexico.
- Muldavin, E., M. P. Moreno, J. Thomson, and P. Mehlhop. 1994b. A vegetation map for White Sands National Monument. Final report prepared for White Sands National Monument: Alamogordo, NM, by New Mexico Natural Heritage Program.
- Muldavin, E., P. Durkin, M. Bradley, M. Stuever, and P. Mehlhop. 2000a. Handbook of wetland vegetation communities of New Mexico. Volume I: Classification and community descriptions. Final report to the New Mexico Environment Department and the Environmental Protection Agency prepared by the New Mexico Natural Heritage Program, University of New Mexico, Albuquerque.
- Muldavin, E., P. Mehlhop, and E. DeBruin. 1994a. A survey of sensitive species and vegetation communities in the Organ Mountains of Fort Bliss. Volume III: Vegetation communities. Report prepared for Fort Bliss, Texas, by New Mexico Natural Heritage Program, Albuquerque.
- Muldavin, E., P. Neville, P. Arbetan, Y. Chauvin, A. Browder, and T. Neville. 2003a. A vegetation map of Carlsbad Caverns National Park, New Mexico. Final report submitted in partial fulfillment of Cooperative Agreement No. Ca-7170-99-004. New Mexico Natural Heritage Program at the University of New Mexico, Albuquerque. 102 pp.
- Muldavin, E., R. DeVelice, and W. Dick-Peddie. 1987. Forest habitat types of the Prescott, Tonto and western Coronado national forests, Arizona. Unpublished final report prepared for Rocky Mountain Forest and Range Experiment Station, CO. 71 pp.
- Muldavin, E., R. Wallace, and P. Mehlhop. 1993a. Riparian ecological site inventory for New Mexico Bureau Land Management lands. Final Report COOP Agreement F91070-0003, USDI Bureau of Land Management, New Mexico State Office, Santa Fe.
- Muldavin, E., V. Archer, and P. Neville. 1998a. A vegetation map of the Borderlands Ecosystem Management Area. Final report submitted to USDA Forest Service, Rocky Mountain Experiment Station, Flagstaff, AZ, by the New Mexico Natural Heritage Program, University of New Mexico, Albuquerque, NM. 58 pp.
- Muldavin, E., Y. Chauvin, and G. Harper. 2000b. The vegetation of White Sands Missile Range, New Mexico: Volume I. Handbook of vegetation communities. Final report to Environmental Directorate, White Sands Missile Range. New Mexico Natural Heritage Program, University of New Mexico, Albuquerque. 195 pp. plus appendices
- Muldavin, E., Y. Chauvin, T. Neville, P. Neville, A. Kennedy, H. Hulse, P. Arbetan, K. Schultz, M. Hall, and M. Reid. 2013c. Vegetation classification and map: El Malpais National Park. Natural Resource Technical Report NPS/SCPN/NRTR--2013/803. National Park Service, Fort Collins, CO.
[http://nhnm.unm.edu/vlibrary/pubs_archive/nhnm/nonsensitive/R13MUL01NMUS.pdf]
- Murray, M. P. 1991. Meadow vegetation change in the subalpine zone of the Marble Mountain Wilderness. Master's thesis, Humboldt State University, Arcata, CA.
- Mutel, C. F. 1973. An ecological study of the plant communities of certain montane meadows in the Front Range of Colorado. Unpublished thesis, University of Colorado, Boulder. 77 pp.
- Mutel, C. F. 1976. From grassland to glacier: An ecology of Boulder County, Colorado. Johnson Publishing Company, Boulder. 169 pp.
- Mutel, C., and J. W. Marr. 1973. A vegetative study of three montane herbaceous basins. *Journal of the Colorado-Wyoming Academy of Science* 7(4):28 (Abstract).
- Mutz, K. M., and J. Queiroz. 1983. Riparian community classification for the Centennial Mountains and South Fork Salmon River, Idaho. Unpublished report prepared for USDA Forest Service Intermountain Region under contract 53-84M8-2-0048 by Meiji Resource Consultants, Layton, UT. 168 pp.
- Mutz, K. M., and R. Graham. 1982. Riparian community type classification-Big Piney Range District, Wyoming. Unpublished report prepared for USDA Forest Service, Intermountain Region under contract 53-84M8-1-974, by Meiji Resource Consultants, Layton, UT. 88 pp.
- Myhre, J., and E. A. Clements. 1972. A study of the flora of the islands and the shoreline of the Snake River between Grandview, Idaho, and Guffey Butte, Owyhee County, Idaho. Unpublished report prepared for Biology Department, College of Idaho, Caldwell. 18 pp.
- Nachlinger, J. L. 1985. The ecology of subalpine meadows in the Lake Tahoe region, California and Nevada. Unpublished thesis, University of Nevada, Reno. 151 pp.

- Nachlinger, J. L., and G. A. Reese. 1996. Plant community classification of the Spring Mountains National Recreation Area, Clark and Nye counties, Nevada. Unpublished report submitted to USDA Forest Service, Humboldt-Toiyabe National Forest, Spring Mountains National Recreation Area, Las Vegas, NV. The Nature Conservancy, Northern Nevada Office, Reno, NV. 85 pp. plus figures and appendices.
- Nachlinger, J., K. Sochi, P. Comer, G. Kittel, and D. Dorfman. 2001. Great Basin: An ecoregion-based conservation blueprint. The Nature Conservancy, Reno, NV. 160 pp. plus appendices.
- Naphan E. A. 1966. Soils of the salt desert shrub areas and their productive capabilities. Pages 44-68 in: Proceeding: Salt desert shrub symposium. USDI, Bureau of Land Management. Cedar City, UT.
- National Wetlands Working Group. 1988. Wetlands of Canada. Ecological Land Classification Series, No. 24. Sustainable Development Branch, Environment Canada, Ottawa, Ontario, and Polyscience Publications Inc., Montreal, Quebec. 452 pp.
- National Wetlands Working Group. 1997. Wetlands of Canada. C. D. A. Rubec, editor. Ecological Land Classification Series No. 24. Environment Canada, Ottawa, and Polyscience Publications, Inc., Montreal. 452 pp.
- NatureServe. No date. International Ecological Classification Standard: International Vegetation Classification. Central Databases. NatureServe, Arlington, VA.
- Naumann, Tamara. Personal communication. Botanist, National Park Service, Dinosaur National Monument, Dinosaur, CO.
- NCC [The Nature Conservancy of Canada]. 2002. Canadian Rockies ecoregional plan. The Nature Conservancy of Canada, Victoria, BC.
- Neely, B., P. Comer, C. Moritz, M. Lammerts, R. Rondeau, C. Prague, G. Bell, H. Copeland, J. Humke, S. Spakeman, T. Schulz, D. Theobald, and L. Valutis. 2001. Southern Rocky Mountains: An ecoregional assessment and conservation blueprint. Prepared by The Nature Conservancy with support from the U.S. Forest Service, Rocky Mountain Region, Colorado Division of Wildlife, and Bureau of Land Management.
- Neill, W. M. 1985. Status reports on invasive weeds: Tamarisk. *Fremontia* 12:22.
- Neilson, R. P., and L. H. Wullstein. 1983. Biogeography of two southwest American oaks in relation to atmospheric dynamics. *Journal of Biogeography* 10:275-297.
- Nelson, L. P., and M. E. Jensen. 1987. Sagebrush-grass community types of the Humboldt National Forest. Unpublished report prepared for USDA Forest Service, Humboldt National Forest, Elko, NV. 80 pp.
- Nelson, M. G. 1976. The montane coniferous forests of the northern Deep Creek Range, Utah. Unpublished thesis, University of Utah, Salt Lake City. 73 pp.
- Newman, D. 1991. Element stewardship abstract for *Bromus rubens* [online]. The Nature Conservancy, Arlington, VA.
- Newman, D. 1992. Element Stewardship Abstract for *Cynodon dactylon*. The Nature Conservancy, Arlington, VA. [<http://www.invasive.org/gist/esadocs/documnts/cynodac.pdf>]
- NHNM [Natural Heritage New Mexico]. No date. Unpublished data on file. Natural Heritage New Mexico, University of New Mexico, Albuquerque.
- Nichols, J. T. 1964a. Soil-vegetation relationships of the 15-mile drainage, Washakie County, Wyoming. Unpublished dissertation, University of Wyoming, Laramie.
- Nichols, J. T. 1964b. Effect of protection from grazing on two vegetative types in the Big Horn Basin of Wyoming. *Wyoming Range Management* 19:60-69.
- Niering, W. A., and R. S. Warren. 1977. Our dynamic tidal marshes: Vegetation changes as revealed by peat analysis. *The Connecticut Arboretum Bulletin* 22.
- Nixon, E. S. 1977. A mountain *Cercocarpus* population revisited. *Great Basin Naturalist* 37:97-99.
- Nixon, K. C. 2002. The oak (*Quercus*) biodiversity of California and adjacent regions. General Technical Report PSW-GTR-184. USDA Forest Service, Pacific Southwest Research Station, Albany, CA.
- Northcutt, B. E. 1978. The plant ecology of Butler Wash, southeastern Utah. Unpublished thesis, University of Colorado, Boulder. 118 pp.
- Northwest Resources Co. 1981. Grass Creek Mine Application No. 211-T1, on file at Wyoming Department of environmental Quality, Land Quality Division, Cheyenne.
- Norton, B. E., J. Tuhy, and S. Jensen. 1981. Riparian community classification for the Grey's River, Wyoming. Unpublished final report prepared by Department of Range Science, Utah State University, Logan for USDA Forest Service, Region 4, Ogden, UT. 188 pp.
- Odion, D. C., R. M. Callaway, W. R. Ferren, and F. W. Davis. 1992. Vegetation of Fish Slough, an Owens Valley wetland ecosystem. Pages 171-196 in: C.A. Hall and B. Widawski, editors. The history of water: Eastern Sierra Nevada, Owens Valley, White-Inyo Mountains. White Mountains Research Station Symposium 4. University of California, White Mountain Research Station, Los Angeles, CA.
- Ogle, D. G. 2001. Crested wheat grass *Agropyron cristatum* (L.) Gaertn. In: Plant guide [online]. USDA NRCS National Plant Data Center, Baton Rouge, LA, and Boise, Idaho.
- Olson, R. A., and W. A. Gerhart. 1982. A physical and biological characterization of riparian habitat and its importance to wildlife in Wyoming. Unpublished report prepared for Wyoming Fish and Game Department, Cheyenne, WY. 188 pp.
- ORNHP [Oregon Natural Heritage Program]. No date. Unpublished data files. Oregon Natural Heritage Program, The Nature Conservancy, Portland, OR.
- Osborn, L. W. 1974. Soil-plant relationships in a saltgrass meadow. Unpublished thesis, Colorado State University, Fort Collins. 41 pp.

- Ostler, W. K., D. J. Hansen, D. C. Anderson, and D. B. Hall. 2000. Classification of vegetation on the Nevada Test Site. DOE/NV/11718-477. U.S. Department of Energy, Bechtel Nevada Ecological Services, Las Vegas, NV. 102 pp.
- Overholt, W. A., R. Diaz, M. Hanson, and D. Williams. 2015. *Phragmites* in Florida. ENY-860. Entomology and Nematology Department, UF/IFAS Extension. Revised March 2015 (Original publication date August 2011). [<https://edis.ifas.ufl.edu/pdffiles/IN/IN89800.pdf>]
- Ownbey, G. B., and T. Morley. 1991. Vascular plants of Minnesota: A checklist and atlas. University of Minnesota Press, Minneapolis.
- Padgett, W. G. 1982. Ecology of riparian plant communities in southern Malheur National Forest. Unpublished thesis, Oregon State University, Corvallis. 143 pp.
- Padgett, W. G., A. P. Youngblood, and A. H. Winward. 1988a. Riparian community type classification of Utah and southeastern Idaho. Research Paper R4-ECOL-89-0. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.
- Padgett, W. G., A. P. Youngblood, and A. H. Winward. 1988b. Riparian community type classification of Utah. Publication R4-ECOL-88-01. USDA Forest Service, Forest and Range Experiment Station, Ogden, UT.
- Padgett, W. G., A. P. Youngblood, and A. H. Winward. 1989. Riparian community type classification of Utah and southeastern Idaho. Research Paper R4-ECOL-89-0. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.
- Padgett, W. G., and M. E. Manning. 1988. Preliminary riparian community type classification for Nevada. Draft. Unpublished report prepared for USDA Forest Service Region IV, Intermountain Region Ecology and Classification Program, Ogden, UT.
- Page, C. N. 1997. The ferns of Britain and Ireland. Second edition. Cambridge University Press.
- Parson, D. J., and S. H. DeBenedetti. 1979. Impact of fire suppression in a mixed-conifer forest. *Forest Ecology and Management* 2:21-33.
- Pase, C. P., and E. F. Layser. 1977. Classification of riparian habitat in the Southwest. Pages 5-9 in: Importance, preservation and management of riparian habitats: A symposium. General Technical Report RM-43. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
- Passey, H. B., V. K. Hugie, E. W. Williams, and D. E. Ball. 1982. Relationships between soil, plant community, and climate on rangelands of the Intermountain West. USDA Soil Conservation Service, Technical Bulletin 1669. Salt Lake City, UT. 123 pp.
- Paulsen, H. A., Jr. 1960. Plant cover and forage use of alpine sheep ranges in the central Rocky Mountains. *Iowa State Journal of Science* 34(4):731-748.
- Paulsen, H. A., Jr. 1970a. The ecological response of species in a Thurber fescue community to manipulative treatments. Unpublished dissertation, Colorado State University, Fort Collins.
- Paulsen, H. A., Jr. 1970b. Competition and successional patterns on Thurber fescue grasslands of western U.S.A. XI International Grassland Congress (11/70) Proceedings 11:662-665.
- Pavek, D. S. 1993c. *Achnatherum speciosum*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>]
- Paysen, T. E., J. A. Derby, H. Black, Jr., V. C. Bleich, and J. W. Mincks. 1980. A vegetation classification system applied to southern California. General Technical Report PSW-45. USDA Forest Service, USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA.
- Paysen, T. E., R. J. Ansley, J. K. Brown, G. J. Gottfried, S. M. Haase, M. J. Harrington, M. G. Narog, S. S. Sackett, and R. C. Wilson. 2000. Chapter 6: Fire in western shrubland, woodland, and grassland ecosystems. Pages 121-159 in: J. K. Brown and J. Kapler-Smith, editors. *Wildland fire in ecosystems: Effects of fire on flora*. General Technical Report RMRS-GTR-42-volume 2. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT. 257 pp.
- Pearcy, F. W., and A. T. Harrison. 1974. Comparative photosynthetic and reparatory gas exchange characteristics of *Atriplex lentiformis* (Torr.) Wats in coastal and desert habitats. *Ecology* 55:1104-1111.
- Peet, R. K. 1975. Forest vegetation of the east slope of the northern Colorado Front Range. Unpublished dissertation, Cornell University, Ithaca, NY.
- Peet, R. K. 1978a. Latitudinal variation in southern Rocky Mountain forests. *Journal of Biogeography* 5:275-289.
- Peet, R. K. 1981. Forest vegetation of the Colorado Front Range. *Vegetatio* 45:3-75.
- Peet, R. K. 2000. Forests and meadows of the Rocky Mountains. Chapter 3 in: M. G. Barbour and W. D. Billings, editors. *North American terrestrial vegetation*. Second edition. Cambridge University Press, New York. 434 pp.
- Peinado, M., F. Alcaraz, J. Delgadillo, M. De La Cruz, J. Alvarez, and J. L. Aguirre. 1994b. The coastal salt marshes of California and Baja California: Phytosociological typology and zonation. *Vegetatio* 110:55-66.
- Peinado, M., F. Alcaraz, J. L. Aguirre, and J. Delgadillo. 1995c. Major plant communities of warm North American deserts. *Journal of Vegetation Science* 6:79-94.
- Peterson, D. L., and M. J. Russo. 1988. Element stewardship abstract for *Cortaderia jubata* [online]. The Nature Conservancy, Arlington, VA.
- Peterson, E. B. 2008. International Vegetation Classification alliances and associations occurring in Nevada with proposed additions. Nevada Natural Heritage Program, Carson City, NV. 348 pp.
- Peterson, Eric. Personal communication. Plant Ecologist, Nevada Natural Heritage Program, Department of Conservation and Natural Resources, Carson City, NV.
- Peterson, J. S. 1983. Status report for *Lupinus crassus*. Unpublished report prepared for the Colorado Natural Heritage, Fort Collins, CO.
- Peterson, P. M. 1984a. Flora and physiognomy of the Cottonwood Mountains, Death Valley National Monument, California. University of Nevada Cooperative National Park Resources Studies Unit Report CPSU/UNLV 022/06. Las Vegas, NV.

- Peterson, P. M. 1984b. Flora and physiognomy of the Cottonwood Mountains, Death Valley National Monument, California. Master's thesis, University of Nevada, Las Vegas, NV.
- Pfister, R. D. 1972. Vegetation and soils in the subalpine forests of Utah. Unpublished dissertation, Washington State University, Pullman. 98 pp.
- Pfister, R. D., B. L. Kovalchik, S. F. Arno, and R. C. Presby. 1977. Forest habitat types of Montana. General Technical Report INT-34. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 174 pp.
- Phillips, C. M. 1977. Willow carrs of the upper Laramie River Valley, Colorado. Unpublished thesis, Colorado State University, Fort Collins. 71 pp.
- Pickart, A. J. 2006. Vegetation of diked herbaceous wetlands of Humboldt Bay National Wildlife Refuge: Classification, description, and ecology. USDI Fish and Wildlife Service. Humboldt Bay National Wildlife Refuge, Arcata, CA.
- Pieper, R. D. 1968. Comparison of vegetation on grazed and ungrazed pinyon-juniper grassland sites in south-central New Mexico. *Journal of Range Management* 21:51-53.
- Pierce, J. R. 1986. Wetland community types of west-central Montana. Unpublished draft report prepared for the USDA Forest Service, Region One, Missoula, MT. 57 pp.
- Pierce, J. R., and Johnson. 1986. Livestock grazing and riparian/stream ecosystems. Pages 39-45 in: Proceedings, Forum - Grazing and riparian/stream ecosystems. Trout Unlimited, Inc., Vienna, VA.
- Pineda, P. M. 2000. Invertebrate inventory of Indian Spring Natural Area, Saguache County, Colorado. Field Season 1999. Final report to Colorado Natural Areas Program. Denver, CO. 37 pp.
- Pineda, P. M., R. J. Rondeau, and A. Ochs. 1999. A biological inventory and conservation recommendations for the Great Sand Dunes and San Luis Lakes, Colorado. Report prepared for The Nature Conservancy, San Luis Valley Program. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO. 86 pp.
- Potkin, M., and L. Munn. 1989. Subalpine and alpine plant communities in the Bridger Wilderness, Wind River Range, Wyoming. USDA Forest Service Contract No. 53-8555-3-00015. Department of Plant, Soil, and Insect Sciences, University of Wyoming, Laramie. 117 pp. plus appendix.
- Potter, D. A. 2005. Riparian plant community classification: West slope, central and southern Sierra Nevada, California. Technical Paper R5-TP-022. USDA Forest Service, Pacific Southwest Region, Vallejo, CA. 634 pp.
- Potter, L. D., R. C. Reynolds, Jr., and E. T. Louderbough. 1985. Mancos shale and plant community relationships: Analysis of shale, soil, and vegetation transects. *Journal of Arid Environments* 9:147-165.
- Poulton, C. E. 1955. Ecology of the non-forested vegetation in Umatilla and Morrow counties, Oregon. Unpublished dissertation. State College of Washington, Pullman. 166 pp.
- Powell, A. M. 1988b. Trees and shrubs of Trans-Pecos Texas including Big Bend and Guadalupe Mountains national parks. Big Bend Natural History Assoc., Inc. 536 pp.
- Powell, D. C. 1988a. Aspen community types of the Pike and San Isabel national forests in south-central Colorado. Report R2-ECOL-88-01. USDA Forest Service, Rocky Mountain Region, Denver, CO. 254 pp.
- Price, J., et al. 1981. Ecological study of the Alvord Basin Dunes, southeastern Oregon. Oregon State University Technical Report, Corvallis.
- Price, K. P., and J. D. Brotherson. 1987. Habitat and community relationships of cliffrose (*Cowania mexicana* var. *stansburiana*) in central Utah. *Great Basin Naturalist* 47(1):132-151.
- Ralston, G. L. 1969. Plant zonation on dune sands of Washoe Lake, Washoe County, Nevada. Unpublished thesis, University of Nevada, Reno.
- Ramaley, F. 1915. The relative importance of different species in a mountain grassland. *Botanical Gazette* 60:154-157.
- Ramaley, F. 1916a. Quadrat studies in a mountain grassland. *Botanical Gazette* 62:70-74.
- Ramaley, F. 1916b. Dry grassland of a high mountain park in northern Colorado. *The Plant World* 19(4):249-270.
- Ramaley, F. 1919a. The role of sedges in some Colorado plant communities. *American Journal of Botany* 6:120-130.
- Ramaley, F. 1937. Sand-hill vegetation in northwest-central Colorado. *Journal of the Colorado-Wyoming Academy of Science* 2(2):32-33.
- Ramaley, F. 1939a. Life forms of plants in Colorado sandhills. *Journal of the Colorado-Wyoming Academy of Science* 2(5):33 (Abstract).
- Ramaley, F. 1939b. Sand-hill vegetation of northeastern Colorado. *Ecological Monographs* 9:1-51.
- Ramaley, F. 1942. Vegetation of the San Luis Valley in southern Colorado. *University of Colorado Studies, Series D*, 1:231-277.
- Ratliff, R. D. 1979. Meadow sites of the Sierra Nevada, California: Classification and species relationships. Dissertation, New Mexico State University, Las Cruces, NM.
- Ratliff, R. D. 1982. A meadow site classification for the Sierra Nevada, California. General Technical Report PSW-10. USDA Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, CA. 16 pp.
- Ratliff, R. D. 1985. Meadows in the Sierra Nevada of California: State of knowledge. General Technical Report PSW-84. USDA Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, CA. 52 pp.
- Ream, R. D. 1960. An ordination of the oak communities of the Wasatch Mountains. M.S. thesis, University of Utah, Salt Lake City. 52 pp.
- Ream, R. R. 1964. The vegetation of the Wasatch Mountains, Utah and Idaho. Unpublished Ph.D. dissertation, University of Wisconsin, Madison. 190 pp.
- Redente, E. F., J. E. Friedlander, and T. McLendon. 1992. Response of early and late semiarid seral species to nitrogen and phosphorus gradients. *Plant and Soil* 140(1):127-135.

- Redmann, R. E. 1972. Plant communities and soils of an eastern North Dakota prairie. *Bulletin of the Torrey Botanical Club* 99(2):65-76.
- Reed, P. B., Jr. 1988. National list of plant species that occur in wetlands: 1988 national summary. USDI Fish & Wildlife Service. Biological Report 88(24).
- Reid, M. 1990. Yampa River Basin riparian vegetation classification project. Unpublished data prepared for The Nature Conservancy, Colorado Field Office and Western Heritage Task Force, Boulder, CO.
- Reid, M. S., and M. E. Hall. 2010. Vegetation classification of Grand Canyon National Park. Draft report submitted to National Park Service, Fort Collins, CO.
- Reid, M. S., K. A. Schulz, P. J. Comer, M. H. Schindel, D. R. Culver, D. A. Sarr, and M. C. Damm. 1999. An alliance level classification of vegetation of the coterminous western United States. Unpublished final report to the University of Idaho Cooperative Fish and Wildlife Research Unit and National Gap Analysis Program, in fulfillment of Cooperative Agreement 1434-HQ-97-AG-01779. The Nature Conservancy, Western Conservation Science Department, Boulder, CO.
- Reid, M. S., L. S. Engelking, and P. S. Bourgeron. 1994. Rare plant communities of the conterminous United States, Western Region. Pages 305-620 in: D. H. Grossman, K. L. Goodin, and C. L. Reuss, editors. Rare plant communities of the conterminous United States, an initial survey. The Nature Conservancy, Arlington, VA.
- Reid, W. H. 1974. Analysis of plant ecological systems through simulation of individual organisms. Unpublished dissertation, University of Colorado, Boulder. 265 pp.
- Reid, W. H. 1980. Vegetative structure, physical environment and disturbance in White Sands National Monument, New Mexico. Pages 71-85 in: Proceedings of the Second Conference on Scientific Research in the National Parks, Volume 9. Human Impact on Natural Resources.
- Reynolds, S. A., and E. L. Berlow. 2002. *Artemisia rothrockii*. In: J. K. Francis, editor. Wildland shrubs of the United States and its territories: Thamnisc descriptions [online]. USDA Forest Service, International Institute of Tropical Forestry and Shrub Sciences Laboratory, Provo, UT.
- Rice, B. L., and M. Westoby. 1978. Vegetative responses of some Great Basin shrub communities protected against jackrabbits or domestic stock. *Journal of Range Management* 31(1):28-34.
- Richard, C., G. Kittel, and S. Kettler. 1996. A classification of the riparian vegetation of the San Juan National Forest. Draft 1 report. Colorado Natural Heritage Program, Colorado State University, Fort Collins.
- Rickard, W. H., and J. C. Beatley. 1965. Canopy-coverage of the desert shrub vegetation mosaic of the Nevada Test Site. *Ecology* 46(4):524-529.
- Riser, R. J., and M. Fry. 1994. Montane shrubland--SRM 209. Page 18 in: T. N. Shiflet, editor. Rangeland cover types of the United States. Society for Range Management, Denver, CO.
- Roberts, D. W., D. W. Wight, and G. P. Hallsten. 1992. Plant community distribution and dynamics in Bryce Canyon National Park. Unpublished final report for Bryce Canyon National Park Project PX1200-7-0966. 146 pp.
- Robertson, J. H. 1971. Changes on a sagebrush-grass range in Nevada ungrazed for 30 years. *Journal of Range Management* 24:397-400.
- Rocchio, Joe. Personal communication. Ecologist. Washington Natural Heritage Program, Department of Natural Resources, Olympia, WA.
- Rodriguez, D., K. G. Sikes, T. Keeler-Wolf, G. Kittel, J. Curtis, C. Curley, and J. Evens. 2017. Vegetation classification of Channel Islands National Park. Report to the National Park Service, Fort Collins, CO.
- Rogers, C. M. 1953. The vegetation of the Mesa de Maya region of Colorado, New Mexico, and Oklahoma. *Lloydia* 16(4):257-290.
- Romme, W. H. 1982. Fire and landscape diversity in subalpine forests of Yellowstone National Park. *Ecological Monographs* 52:199-221.
- Romme, W. H., C. D. Allen, J. D. Balley, W. L. Baker, B. T. Bestelmeyer, P. M. Brown, K. S. Eisenhart, M. L. Floyd, D. W. Huffman, B. F. Jacobs, R. F. Miller, E. H. Muldavin, T. W. Swetnam, R. J. Tausch, and P. J. Weisberg. 2009. Historical and modern disturbance regimes, stand structures, and landscape dynamics in pinon-juniper vegetation of the western United States. *Rangeland Ecology & Management* 62:203-222.
- Romme, W. H., L. Floyd-Hanna, and D. D. Hanna. 2003. Ancient pinon-juniper forests of Mesa Verde and the West: A cautionary note for forest restoration programs. Pages 335-350 in: P. N. Omi and L. A. Joyce, technical editors. Fire, fuel treatments, and ecological restoration: Conference proceedings. RMRS-P-29. USDA Forest Service, Rocky Mountain Forest and Experiment Station, Fort Collins, CO.
- Rondeau, R. 2001. Ecological system viability specifications for Southern Rocky Mountain ecoregion. First edition. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO. 181 pp.
- Rothwell, G. W. 1996. Pteridophytic evolution: An often underappreciated phylogenetic success story. *Review of Paleobotany and Palynology* 90:209-222.
- Roughton, R. D. 1966. Age structure of browse populations. Unpublished thesis, Colorado State University, Fort Collins. 154 pp.
- Roughton, R. D. 1972. Shrub age structures on a mule deer winter range in Colorado. *Ecology* 53(4):615-625.
- Rundel, P. W., D. J. Parsons, and D. T. Gordon. 1977. Montane and subalpine vegetation of the Sierra Nevada and Cascade Ranges. Pages 559-599 in: M. G. Barbour and J. Major, editors. Terrestrial vegetation of California. Wiley-Interscience, reprinted 1988 by the California Native Plant Society, Sacramento, CA.

- Rust, S. K. 1999. Pinyon-juniper woodland classification and description in Research Natural Areas of southeastern Idaho. In: S. B. Monson and R. Stevens, compilers. Proceedings: Ecology and management of pinyon-juniper communities within the interior west; 1997 September 15-18; Provo, UT. Proceedings RMRS-P-9. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT. 411 pp.
- Rust, Steve. Personal communication. Ecologist, Conservation Data Center, Idaho Department of Fish and Game, Boise, ID.
- Rydberg, P. A. 1915. Phytogeographical notes on the Rocky Mountain Region. V. Grasslands of the subalpine and montane zones. *Bulletin of the Torrey Botanical Club* 42:629-643.
- Rzedowski, J. 1981. *Vegetación de México*. Editorial Limusa, Mexico City, Mexico. 432 pp.
- Sabinske, D. W. 1972. The sagebrush community of Grand Teton National Park: A vegetation analysis. Unpublished thesis, University of Wyoming, Laramie.
- Sada, D. W., and D. J. Cooper. 2012. Furnace Creek springs restoration and adaptive management plan, Death Valley National Park, California. Report for Death Valley National Park. Desert Research Institute, Reno, NV, and Colorado State University, Fort Collins, CO.
- Saltonstall, K. 2002. Cryptic invasion by a non-native genotype of the common reed, *Phragmites australis*, into North America. *Proceedings of the National Academy of Science* 99:2445-2449.
- Saltonstall, K., P. M. Peterson, and R. J. Soreng. 2004. Recognition of *Phragmites australis* subsp. *americanus* (Poaceae: Arundinoideae) in North America: Evidence from morphological and genetic analyses. *Sida* 21:683-692.
- Sanderson, J., and M. March. 1996. Extreme rich fens of South Park, Colorado: Their distribution, identification, and natural heritage significance. Report submitted to Park County, the Colorado Department of Natural Resources, and the Environmental Protection Agency. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.
- Sanderson, J., and S. Kettler. 1996. A preliminary wetland vegetation classification for a portion of Colorado's west slope. Report prepared for Colorado Department of Natural Resources, Denver, CO, and U.S. Environmental Protection Agency, Region VIII, Denver, CO. Colorado Natural Heritage Program, Fort Collins, CO. 243 pp.
- Sarr, D. 1995. Grazing, graminoids, and hysteresis: Exploring relationships between livestock production, riparian communities, and ecosystem recovery in the southern Sierra Nevada, California. Unpublished M.A. thesis, University of California, Santa Barbara. 167 pp.
- Saul, S. 1974. A report on the proposed Harney Lake Research Natural Area. Malheur National Wildlife Refuge, Burns, OR. 16 pp.
- Savage, D. E. 1968. The relationship of sage grouse to upland meadows in Nevada. Unpublished thesis, University of Nevada, Reno.
- Savage, M., and T. W. Swetnam. 1990. Early 19th-century fire decline following sheep pasturing in a Navajo ponderosa pine forest. *Ecology* 71(6):2374-2378.
- Sawyer, J. O. 2006. *Northwest California: A natural history*. University of California Press, Berkeley, CA.
- Sawyer, J. O. 2007. Forests of northwestern California. Pages 253-295 in: M. G. Barbour, T. Keeler-Wolf, and A. Schoenherr, editors. *Terrestrial vegetation of California*, third edition. University of California Press, Berkeley, CA.
- Sawyer, J. O., and D. A. Thornburgh. 1977. Montane and subalpine vegetation of the Klamath Mountains. Pages 699-732 in: M. G. Barbour and J. Major, editors. *Terrestrial vegetation of California*. John Wiley and Sons, New York.
- Sawyer, J. O., and T. Keeler-Wolf. 1995. *A manual of California vegetation*. California Native Plant Society, Sacramento. 471 pp.
- Sawyer, J. O., and T. Keeler-Wolf. 2007. Alpine vegetation. Pages 539-573 in: M. G. Barbour, T. Keeler-Wolf, and A. A. Schoenherr, editors. *Terrestrial vegetation of California*. Third edition. University of California Press, Berkeley.
- Sawyer, J. O., T. Keeler-Wolf, and J. Evens. 2009. *A manual of California vegetation*. Second edition. California Native Plant Society, Sacramento CA. 1300 pp.
- Scher, J. S. 2002. *Juniperus scopulorum*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 25 June 2015).
- Schlatterer, E. F. 1972. A preliminary description of plant communities found on the Sawtooth, White Cloud, Boulder, and Pioneer mountains. Unpublished report prepared for USDA Forest Service, Intermountain Region, Ogden, UT. 111 pp.
- Schlesinger, W. H., J. F. Reynolds, G. L. Cunningham, L. F. Hueneke, W. M. Jarrell, R. A. Virginia, and W. G. Whitford. 1990. Biological feedbacks in global desertification. *Science* 247:1043-1048.
- Schlesinger, R. A., and E. L. Sanders. 1982. Quantitative analysis of vegetation at the Richvale vernal pools, California. *American Journal of Botany* 69:734-742.
- Schmoll, H. M. 1935. *Vegetation of the Chimney Rock area, Pagosa-Piedra region, Colorado*. Private Edition, Distributed by University of Chicago Libraries, Chicago, IL. 58 pp.
- Schoenherr, A. A., and J. H. Burk. 2007. Colorado Desert vegetation. Pages 657-682 in: M. G. Barbour, T. Keeler-Wolf, and A. A. Schoenherr, editors. 2007. *Terrestrial vegetation of California*. Third edition. University of California Press, Berkeley.
- Schramm, D. R. 1982. Floristics and vegetation of the Black Mountains, Death Valley National Monument. Unpublished report prepared for the University of Nevada, Las Vegas.
- Schulz, K. A., and M. E. Hall. 2011. Vegetation inventory project: Great Basin National Park. Unpublished report submitted to USDI National Park Service, Mojave Desert Inventory and Monitoring Network. NatureServe, Western Regional Office, Boulder, CO. 30 pp. plus Appendices A-H.
- Scow, K. L., L. D. Culwell, and L. A. Larsen. 1987. Vegetation inventory of the Rock Creek Study Area, Sanders County, Montana. Unpublished report prepared for Asarco, Inc., Wallace, ID.
- Seminole I Mine Application. No date. Application No. 378-T1, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne, WY.

- Seyer, S. 1984. Inventory of Guard Slough wild-rye stand. Unpublished report prepared for Oregon Natural Heritage Program, Portland, OR.
- Shanks, D. L. 1977. Aerial photo densitometry for rangeland planning and evaluation. Unpublished thesis, Colorado State University, Fort Collins. 66 pp.
- Shantz, H. L. 1924. Desert shrub vegetation. From Atlas of American Agriculture. Part I. The physical basis of agriculture. Section E, Natural vegetation. USDA Bureau of Agricultural Economics, Washington, DC. 9 pp.
- Shaw, D. W., E. F. Aldon, and C. LoSapio, technical coordinators. 1995. Desired future conditions for pinon-juniper ecosystems. Proceedings from the symposium; 1994 August 8-12; Flagstaff, AZ. General Technical Report RM-258. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 226 pp.
- Shaw, N. L., M. R. Haferkamp, and E. G. Hurd. 2002. *Grayia spinosa*. In: J. K. Francis, editor. Wildland shrubs of the United States and its territories: Thamnisc descriptions online. USDA Forest Service, International Institute of Tropical Forestry and Shrub Sciences Laboratory, Provo, UT.
- Shaw, R. B., S. L. Anderson, K. A. Schultz, and V. E. Diersing. 1989. Plant communities, ecological checklist, and species list for the U.S. Army Pinon Canyon Maneuver Site, Colorado. Colorado State University, Department of Range Science, Science Series No. 37, Fort Collins. 71 pp.
- Shaw, S., and C. G. Fredine. 1971. Wetlands of the United States. Circular 39. U.S. Department of the Interior, U.S. Fish and Wildlife Service, Washington, DC. 67 pp.
- Sheehy, D. P., and A. H. Winward. 1981. Relative palatability of seven *Artemisia* taxa to mule deer and sheep. Journal of Range Management 34(5):397-399.
- Shelford, V. E. 1954. Some lower Mississippi Valley flood plain biotic communities: Their age and elevation. Ecology 35:1-14.
- Shephard, M. E. 1995. Plant community ecology and classification of the Yakutat Foreland, Alaska. R10-TP-56. USDA Forest Service, Alaska Region. 213 pp. plus appendices.
- Shepherd, H. R. 1975. Vegetation of two dissimilar bighorn sheep ranges in Colorado. Colorado Division of Wildlife Report 4. 223 pp.
- Shepperd, W. D., P. C. Rogers, D. Burton, and D. L. Bartos. 2006. Ecology, biodiversity, management, and restoration of aspen in the Sierra Nevada. General Technical Report RMRS-GTR-178. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO. 122 pp.
- Shields, L. M., W. H. Rickard, and F. Drouet. 1959. A botanical study of nuclear effects at the Nevada Test Site. 1958 Annual Report, New Mexico Highlands University, to U.S. Atomic Energy Commission.
- Shiflet, T. N., editor. 1994. Rangeland cover types of the United States. Society for Range Management. Denver, CO. 152 pp.
- Shupe, J. B., J. D. Brotherson, and S. R. Rushforth. 1986. Patterns of vegetation surrounding springs in Goshen Bay, Utah County, Utah, U.S.A. Hydrobiologia 139:97-107.
- Shute, D., and N. E. West. 1978. The application of ECOSYM vegetation classifications to rangelands near Price, Utah. Appendix reports 14 and 16 in: J. A. Henderson, L. S. Davis, and E. M. Ryberg, editors. ECOSYM: A classification and information system for wildland resource management. Utah State University, Logan. 53 pp.
- Simkins, E. C. 1931. The alpine flora of Mt. Niwot, Colorado. Unpublished thesis, University of Colorado, Boulder. 68 pp.
- Simonin, K. A. 2001a. *Atriplex confertifolia*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 29 July 2011).
- Simonin, K. A. 2001b. *Bromus rubens*, *Bromus madritensis*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 16 December 2013).
- Simpson, J. 1876. Report of explorations across the Great Basin of the territory of Utah for a direct wagon-route from Camp Floyd to Genoa, in Carson Valley, in 1859. Government Printing Office, Washington, DC. 518 pp.
- Singh, T., and N. E. West. 1971. Comparison of some multivariate analyses of perennial *Atriplex* vegetation in southeastern Utah. Vegetatio 23(5-6):289-313.
- Skull Point Mine Application. No date. Application No. 2335-T2, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.
- Skull Point Mine Permit Renewal. No date. On file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.
- Smith, D. R. 1967. Effects of cattle grazing on a ponderosa pine-bunchgrass range in Colorado. General Technical Bulletin 1371. USDA Forest Service, Washington, DC. 60 pp.
- Smith, E. L., Jr. 1966. Soil-vegetation relationships of some *Artemisia* types in North Park, Colorado. Unpublished dissertation, Colorado State University, Fort Collins. 27 pp.
- Smith, J. No date (b). Comprehensive data base for surface mining in Wyoming. Unpublished data, Department of Environmental Quality, Land Quality Division, Cheyenne.
- Smith, J. P., Jr., and K. W. Allred. 2016. *Phragmites australis*. In Jepson Flora Project, editors. Jepson eFlora. [http://ucjeps.berkeley.edu/cgi-bin/get_IJM.pl?tid=37931] (accessed on November 18, 2016).
- Smith, S. 1994b. Ecological guide to eastside pine plant associations, northeastern California. R5-ECOL-TP-004. USDA Forest Service, Pacific Southwest Region, San Francisco, CA. 174 pp.
- Smith, S. 1998b. Riparian community type classification for national forests in northeastern California: First approximation. USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA.

- Smith, S. D., and C. L. Douglas. 1989. The ecology of saltcedar (*Tamarix chinensis*) in Death Valley National Monument and Lake Mead National Recreation Area: An assessment of techniques and monitoring for saltcedar control in the park system. University of Nevada Cooperative National Park Resources Studies Unit Report 041/03, Las Vegas. 63 pp.
- Sogge, M. K., S. J. Sferra, and E. H. Paxton. 2008. *Tamarix* as habitat for birds: Implications for riparian restoration in the southwestern United States. *Restoration Ecology* 16(1):145-154.
- Soil Conservation Service. 1978. Range site descriptions for Colorado. Technical Guide, Section II-E. USDA Soil Conservation Service, Colorado State Office, Denver.
- Soil Conservation Service. No date. Range site descriptions of vegetation in Colorado. Unpublished report series MLRA dating from 1975 to 1989. Soil Conservation Service, Colorado Field Office, Denver.
- Solomeshch, A., and M. Barbour. 2006. Defining restoration targets for Great Valley Grassland State Park. *Grasslands* 16:1, 12-17.
- Spackman, S., B. Jennings, J. Coles, C. Dawson, M. Minton, A. Kratz, and C. Spurrier. 1997. Colorado rare plant field guide. Prepared for Bureau of Land Management, U.S. Forest Service and U.S. Fish and Wildlife Service by Colorado Natural Heritage Program.
- Spolsky, A. M. 1979. An overview of the plant communities of Anza Borrego Desert State Park. Unpublished report. State of California, The Resource Agency, Department of Parks and Recreation, Anza-Borrego Desert State Park, Borrego Springs, CA.
- Sproul, F., T. Keeler-Wolf, P. Gordon-Reedy, J. Dunn, A. Klein, and K. Harper. 2011. Vegetation classification manual for western San Diego County. AECOM, California Department of Fish and Game, San Diego Area Governments.
- Starr, C. R. 1974. Subalpine meadow vegetation in relation to environment at Headquarters Park, Medicine Bow Mountains, Wyoming. Unpublished thesis, University of Wyoming, Laramie.
- Stearns-Roger, Inc. 1978. Rawhide Energy Project. Transmission system, ecological investigations. Volume II. Technical baseline report to Platte River Power Authority. 51 pp.
- Stebbins, G. L., and J. Major. 1965. Endemism and speciation in the California flora. *Ecological Monographs* 35:1-35.
- Stebbins, R. C. 2003. A field guide to western reptiles and amphibians. Third edition. Houghton Mifflin Company, Boston.
- Steele, R. 1990. *Pinus flexilis*, limber pine. Pages 348-354 in: R. M. Burns and B. H. Honkala, editors. *Silvics of North America*. Volume 1: Conifers. Agriculture Handbook 654. USDA Forest Service, Washington, DC.
- Steele, R., and K. Geier-Hayes. 1995. Major Douglas-fir habitat types of central Idaho: A summary of succession and management. General Technical Report INT-GTR-331. USDA Forest Service, USDA Forest Service Intermountain Research Station, Ogden, UT.
- Steele, R., R. D. Pfister, R. A. Ryker, and J. A. Kittams. 1981. Forest habitat types of central Idaho. General Technical Report INT-114. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 138 pp.
- Steele, R., S. V. Cooper, D. M. Ondov, D. W. Roberts, and R. D. Pfister. 1983. Forest habitat types of eastern Idaho - western Wyoming. General Technical Report INT-144. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 122 pp.
- Steen, O. A., and R. A. Coupé. 1997. A field guide to forest site identification and interpretation for the Cariboo Forest Region. Land Management Handbook No. 39. Parts 1 and 2. British Columbia Ministry of Forests Research Program, Victoria, BC.
- Steen, O. A., and R. L. Dix. 1974. A preliminary classification of Colorado subalpine forests: A working guide. Unpublished report prepared by the USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 9 pp.
- Steger, R. E. 1970. Soil moisture and temperature relationships of six salt desert shrub communities in northcentral Wyoming. Unpublished thesis, University of Wyoming, Laramie.
- Steinauer, G. 1989. Characterization of the natural communities of Nebraska. Appendix D, pages 103-114 in: M. Clausen, M. Fritz, and G. Steinauer. The Nebraska Natural Heritage Program, two year progress report. Unpublished document. Nebraska Game and Parks Commission, Natural Heritage Program, Lincoln, NE.
- Steinberg, P. D. 2002a. *Artemisia arbuscula*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 30 May 2011).
- Steinhoff, H. W. 1978. Management of Gambel oak associations for wildlife and livestock. Unpublished report prepared for USDA Forest Service, Denver, CO. 119 pp.
- Stewart, B. K. 1940. Plant ecology and paleoecology of the Creede Valley, Colorado. Unpublished dissertation, University of Colorado, Boulder. 154 pp.
- Stillman, K. T. 1980. Meadow vegetation on meta-sedimentary and metavolcanic parent materials in the north central Marble Mountains, California. Master's thesis, Humboldt State University, Arcata, CA.
- Stoddart, L. A. 1941. The palouse grassland association in northern Utah. *Ecology* 22(2):158-163.
- Stoecker-Keammerer Consultants. No date (a). Black Thunder Mine Application No. 233-T3, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.
- Stone, C., M. G. Willoughby, and A. Rosendal. 2007. Guide to range plant community types and carrying capacity for the Peace River Parkland subregion in Alberta: First approximation. Publication No. T/143. Sustainable Resource Development, Agriculture and Agri-Food Canada, Edmonton. 143 pp. ISBN: 978-0-7785-6500 [online edition].
- Stout, D., J. Buck-Diaz, S. Taylor, and J. M. Evens. 2013. Vegetation mapping and accuracy assessment report for Carrizo Plain National Monument. California Native Plant Society, Vegetation Program, Sacramento, CA. 71 pp.
- Stromberg, J. 1995a. Mesquite bosques. Element Stewardship Abstract prepared for The Nature Conservancy, AZ. 30 pp.
- Stromberg, J. 1995b. *Populus fremontii* - *Salix gooddingii* Riparian Forest. Element Stewardship Abstract prepared for The Nature Conservancy, AZ. 30 pp.

- Stromberg, J. C. 1993a. Fremont cottonwood-Goodding willow riparian forests: A review of their ecology, threats, and recovery potential. *Journal of the Arizona-Nevada Academy of Science* 27(1):97-110.
- Strong, L. L. 1980. Estimating phytomass production of habitat types on sagebrush steppe. Unpublished thesis, Colorado State University, Fort Collins. 133 pp.
- Stuever, M. C., and J. S. Hayden. 1997a. Plant associations of Arizona and New Mexico. Edition 3. Volume 2: Woodlands. USDA Forest Service, Southwestern Region, Habitat Typing Guides. 196 pp.
- Sturges, D. L. 1968. Hydrologic properties of peat from a Wyoming mountain bog. *Soil Science* 106:262-264.
- Sugihara, N. G., J. W. van Wagtenonk, K. E. Shaffer, J. Fites-Kaufman, and A. E. Thode, editors. 2006. Fire in California's ecosystems. University of California Press, Berkeley.
- Sullivan, J. 1992. *Lolium perenne*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>]
- Sullivan, J. 1993a. *Equisetum arvense*. In: Fire Effects Information System [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [http://www.fs.fed.us/database/feis/plants/fern/equarv/botanical_and_ecological_characteristics.html] (accessed January 2006)
- Swanson, D. K., C. L. Schmitt, D. M. Shirley, V. Erickson, K. J. Schuetz, M. L. Tatum, and D. C. Powell. 2010. Aspen biology, community classification, and management in the Blue Mountains. General Technical Report PNW-GTR-806. USDA Forest Service Forest Service, Pacific Northwest Research Station, Portland, OR. 117 pp.
- Swearingen, J., and K. Saltonstall. 2010. *Phragmites* field guide: Distinguishing native and exotic forms of common reed (*Phragmites australis*) in the United States. Plant Conservation Alliance, Weeds Gone Wild. [<http://www.nps.gov/plants/alien/pubs/index.htm>]
- Swearingen, J., and K. Saltonstall. 2012. *Phragmites* field guide: Distinguishing native and exotic forms of common reed (*Phragmites australis*) in the United States. TN Plant Materials No. 56. USDA Natural Resources Conservation Service, Boise, ID. 23 pp. [http://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/idpmctn11494.pdf]
- Sweetwater Uranium Project. 1978. Application No. 481, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.
- Sweetwater Uranium Project. No date. Application for amendment No. 1, on file at Wyoming Department of Environmental Quality, Land Quality Division, Cheyenne.
- Szaro, R. C. 1989. Riparian forest and scrubland community types of Arizona and New Mexico. *Desert Plants Special Issue* 9(3-4):70-139.
- Tanner, W. W. 1983. *Lampropeltis pyromelana*. *Catalogue of American Amphibians and Reptiles* 342.1-342.2.
- Tart, D. L. 1996. Big sagebrush plant associations of the Pinedale Ranger District. Final review draft. Bridger-Teton National Forest, Jackson WY. 97 pp.
- Taylor, D. W. 1979. Ecological survey of the vegetation of White Mountain Natural Area, Inyo National Forest, California. Unpublished report. USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA.
- Taylor, D. W. 1984. Vegetation of the Harvey Monroe Hall Research Natural Area, Inyo National Forest, California. Unpublished report. USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA.
- Taylor, D. W. 1990. Indian Summit RNA. Pages 72-73 in: T. Keeler-Wolf. Ecological surveys of Forest Service Research Natural Areas in California. General Technical Report PSW-125. USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA.
- Taylor, D. W., and D. C. Randall. 1977. Ecological survey of the vegetation of the proposed Peavine Research Natural Area, El Dorado National Forest, California. Unpublished report. USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA.
- Taylor, D. W., and K. A. Teare. 1979a. Ecological survey of the vegetation of the proposed Trelorita Research Natural Area, Shasta-Trinity National Forest, Trinity County, California. Unpublished report. USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA.
- Taylor, D. W., and K. A. Teare. 1979b. Ecological survey of the vegetation of the proposed Smoky Creek Research Natural Area, Shasta-Trinity National Forest, Trinity County, California. Unpublished report. USDA Forest Service, Pacific Southwest Research Station, Berkeley, CA.
- Terwilliger, C., Jr., and E. L. Smith. 1978. Range resource types in North Park, Colorado. *Colorado State University Range Science Department Science Series* 32. 48 pp.
- Terwilliger, C., Jr., and J. A. Tiedemann. 1978. Habitat types of the mule deer critical winter range and adjacent steppe region of Middle Park, Colorado. Unpublished report prepared for USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 108 pp.
- Terwilliger, C., Jr., K. Hess, and C. H. Wasser. 1979b. The habitat types of Region II. USDA Forest Service: A preliminary list and description. Unpublished initial progress report for Habitat Type Classification, Region 2, USDA Forest Service.
- Terwilliger, C., K. Hess, and C. Wasser. 1979a. Key to the preliminary habitat types of Region 2. Addendum to initial progress report for habitat type classification. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO.
- Thatcher, A. P. 1975. The amount of blackbrush in the natural plant community is largely controlled by edaphic conditions. Pages 155-156 in: *Proceedings Wildland Shrubs: Symposium and workshop*. USDA Forest Service, Provo, UT.
- Thilenius, J. F., and D. R. Smith. 1985. Vegetation and soils of an alpine range in the Absaroka Mountains, Wyoming. General Technical Report RM-121. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 18 pp.

- Thilenius, J. F., and G. R. Brown. 1987. Herded vs. unherded sheep grazing systems on an alpine range in Wyoming. General Technical Report RM-147. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
- Thilenius, J. F., G. R. Brown, and A. L. Medina. 1995. Vegetation on semi-arid rangelands, Cheyenne River Basin, Wyoming. General Technical Report RM-GTR-263. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 60 pp.
- Thomas, K. A. 1996. Vegetation and floristic diversity in the Mojave Desert of California: A regional conservation evaluation. Dissertation, University of California, Santa Barbara, CA.
- Thomas, K. A., T. Keeler-Wolf, J. Franklin, and P. Stine. 2004. Mojave Desert Ecosystem Program: Central Mojave vegetation mapping database. U.S. Geological Survey, Western Regional Science Center. 251 pp.
- Thompson, J. 2001. Draft vegetation associations of Zion National Park, Utah. Prepared for Association for Biodiversity Information, Boulder.
- Thompson, W. H., and P. L. Hansen. 2002. Classification and management of riparian and wetland sites of Alberta's Grasslands Natural Region and adjacent subregions. Bitterroot Restoration, Inc., Cows and Fish, Lethbridge. 416 pp.
- Thompson, W. H., and P. L. Hansen. 2003. Classification and management of riparian and wetland sites of Alberta's Parkland Natural Region and Dry Mixedwood Natural Subregion. Bitterroot Restoration, Inc. Prepared for the Alberta Riparian Habitat Management Program-Cows and Fish, Lethbridge, Alberta. 340 pp.
- Thorne Ecological Institute. 1973a. Environmental setting of the Parachute Creek Valley: An ecological inventory. Unpublished report prepared for Colony Development Operations, Atlantic Richfield Company, by Thorne Ecological Institute, Boulder, CO. [Veg.: pages 36-40, map].
- Thorne Ecological Institute. 1973b. Pages 26-30 in: Part 1 of Vegetation. The Colony Environmental Study - Parachute Creek, Garfield County, Colorado. Unpublished report prepared for Colony Development Operation by Thorne Ecological Institute, Boulder, CO.
- Thorne, R. F. 1976. The vascular plant communities of California. Pages 1-31 in: J. Latting, editor. Plant communities of southern California. California Native Plant Society, Sacramento.
- Thorne, R. F. 1977. Montane and subalpine forests of the Transverse and Peninsular ranges. Pages 537-557 in: M. G. Barbour and J. Major, editors. Terrestrial vegetation of California. Wiley-Interscience, reprinted 1988 by the California Native Plant Society, Sacramento, CA.
- Thorne, R. F. 1982. The desert and other transmontane plant communities of southern California. *Aliso* 10(2):219-257.
- Thorne, R. F., A. A. Schoenherr, C. D. Clements, and J. A. Young. 2007. Transmontane coniferous vegetation. Pages 574-586 in: M. G. Barbour, T. Keeler-Wolf, and A. A. Schoenherr, editors. Terrestrial vegetation of California. Third edition. University of California Press, Berkeley.
- Tiedemann, J. A. 1978. Phyto-edaphic classification of the Piceance Basin. Unpublished dissertation, Colorado State University, Fort Collins. 281 pp.
- Tiedemann, J. A., R. E. Francis, C. Terwilliger, Jr., and L. H. Carpenter. 1987. Shrub-steppe habitat types of Middle Park, Colorado. Research Paper RM-273. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 20 pp.
- Tirmenstein, D. 1990. *Yucca schidigera*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>]
- Tirmenstein, D. 1999c. *Artemisia tridentata* ssp. *tridentata*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 13 July 2007).
- Tirmenstein, D. 1999d. *Quercus turbinella*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 11 March 2010).
- Tirmenstein, D. 1999h. *Juniperus occidentalis*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 31 August 2015).
- Tisdale, E. W. 1947. The grasslands of the southern interior of British Columbia. *Ecology* 28(4):346-382.
- Tisdale, E. W. 1979. A preliminary classification of Snake River Canyon grasslands in Idaho. *Forestry, Wildlife, and Range Experiment Station Bulletin No. 32*, University of Idaho, Moscow. 8 pp.
- Tisdale, E. W. 1986. Canyon grasslands and associated shrublands of west-central Idaho and adjacent areas. *Bulletin No. 40*. Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow. 42 pp.
- Tisdale, E. W. 1994a. Black sagebrush--SRM 405. Page 44 in: T. N. Shiflet, editor. *Rangeland cover types of the United States*. Society for Range Management, Denver, CO
- Tisdale, E. W. 1994b. Low sagebrush--SRM 406. Pages 45 in: T. N. Shiflet, editor. *Rangeland cover types of the United States*. Society for Range Management, Denver, CO.
- Tisdale, E. W., and M. Hironaka. 1981. The sagebrush-grass region: A review of the ecological literature. *University of Idaho Forest, Wildlife, and Range Experiment Station Bulletin 33, Contribution 29*. Moscow. 31 pp.
- Tisdale, E. W., M. Hironaka, and M. A. Fosberg. 1965. An area of pristine vegetation in Craters of the Moon National Monument, Idaho. *Ecology* 46(3):349-352.
- TNC [The Nature Conservancy]. 1995b. Element Stewardship Abstract for North American cattails. The Nature Conservancy, Arlington, VA. 16 pp.
- Topik, C., N. M. Halverson, and D. G. Brockway. 1986. Plant associations and management guide for the western hemlock zone. R6-ECOL-230a-1986. USDA Forest Service, Gifford Pinchot National Forest, Pacific Northwest Region, Portland, OR. 137 pp.

- Townsend, T. W. 1966. Plant characteristics relating to the desirability of rehabilitating the *Arctostaphylos patula-Ceanothus velutinus-Ceanothus prostratus* association on the east slope of the Sierra Nevada. Unpublished thesis, University of Nevada, Reno. 90 pp.
- TPWD [Texas Parks and Wildlife Department]. 1989d. Monahans Sandhills State Park summary of representative plant communities. October 1989. Texas Parks and Wildlife Department, Austin.
- TPWD [Texas Parks and Wildlife Department]. 1990a. Department lands inventory: Franklin Mountains State Park -- Summary of representative plant communities. Unpublished report. Texas Parks and Wildlife Department, Austin, TX. 57 pp. plus appendices.
- Trammell, V. M., and J. R. Trammell, Jr. 1977. Plant communities of Roxborough Park, Douglas County, Colorado. Unpublished report prepared by Arapahoe Community College, Littleton, CO. 14 pp.
- Tratz, W. M. 1978. Postfire vegetational recovery, productivity, and herbivore utilization of a chaparral-desert ecotone. Master's thesis, California State University, Los Angeles, CA.
- Tueller, P. T. 1994. Salt desert scrub--SRM 414. Page 53 in: T. N. Shiflet, editor. Rangeland cover types of the United States. Society for Range Management, Denver, CO.
- Tueller, P. T., and R. E. Eckert, Jr. 1987. Big sagebrush (*Artemisia tridentata vaseyana*) and longleaf snowberry (*Symphoricarpos oreophilus*) plant associations in northeastern Nevada. *Great Basin Naturalist* 47(1):117-131.
- Tueller, P. T., and W. H. Blackburn. 1974. Condition and trend of the big sagebrush/needle-and-thread habitat type in Nevada. *Journal of Range Management* 27(1):36-40.
- Tueller, P. T., D. H. Heinze, and R. E. Eckert. 1966. A tentative list of existing Nevada plant communities (A third approximation). Unpublished report prepared for the Department of Range Wildlife and Forestry, University of Nevada, Reno. 14 pp.
- Tueller, P. T., R. J. Tausch, and V. Bostick. 1991. Species and plant community distribution in a Mojave-Great Basin desert transition. *Vegetatio* 92:133-150.
- Tuhy, J. S. 1981. Stream bottom community classification for the Sawtooth Valley, Idaho. Unpublished thesis, University of Idaho, Moscow. 230 pp.
- Tuhy, J. S., and J. A. MacMahon. 1988. Vegetation and relict communities of Glen Canyon National Recreation Area. Unpublished final report prepared for USDI National Park Service, Rocky Mountain Region, Lakewood, CO. Utah State University, Logan. 299 pp.
- Tuhy, J. S., and S. Jensen. 1982. Riparian classification for the Upper Salmon and Middle Fork Salmon River drainages, Idaho. Unpublished report prepared for the USDA Forest Service, Intermountain Region by White Horse Associates, Smithfield, UT. 183 pp.
- Tuhy, J., P. Comer, D. Dorfman, M. Lammert, B. Neely, L. Whitham, S. Silbert, G. Bell, J. Humke, B. Baker, and B. Cholvin. 2002. An ecoregional assessment of the Colorado Plateau. The Nature Conservancy, Moab Project Office. 112 pp. plus maps and appendices.
- Turner G. T. 1975. Mountain grassland ecosystem. Research Paper RM-161. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
- Turner, G. T. 1969. Response of mountain grassland vegetation to gopher control, reduced grazing, and herbicide. *Journal of Range Management* 22:377-383.
- Turner, G. T., and E. J. Dortignac. 1954. Infiltration, erosion and herbage production of some mountain grasslands in western Colorado. *Journal of Forestry* 52:858-860.
- Turner, R. M. 1982a. Sonoran desertscrub. Chapter 154.1 in: D. E. Brown, editor. Biotic communities of the American Southwest-United States and Mexico. *Desert Plants Special Issue* 4(1-4):1-342.
- Turner, R. M. 1982b. Mohave desertscrub. Pages 157-168 in: D. E. Brown, editor. Biotic communities of the American Southwest-United States and Mexico. *Desert Plants Special Issue* 4(1-4).
- Turner, R. M. 1982c. Great Basin desertscrub. *Desert Plants* 4:145-155.
- Tweit, S., and K. Houston. 1980. Grassland and shrubland habitat types of the Shoshone National Forest. USDA Forest Service, Rocky Mountain Region, Shoshone National Forest.
- Ungar, I. A. 1965. An ecological study of the vegetation of the Big Salt Marsh, Stafford County, Kansas. *University of Kansas Science Bulletin* 116(1):1-99.
- Ungar, I. A. 1967. Vegetation-soil relationships on saline soils in northern Kansas. *The American Midland Naturalist* 78(1):98-121.
- Ungar, I. A. 1968. Species-soil relationships on the Great Salt Plains of northern Oklahoma. *The American Midland Naturalist* 80(2):392-407.
- Ungar, I. A. 1970. Species-soil relationships on sulfate dominated soils of South Dakota. *The American Midland Naturalist* 83(2):343-357.
- Ungar, I. A. 1972. The vegetation of inland saline marshes of North America, north of Mexico. *Basic Problems and Methods in Phytosociology* 14:397-411.
- Ungar, I. A. 1974b. The effect of soil factors on the distribution of halophytic species at South Park, Colorado. *Bulletin of the Ecological Society of America* 55(2):31-32 (Abstract).
- Ungar, I. A. 1974c. Halophyte communities of Park County, Colorado. *Bulletin of the Torrey Botanical Club* 101:145-152.
- Ungar, I. A., W. Hogan, and M. McClennand. 1969. Plant communities of saline soils at Lincoln, Nebraska. *The American Midland Naturalist* 82(2):564-577.
- USBOR [U.S. Bureau of Reclamation]. 1976. Flora and terrestrial vertebrate studies of the Grand Valley, Colorado. Pages 56-85 and 283-354 in: Final report to the U.S. Bureau of Reclamation by Ecology Consultants, Inc., Fort Collins, CO.

- USDA NRCS [Natural Resources Conservation Service]. No date. The PLANTS Database. USDA Natural Resources Conservation Service, National Plant Data Center, Baton Rouge, LA. [<http://plants.usda.gov/>]
- USFS [U.S. Forest Service]. 1937. Range plant handbook. Dover Publications Inc., New York. 816 pp.
- USFS [U.S. Forest Service]. 1981a. TES-7, South La Luz grazing allotment. Unpublished report prepared for USDA Forest Service, Southwestern Region, Albuquerque, NM. Various pages, appendices and maps.
- USFS [U.S. Forest Service]. 1983a. TES-4, Coyote Ranger District. Unpublished report prepared for USDA Forest Service, Southwestern Region, Albuquerque, NM. Various pages, appendices and maps.
- USFS [U.S. Forest Service]. 1983b. Plant associations of Region Two. Third edition. USDA Forest Service, Region Two, Range, Wildlife, and Ecology, Denver, CO. 379 pp.
- USFS [U.S. Forest Service]. 1985c. TES-1, Terrestrial ecosystem survey handbook, appendix B. Unpublished report prepared for USDA Forest Service, Southwestern Region, Albuquerque, NM. Various pages, appendices and maps.
- USFS [U.S. Forest Service]. 1985e. TES-3, western part Rio Arriba County. Unpublished report prepared for USDA Forest Service, Southwestern Region, Albuquerque, NM. Various pages, appendices and maps.
- USFS [U.S. Forest Service]. 1992. Draft habitat types of the Little Missouri National Grasslands. Medora and McKenzie ranger districts, Custer National Forest. Dickinson, ND.
- Vaghti, M. G. 2003. Riparian vegetation classification in relation to environmental gradients, Sacramento River, CA. Thesis, University of California, Davis.
- Vaghti, M., and T. Keeler-Wolf. 2004. Suisun Marsh vegetation mapping change detection 2003: A report to the California Department of Water Resources. California Department of Fish and Game-Wildlife Habitat Data Analysis Branch, Sacramento, CA.
- Van Auken, O. W., and J. K. Bush. 1988. Dynamics of establishment, growth, and development of black willow and cottonwood in the San Antonio River forest. *Texas Journal of Science* 40:269-277.
- Van Pelt, N. S. 1978. Woodland parks in southeastern Utah. Unpublished thesis, University of Utah, Salt Lake City.
- Vasek, F. C. 1985. Southern California white fir (Pinaceae). *Madroño* 32:65-77.
- Vasek, F. C., and M. G. Barbour. 1988. Mojave Desert scrub vegetation. Pages 835-867 in: M. G. Barbour and J. Major, editors. *Terrestrial vegetation of California: New expanded edition. Special Publication 9, California Native Plant Society, Sacramento.* 1030 pp.
- Vasek, F. C., and R. F. Thorne. 1977. Transmontane coniferous vegetation. Pages 797-832 in: M. G. Barbour and J. Major, editors. *Terrestrial vegetation of California.* Wiley-Interscience, reprinted 1988 by the California Native Plant Society, Sacramento, CA.
- Vasek, F. C., H. B. Johnson, and D. H. Eslinger. 1975. Effects of pipeline construction on creosote bush scrub vegetation of the Mojave Desert. *Madroño* 23:1-13.
- Veblen, T. T. 1986. Age and size structure of subalpine forests in the Colorado Front Range. *Bulletin of the Torrey Botanical Club* 113(3):225-240.
- VegCAMP and AIS [Vegetation Classification and Mapping Program and Aerial Information Systems, Inc.]. 2013. 2012 California desert vegetation map and accuracy assessment in support of the Desert Renewable Energy Conservation Plan. Unpublished report to California Department of Fish and Wildlife Renewable Energy Program and the California Energy Commission. California Department of Fish and Wildlife, Vegetation Classification and Mapping Program and Aerial Information Systems, Inc.
- Vest, E. D. 1962a. Biotic communities in the Great Salt Lake Desert. Institute of Environmental Biological Research, Ecology and Epizooology Series 73. Division of Biological Science, University of Utah. 122 pp.
- Vest, E. D. 1962b. The plant communities and associated fauna of Dugway Valley in western Utah. Unpublished dissertation, University of Utah, Salt Lake City.
- Vestal, A. G. 1914. Prairie vegetation of a mountain-front area in Colorado. *Botanical Gazette* 58(5):377-400.
- Viereck, L. A., C. T. Dyrness, A. R. Batten, and K. J. Wenzlick. 1992. The Alaska vegetation classification. General Technical Report PNW-GTR286. USDA Forest Service, Pacific Northwest Research Station, Portland, OR. 278 pp.
- Vogl, R. J., and L. T. McHargue. 1966. Vegetation of California fan palm oases on the San Andreas fault. *Ecology* 47:532-540.
- Volland, L. A. 1976. Plant communities of the central Oregon pumice zone. USDA Forest Service R-6 Area Guide 4-2. Pacific Northwest Region, Portland, OR. 113 pp.
- Volland, L. A. 1978. Trends in standing crop and species composition of a rested Kentucky bluegrass meadow over an 11-year period. Pages 525-529 in: D. N. Hyder, editor. *Proceedings, First International Rangeland Congress, Denver, CO.*
- Volland, L. A., and J. D. Dell. 1981. Fire effects on Pacific Northwest forest and range vegetation. USDA Forest Service. Pacific Northwest Region, Portland, OR. 23 pp.
- Von Loh, J. 2000. Draft local descriptions of the vegetation associations of Ouray National Wildlife Refuge. USGS Bureau of Reclamation, Remote Sensing and GIS Group, Denver Federal Center, Denver.
- Von Loh, J., D. Cogan, K. Schulz, D. Crawford, T. Meyer, J. Pennell, and M. Pucherelli. 2002. USGS-USFWS Vegetation Mapping Program, Ouray National Wildlife Refuge, Utah. USDI Bureau of Reclamation, Remote Sensing and GIS Group, Technical Memorandum 8260-02-03. Denver Federal Center, Denver, CO. 225 pp.
- Vories, K. C. 1974. A vegetation inventory and analysis of the Piceance Basin and adjacent drainages. Unpublished thesis. Western State College of Colorado, Gunnison. 243 pp.
- Voss, E. G. 1972. Michigan flora: A guide to the identification and occurrence of the native and naturalized seed-plants of the state. Part I. Gymnosperms and Monocots. Cranbrook Institute of Science. 488 pp.

- Waddell, D. R. 1982. Montane forest vegetation-soil relationships in the Yolla Bolly Mountains, northern California. Master's thesis, Humboldt State University, Arcata, CA.
- Wagner, W. H., and W. E. Hammitt. 1970. Natural proliferation of floating stems of scouring-rush, *Equisetum hyemale*. The Michigan Botanist 9:166-174.
- Wagner, W. L., W. C. Martin, and E. F. Aldon. 1978. Natural succession on strip-mined lands in northwestern New Mexico. Reclamation Review 1:67-73.
- Waigchler, W. S., R. F. Miller, and P. S. Doescher. 2001. Community characteristics of old-growth western juniper woodlands in the pumice zone of central Oregon. Journal of Range Management 52:1-14.
- Walford, G. M. 1996. Statewide classification of riparian and wetland dominance types and plant communities - Bighorn Basin segment. Report submitted to the Wyoming Department of Environmental Quality, Land Quality Division by the Wyoming Natural Diversity Database. 185 pp.
- Walford, G., G. Jones, W. Fertig, and K. Houston. 1997. Riparian and wetland plant community types of the Shoshone National Forest. Unpublished report. Wyoming Natural Diversity Database for The Nature Conservancy, and the USDA Forest Service. Wyoming Natural Diversity Database, Laramie. 227 pp.
- Walford, G., G. Jones, W. Fertig, S. Mellman-Brown, and K. Houston. 2001. Riparian and wetland plant community types of the Shoshone National Forest. General Technical Report RMRS-GTR-85. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO. 122 pp.
- Walgren, M., L. Andreano, J. Beaulieu, S. Christopher, and C. Jackson. 2005. Resource inventory for Morro Strand State Beach. Unpublished report. California Department of Parks and Recreation, San Luis Obispo, CA.
- Walker, G. R., and J. D. Brotherson. 1982. Habitat relationships of basin wildrye in the high mountain valleys of central Utah. Journal of Range Management 35(5):628-633.
- Ward, R. T., W. Slauson, and R. L. Dix. 1974. The natural vegetation in the landscape of the Colorado oil shale region. Pages 9-17 in: C. W. Cook, editor. Surface rehabilitation of land disturbances resulting from oilshale development. Information Series 11, Environmental Resource Center, Colorado State University, Fort Collins.
- Warner, B. G., and C. D. A. Rubec, editors. 1997. The Canadian wetland classification system. Second revised edition. Wetlands Research Centre, University of Waterloo, ON. 68 pp.
- Warren, A. No date. Range site descriptions in Divide Resource Area. Unpublished report prepared for USDI Bureau of Land Management, Great Divide Resource Area, Rawlins, WY.
- Warren, P. L., and B. D. Treadwell. 1980. Vegetation of the Three-Bar Wildlife Study Area, Mazatzal Mountains, Arizona. Unpublished report prepared for Arizona Game and Fish Department.
- Warren, P. L., K. L. Reichhardt, D. A. Mouat, B. T. Brown, and R. R. Johnson. 1982. Vegetation of Grand Canyon National Park. Cooperative National Park Resources Studies Unit Technical Report 9. Tucson, AZ. 140 pp.
- Warren, P. L., M. C. Hoy, and W. E. Hoy. 1987. Vegetation of Fort Bowie National Historic Site, Arizona. Unpublished report prepared for the National Park Service Cooperative Studies Unit, University of Arizona, Tucson. 24 pp.
- Warren, P. L., M. S. Hoy, and W. E. Hoy. 1992. Vegetation and flora of Fort Bowie National Historic Site, Arizona. Technical Report NPS/WRUA/NRTR-92/43. National Park Service, Western Region Cooperative National Park Resources Studies Unit, University of Arizona, Tucson. 78 pp.
- Wasser, C. H., and K. Hess. 1982. The habitat types of Region II. USDA Forest Service: A synthesis. Final report prepared for USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. 140 pp.
- Watson, J. R. 1912. Plant geography of north central New Mexico: Contributions from the Hull Botanical Laboratory. Botanical Gazette 54:194-217.
- Weaver, J. E., and F. W. Albertson. 1956. Grasslands of the Great Plains: Their nature and use. Johnsen Publishing Co., Lincoln, NE. 395 pp.
- Webb, G. M., and J. D. Brotherson. 1988. Elevational changes in woody vegetation along three streams in Washington County, Utah. Great Basin Naturalist 48:512-529.
- Webb, R. H., J. W. Steiger, and E. B. Newman. 1988b. The response of vegetation to disturbance in Death Valley National Monument, California. U.S. Geological Survey Bulletin 1793, USDI U.S. Geological Survey, Washington, DC.
- Webb, R. H., J. W. Steiger, and R. M. Turner. 1987. Dynamics of Mojave Desert shrub assemblages in the Panamint Mountains, California. Ecology 68(3):478-490.
- Weber, W. A. 1990. Colorado flora: Eastern slope. University Press of Colorado, Niwot, CO. 396 pp.
- Weber, W. A., and R. C. Wittmann. 1996b. Colorado flora: Western slope. University Press of Colorado, Niwot, CO. 496 pp.
- Weixelman, D. A., D. C. Zamudio, and K. A. Zamudio. 1996. Central Nevada riparian field guide. USDA Forest Service Technical Report R4-ECOL-96-01. USDA Forest Service, Intermountain Region.
- Wells, P. V. 1960. Physiognomic intergradation of vegetation on the Pine Valley Mountains in southwestern Utah. Ecology 41:553-556.
- Welsh, S. L. 1957. An ecological survey of the vegetation of the Dinosaur National Monument, Utah. Unpublished thesis, Brigham Young University, Provo, UT. 86 pp.
- Welsh, S. L. 1979. Endangered and threatened plants of Utah: A case study. Great Basin Naturalist Memoirs 3:64-80.
- Welsh, S. L., and L. M. Chatterly. 1985. Utah's rare plants. Great Basin Naturalist 45(2):173-236.
- Welsh, S. L., N. D. Atwood, S. Goodrich, and L. C. Higgins, editors. 1987. A Utah flora. Great Basin Naturalist Memoirs 9. Provo, UT. 894 pp.

- Welsh, S. L., N. D. Atwood, S. Goodrich, and L. C. Higgins. 1993. A Utah flora. Second edition, revised. Jones Endowment Fund, Monte L. Bean Life Science Museum, Brigham Young University, Provo, UT.
- Wentworth, T. R. 1982. Vegetation and flora of the Mule Mountains, Cochise County, Arizona. *Journal of the Arizona-Nevada Academy of Science* 17:29-44.
- West, K. A. 1992. Element Stewardship Abstract: Arizona fescue-slimstem muhly montane grassland. Unpublished report for The Nature Conservancy. Colorado. 8 pp.
- West, N. E. 1979. Survival patterns of major perennials in salt desert shrub communities of southwestern Utah. *Journal of Range Management* 32(6):442-445.
- West, N. E. 1982. Approaches to synecological characterization of wildlands in the Intermountain West. Pages 633-643 in: *In-place resource inventories: Principles & practices. A national workshop*, University of Maine, Orono. Society of American Foresters, McClean, VA. August 9-14, 1981.
- West, N. E. 1983a. Great Basin-Colorado Plateau sagebrush semi-desert. Pages 331-349 in: N. E. West, editor. *Temperate deserts and semi-deserts. Ecosystems of the world, Volume 5*. Elsevier Publishing Company, Amsterdam.
- West, N. E. 1983b. Intermountain salt desert shrublands. Pages 375-397 in: N. E. West, editor. *Temperate deserts and semi-deserts. Ecosystems of the world, Volume 5*. Elsevier Publishing Company, Amsterdam.
- West, N. E. 1983c. Western Intermountain sagebrush steppe. Pages 351-374 in: N. E. West, editor. *Temperate deserts and semi-deserts. Ecosystems of the world, Volume 5*. Elsevier Publishing Company, Amsterdam.
- West, N. E. 1983d. Colorado Plateau-Mohavian blackbrush semi-desert. Pages 399-412 in: N. E. West, editor. *Temperate deserts and semi-deserts. Ecosystems of the world, Volume 5*. Elsevier Publishing Company, Amsterdam.
- West, N. E. 1983e. Southeastern Utah galleta-threeawn shrub steppe. Pages 413-421 in: N. E. West, editor. *Temperate deserts and semi-deserts. Ecosystems of the World, Volume 5*. Elsevier Publishing Company, Amsterdam.
- West, N. E. 1988. Intermountain deserts, shrub steppes, and woodlands. Pages 207-230 in: M. G. Barbour and W. D. Billings, editors. *North American terrestrial vegetation*. Cambridge University Press, New York.
- West, N. E. 1999a. Juniper-pinon savannas and woodlands of western North America. Pages 288-308 in: R. C. Anderson, editor. *Savannas, barrens, and rock outcrop plant communities of North America*. Cambridge University Press, New York.
- West, N. E. 1999b. Distribution, composition, and classification of current juniper-pinyon woodlands and savannas across western North America. Pages 20-23 in: S. B. Monsen and R. Stevens, editors. *Proceedings: Ecology and management of pinyon-juniper communities within the Interior West*. Proceedings RMRS-P-9. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT.
- West, N. E., and J. A. Young. 2000. Intermountain valleys and lower mountain slopes. Pages 255-284 in: M. G. Barbour and W. D. Billings, editors. *North American Terrestrial Vegetation, second edition*. Cambridge University Press, Cambridge.
- West, N. E., and K. I. Ibrahim. 1968. Soil-vegetation relationships in the shadscale zone of southeastern Utah. *Ecology* 49(3):445-456.
- West, N. E., F. D. Provenza, P. S. Johnson, and M. K. Owens. 1984. Vegetation change after 13 years of livestock grazing exclusion on sagebrush semidesert in west central Utah. *Journal of Range Management* 37(3):262-264.
- West, N. E., R. J. Tausch, and P. T. Tueller. 1998. A management-oriented classification of pinyon-juniper woodlands of the Great Basin. General Technical Report RMRS-GTR-12. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT. 42 pp.
- West, N. E., R. J. Tausch, K. H. Rea, and A. R. Southard. 1978. Soils associated with pinyon-juniper woodlands of the Great Basin. Pages 68-88 in: C. T. Youngberg, editor. *Forest soils and land use, Proceedings of the 5th North American Forest and Soils Conference*, Colorado State University, Fort Collins.
- West, N. E., R. T. Moore, K. A. Valentine, L. W. Law, P. R. Ogden, F. C. Pinkney, P. T. Tueller, and A. A. Beetle. 1972. Galleta: Taxonomy, ecology and management of *Hilaria jamesii* on western rangelands. Utah Agricultural Experiment Station. Bulletin 487. Logan, UT. 38 pp.
- Western Ecology Working Group of NatureServe. No date. *International Ecological Classification Standard: International Vegetation Classification. Terrestrial Vegetation*. NatureServe, Boulder, CO.
- Whipple, S. A. 1975. The influence of environmental gradients on vegetational structure in the subalpine forest of the southern Rocky Mountains. Unpublished dissertation, Colorado State University, Fort Collins.
- Whipple, S. A., and R. L. Dix. 1979. Age structure and successional dynamics of a Colorado subalpine forest. *The American Midland Naturalist* 101(1):142-158.
- Whitfield, C. L., and H. L. Anderson. 1938. Secondary succession in the desert plains grassland. *Ecology* 19:171-180.
- Whitson, T. D., L. C. Burrill, S. A. Dewey, D. W. Cudney, B. E. Nelson, R. D. Lee, R. Parker. 2000. *Weeds of the West*. The Western Society of Weed Science in cooperation with the Western United States Land Grant Universities, Cooperative Extension Services. University of Wyoming, Laramie. 630 pp.
- Wight, J. R. 1965. Site and vegetation characteristics and relationships of juniper communities in northwestern Wyoming Unpublished dissertation, University of Wyoming, Laramie.
- Wight, J. R., and H. G. Fisser. 1968. *Juniperus osteosperma* in northwestern Wyoming: Their distribution and ecology. University of Wyoming Agricultural Experiment Station Science Monograph 7. Laramie. 28 pp.
- Willard, B. E. 1963. Phytosociology of the alpine tundra of Trail Ridge, Rocky Mountain National Park, Colorado. Unpublished dissertation, University of Colorado, Boulder.
- Williams, C. K., and B. G. Smith. 1990. Forested plant associations of the Wenatchee National Forest. Unpublished draft prepared by the USDA Forest Service, Pacific Northwest Region, Portland, OR. 217 pp.
- Williams, C. K., and T. R. Lillybridge. 1983. Forested plant associations of the Okanogan National Forest. R6-Ecol-132b-1983. USDA Forest Service, Pacific Northwest Region, Portland, OR. 140 pp.

- Williams, C. K., and T. R. Lillybridge. 1985. Forested plant associations of the Colville National Forest. Draft. Unpublished field guide prepared for USDA Forest Service.
- Williams, C. K., B. F. Kelly, B. G. Smith, and T. R. Lillybridge. 1995. Forest plant associations of the Colville National Forest. General Technical Report PNW-GTR-360. USDA Forest Service, Pacific Northwest Region, Portland, OR. 140 pp.
- Williams, C. K., T. R. Lillybridge, and B. G. Smith. 1990b. Forested plant associations of the Colville National Forest. Report prepared for USDA Forest Service, Colville National Forest, Colville, WA. 133 pp.
- Willis, E. L. 1939. Plant associations of the Rillito floodplain in Pima County. Unpublished thesis, University of Arizona, Tucson. 48 pp.
- Willoughby, M. G. 2007. Range plant communities and carrying capacity for the Upper Foothills subregion: Sixth Approximation (a revision of the fourth and fifth approximations: Publication Nos. T/003 and T/068). Publication No. T/138. Sustainable Resource Development, Agriculture and Agri-Food Canada, Edmonton. 182 pp. ISBN:978-0-7785-6484 [online edition].
- Willoughby, M. G., C. Stone, C. Hincz, D. Moisey, G. Ehler, and D. Lawrence. 2004. Guide to range plant community types and carrying capacity for the dry and central mixedwood subregions in Alberta. Fourth Approximation. Alberta Sustainable Resource Development, Public Lands and Forests Division, Edmonton, AB. 245 pp.
- Willoughby, M. G., C. Stone, C. Hincz, D. Moisey, G. Ehler, and D. Lawrence. 2006. Guide to range plant community types and carrying capacity for the Dry and Central Mixedwood subregions in Alberta: Sixth approximation (a revision of the fifth approximation, Publication No. T/074). Alberta Sustainable Resource Development, Public Lands and Forests Division, Edmonton. 254 pp. ISBN No. 0-7785-4539-3 [online edition].
- Wilson, B. A., and S. Gray. 2002. Resurrection of a century-old species distinction in *Calamagrostis*. *Madroño* 149:169-177.
- Wilson, D. B. 1967. Growth of *Hordeum jubatum* under various soil conditions and degrees of plant competition. *Canadian Journal of Plant Science* 47:405-412.
- Windell, J. T., B. E. Willard, D. J. Cooper, S. Q. Foster, C. F. Knud-Hansen, L. P. Rink, and G. N. Kiladis. 1986. An ecological characterization of Rocky Mountain montane and subalpine wetlands. USDI Fish and Wildlife Service Biological Report 86(11). 298 pp.
- Winn, R. 1998. Flammulated owl. Pages 210-211 in: H. E. Kingery, editor. Colorado breeding bird atlas. Colorado Bird Atlas Partnership and Colorado Division of Wildlife, Denver.
- Winward, A. 1991. Management in the Sagebrush Steppe. Agricultural Experiment Station, Oregon State University. Special Report 880. 7 pp.
- Winward, A. H. 1970. Taxonomic and ecological relationships of the big sagebrush complex in Idaho. Unpublished dissertation, University of Idaho, Moscow. 90 pp.
- Winward, A. H. 1980b. Taxonomy and ecology of sagebrush in Oregon. Oregon State University Agricultural Experiment Station Bulletin 642:1-15.
- Winward, A. H. 1994. Snowbrush--SRM 420. Page 58 in: T. N. Shiflet, editor. Rangeland cover types of the United States. Society for Range Management, Denver, CO.
- Winward, A. H., and B. A. Youtie. 1976. Ecological inventory of the Lawrence Memorial Grassland Preserve. A report presented to the Pacific Northwest chapter of The Nature Conservancy. 43 pp.
- Winward, A. H., and E. D. McArthur. 1995. Lahontan sagebrush (*Artemisia arbuscula* ssp. *longicaulis*): A new taxon. *Great Basin Naturalist* 55(2):151-157.
- WNDD [Wyoming Natural Diversity Database]. No date. Unpublished data on file. Wyoming Natural Diversity Database, University of Wyoming, Laramie, WY.
- WNHP [Washington Natural Heritage Program]. No date. Unpublished data files. Washington Natural Heritage Program, Department of Natural Resources, Olympia, WA.
- Wolfram, H. W., and M. A. Martin 1965. Big sagebrush in Fresno County, California. *Journal of Range Management* 18:285-286.
- Wood, S., E. T. Bennet, E. Muldavin, and S. Yanoff. 1998. Vegetation classification and map for Fort Bliss, Texas and New Mexico. Final report to the Directorate of Environment, Fort Bliss, TX, by the New Mexico Natural Heritage Program, University of New Mexico, Albuquerque.
- Woodbury, A. M., S. D. Durrant, and S. Flowers. 1961. A survey of vegetation in the Navajo Reservoir basin. University of Utah Anthropological Papers 51, Salt Lake City. 99 pp.
- Wright, H. A., and A. W. Bailey. 1982b. Fire ecology: United States and southern Canada. Wiley-Interscience Publication, John Wiley & Sons, New York. 501 pp.
- Wright, H. A., L. F. Neuenschwander, and C. M. Britton. 1979. The role and use of fire in sagebrush-grass and pinyon-juniper plant communities: A state of the art review. General Technical Report INT-58. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.
- Wright, H. E., Jr., A. M. Bent, B. S. Hansen, and L. J. Mahar, Jr. 1973. Present and past vegetation of the Chuska Mountains, northwestern New Mexico. *Geological Society of America Bulletin* 84:1155-1179.
- Wright, R. D., and H. A. Mooney. 1965. Substrate-oriented distribution of bristlecone pine in the White Mountains of California. *American Midland Naturalist* 73:257-284.
- Yake, S., and J. D. Brotherson. 1979. Differentiation of serviceberry habitats in the Wasatch Mountains of Utah. *Journal of Range Management* 32(4):379-386.
- Yoder, V. 1983. Vegetation of the Alabama Hills region, Inyo County, California. *Madroño* 30:118-126.
- York, J. C., and W. A. Dick-Peddie. 1969. Vegetation changes in southern New Mexico during the past hundred years. Pages 157-166 in: W. O. McGinnies and B. J. Goldman, editors. *Arid lands in perspective*. University of Arizona Press, Tucson.

- Young, J. A., and R. A. Evans. 1973. Downy brome-intruder in the plant succession of big sagebrush communities in the Great Basin. *Journal of Range Management* 26:410-415.
- Young, J. A., and R. A. Evans. 1978. Population dynamics after wildfires in sagebrush grasslands. *Journal of Range Management* 31:283-289.
- Young, J. A., C. D. Clements, and H. C. Jansen. 2007b. Sagebrush steppe. Pages 587-608 in: M. G. Barbour, T. Keeler-Wolf, and A. Schoenherr, editors. *Terrestrial vegetation of California*, third edition. University of California Press, Berkeley, CA.
- Young, J. A., R. A. Evans, and J. Major. 1977. Sagebrush steppe. Pages 763-796 in: M. G. Barbour and J. Major, editors. *Terrestrial vegetation of California*. John Wiley & Sons, New York.
- Young, J. A., R. A. Evans, B. A. Roundy, and J. A. Brown. 1986. Dynamic landforms and plant communities in a pluvial lake basin. *Great Basin Naturalist* 46(1):1-21.
- Young, J. A., R. A. Evans, J. D. Budy, and A. Torell. 1982. Cost of controlling maturing western juniper trees. *Journal of Range Management* 35(4):437-442.
- Youngblood, A. P., and R. L. Mauk. 1985. Coniferous forest habitat types of central and southern Utah. General Technical Report INT-187. USDA Forest Service, Intermountain Research Station, Ogden, UT. 89 pp.
- Youngblood, A. P., and W. F. Mueggler. 1981. Aspen community types on the Bridger-Teton National Forest in western Wyoming. Research Paper INT-272. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 34 pp.
- Youngblood, A. P., W. G. Padgett, and A. H. Winward. 1985a. Riparian community type classification of eastern Idaho-western Wyoming. R4-Ecol-85-01. USDA Forest Service, Intermountain Region, Ogden, UT. 78 pp.
- Youngblood, A. P., W. G. Padgett, and A. H. Winward. 1985b. Riparian community type classification of northern Utah and adjacent Idaho. Unpublished report prepared for USDA Forest Service, Intermountain Region, Ogden, UT. 104 pp.
- Youtie, B. A., and A. H. Winward. 1977. Plants and plant communities of the John Day Fossil Beds National Monument. Unpublished report to USDI National Park Service, John Day. 71 pp.
- Zamora, B. A. 1983. Forest habitat types of the Spokane Indian Reservation. Agricultural Research Center, Washington State University Research Bulletin XB-0936-1983.
- Zamora, B., and P. T. Tueller. 1973. *Artemisia arbuscula*, *A. longiloba*, and *A. nova* habitat types in northern Nevada. *Great Basin Naturalist* 33(4):225-242.
- Zedler, J. B. 1982. The ecology of southern California coastal salt marshes: A community profile. U.S. Fish and Wildlife Service, Biological Services Program, Washington, D.C. FWS/OBS-81/54. 110 pp.
- Zedler, J. B., C. S. Nordby, and B. E. Kus. 1992. The ecology of Tijuana estuary, California: A national estuarine research reserve. Unpublished report. NOAA, Office of Coastal Resources Management, Sanctuaries and Reserves Division, Washington, DC.
- Zimmerman, T. 1978. Skull Creek Study Area Forestry. Unpublished report. USDI Bureau of Land Management, Craig District Office, Craig, CO. 62 pp.
- Zlatnik, E. 1999d. *Agropyron cristatum*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 4 December 2013).
- Zlatnik, E. 1999e. *Juniperus osteosperma*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 25 June 2015).
- Zouhar, K. 2003. *Bromus tectorum*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 4 December 2013).
- Zouhar, K. 2003b. *Tamarix* spp. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>]
- Zouhar, K. L. 2001a. *Abies concolor*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 27 April 2010).
- Zouhar, K. L. 2001b. *Pinus monophylla*. In: Fire Effects Information System [Online]. USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). [<http://www.fs.fed.us/database/feis/>] (accessed 2 January 2011).
- Zwinger, A. H., and B. E. Willard. 1996. Land above the trees: A guide to American alpine tundra. Johnson Books, Boulder, CO. 425 pp.