Field Key to Ecological Systems and Target Alliances of the Sonoran and Mojave Deserts

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TABLE OF CONTENTS

Introduction

The following keys to NatureServe ecological systems and selected US-NVC vegetation alliances cover the areas found in NLCD map zones: 13 and 14 (Sonoran and Mojave Deserts). The systems and alliances included in these keys are intended to represent the legend that LANDFIRE will be striving to map for existing vegetation in the Sonoran and Mojave Deserts (Figure 1). Some types are in the keys that characteristically occur at small spatial scales (generally <2 ha in size) and hence may not be mappable by the LANDFIRE project. However, we have chosen to be inclusive in the keys, so that the user will have information on these system types for comparison purposes. In some cases they may be important for modeling fire condition class and, given their relative distinctiveness on the landscape, they may indeed be mappable.

Plant names are almost always in Latin and follow the nomenclature of Kartesz (1999). In limited cases, we have included synonyms for some taxa.

The keys are "dichotomous", which means the user follows the order of the 'couplets' and makes a choice between the 2 options represented in the couplet. The ordering of the couplets in each key does matter, and the user should choose the option in each couplet that best fits the data or field situation. A choice leads the user to the next couplet to be utilized in the keying process, via a number at the far right, or else leads to a final result (an ecological system type or an alliance).

If the choice the user makes leads to a "result", then either an Ecological System is named or a Vegetation Alliance is named. Alliances are recognizable because "alliance" is in the name, and they all start with one or more Latin names (e.g. *Pinus ponderosa* Woodland Alliance).

Systems do not include Latin species names in them, and always start with a Biogeographic region (e.g. Columbia Plateau Steppe and Grassland). If an ecological system is followed by a number in parentheses, then the couplet so numbered is to alliances that are part of the system and which may be mappable.

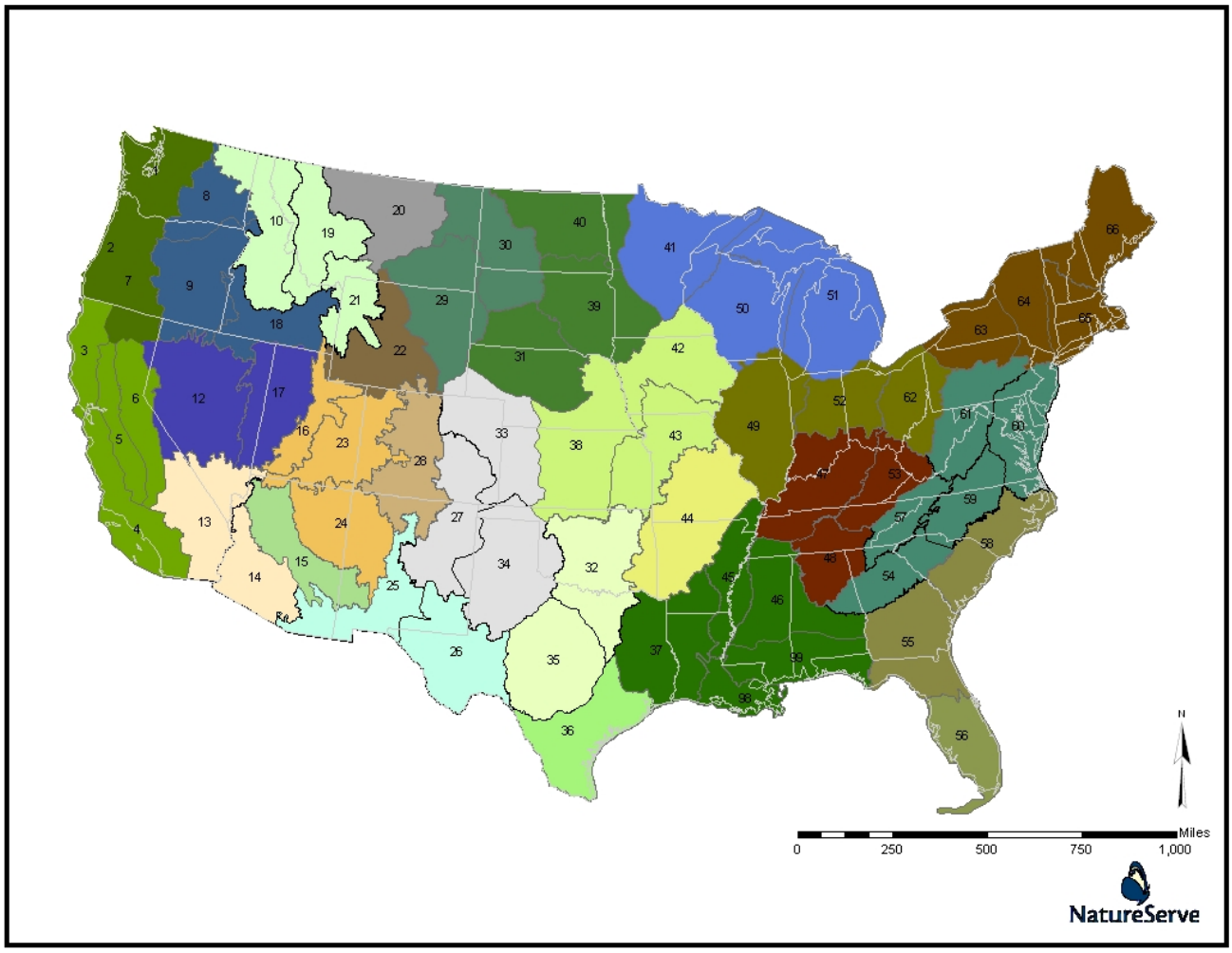

Figure 1. LANDFIRE map zone clusters with keys to ecological systems and selected alliances.

All the keys follow the same logic. First the user determines if the vegetation (or land cover) is 'sparse'; if not then you go to Key A and are lead into riparian or wetland woodlands or shrublands, then to upland deciduous forest/woodlands, then to upland coniferous forests/woodlands, then savannas, then shrublands and shrub-steppe. The second section of each key (Key B) is for the herbaceous systems and alliances, and keys through wetland/riparian situations first.

Keys are generally based on dominance within vegetation strata, with tree cover generally considered first, then that of shrubs, then the herbaceous component. Codominant species within a given strata are important as well, in some cases a system type or alliances will have 2 or more codominant species, which may or may not be present in all stands. Many ecological systems will have a variable physiognomy; where appropriate these variable systems have been placed into the keys in several places (i.e. some grassland systems have a "shrub-steppe" physiognomy and hence will be in the key both as shrub-steppe and herbaceous). Some terminology is commonly employed throughout the keys that distinguish general spatial characteristics of the vegetation or environmental setting. For example 'matrix' types of vegetation are dominant across the majority of a given landscape, while 'large patch' types tend to occur as distinctive patches within the larger 'matrix.' Elevation-based life zones are

commonly employed, with reference to 'alpine,' 'subalpine,' 'montane,' or 'foothill' zones. These zones vary in actual elevational thresholds across multiple map zones, and within individual map zones. More precise definition of these elevation breaks by map zone could be accomplished with additional research.

In the next section of the document we have provided a table showing the LANDFIRE legend units that represent non-natural vegetation and a short description for each of them. They are not formally incorporated into the keys, since they are typically recognizable without the use of a key, or else their floristic composition is so variable as to be not useful in a field key. Our primary purpose was to provide keys for the natural and near-natural vegetation of these zones.

Land Use, Unvegetated, Semi-natural and Altered Vegetation

LAND USE OR UNVEGETATED SURFACES	
Open Water	Open water
Developed	Generally developed lands.
Developed, Open Space	Vegetation (primarily grasses) planted in developed settings for recreation, erosion control, or aesthetic purposes. Impervious surfaces account for less than 20% of total cover. Examples include parks, lawns, golf courses, airport grasses, and industrial site grasses.
Developed, Low Intensity	Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20-50% of total cover. These areas most commonly include single-family housing units.
Developed, Medium Intensity	Includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50-80% of the total cover. These areas most commonly include single-family housing units
Developed, High Intensity	Includes highly developed areas where people reside in high numbers. Examples include apartment complexes, row houses and commercial/industrial. Impervious surfaces account for 80 to100% of the total cover.
Agriculture	Generally developed for agricultural uses.
Pasture/Hay	These agriculture lands typically have perennial herbaceous cover (e.g. regularly-shaped plantings) used for livestock grazing or the production of hay. There are obvious signs of management such as irrigation and haying that distinguish it from natural grasslands. Identified CRP lands are included in this land cover type.
Cultivated Crops and Irrigated Agriculture	These areas used for the production of crops, such as corn, soybeans, small grains, sunflowers, vegetables, and cotton, typically on an annual cycle. Agricultural plant cover is variable depending on season and type of farming. Other areas include more stable land cover of orchards and vineyards.
Perrennial Ice/Snow	
SEMI-NATURAL / ALTERED VEGETATION	
Ruderal Vegetation	Vegetation resulting from succession following significant anthropogenic disturbance of an area. It is generally characterized by unnatural combinations of species (primarily native species, though they often contain slight or substantial numbers and amounts of species alien to the region as well)
Ruderal Upland - Old Field	
Ruderal Upland - Abandoned Tree Plantation	
Ruderal Wetland	
Introduced Vegetation	Vegetation dominated by introduced species. These are spontaneous, self-perpetuating, and not (immediately) the result of planting, cultivation, or human maintenance. Land occupied by introduced vegetation is generally permanently altered (converted) unless restoration efforts are undertaken.
Introduced Upland Vegetation - Treed	Land cover is significantly altered/disturbed by introduced tree species.
Introduced Upland Vegetation - Shrub	Land cover is significantly altered/disturbed by introduced woody and/or herbaceous vegetation.

Introduced Upland Vegetation - Annual and Biennial Forbland	Land cover is significantly altered/disturbed by introduced annual and biennial forbs. Natural vegetation types are no longer recognizable. Typical species that dominate these areas are *Centaurea repens, Chrysanthemum leucanthemum, Circium arvense, C. vulgare, Euphorbia esula, Lepidium latifolia, Cardus nutans, Centaurea spp (difusa, solstitialis). Salsola kali, Kochia scoparia, Halogeton glomeratus, Melilotus officionalis*, *M. albus,* and *Cardaria officionalis.*
Introduced Upland Vegetation – Annual Grassland	Land cover is significantly altered/disturbed by introduced annual grasses. Natural vegetation types are no longer recognizable. Typical species include *Bromus japonicus, B. rigidus, B. rubens, B. tectorum, Taeniatherum caput-medusae*, and/or *Schismus barbatus*.
California Annual Grassland	Land cover dominated by introduced, non-native annual grasses within the central valley and coastal portions of California. Natural vegetation types are no longer recognizable. Grass and forb species include *Bromus* spp. (e.g., *madritensis, diandris, hordeaceus), Eschschlozia californica, Aira caryophyllea, Lasthenia spp., Castilleja spp., Avena spp, Mesembryanthemum, Malephora,* and/or *Carpobrotus*, commonly referred to as 'iceplant.' The native shrubs *Ambrosia chamissonis, Eriogonum latifolium,* and/or *Abronia latifolia* may be present as emergents. *Poa douglasii* may also be present.
Introduced Upland Vegetation - Perennial Grassland and Forbland	Land cover is significantly altered/disturbed by introduced, non-native perennial grasses and forbs. Natural vegetation types are no longer recognizable. Grass species include *Agropyron cristatum, Poa bulbosa, Bromus inermis, Phleum pratense*, and *Poa pratensis*. Forbs may include: *Centarea spp., Cirsium arvense, Euphorbia esula, Lepidium spp., Melilotus spp*.
Introduced Riparian Vegetation	Land cover is altered/disturbed and dominated by introduced woody vegetation (woodlands and shrublands). Typical riparian trees and shrubs include *Elaeagnus angustifolia, Tamarix* spp., *Triadica sebifera,* etc.
Introduced Wetland Vegetation	Land cover is altered/disturbed and dominated by introduced wetland vegetation. Species may include *Lythrum salicaria, Phalaris arundancea, Phragmites australis*, etc.
Modified/Managed Vegetation	Vegetation resulting from management or modification of natural/near natural; vegetation, but producing a structural and floristic combination not clearly known to have a natural analogue. Modified vegetation may be easily restorable by either management, restoration of ecological processes, and/or succession.
Modified/Managed Upland Vegetation	Land cover is apparently managed/modified and dominated by trees and/or shrubs. Vegetation is a mixture of herbaceous, shrub, and tree species.
Recently Burned Forest and Woodland	Land cover is apparently modified by recent fires which have burned forest and woodland vegetation. Vegetation is a mixture of herbaceous, shrub, and tree species.
Recently Burned Shrubland	Land cover is apparently modified by recent fires which have shrubland vegetation. Vegetation is a mixture of herbaceous and shrub species.
Recently Burned Grassland	Land cover is apparently modified by recent fires which have burned grassland vegetation. Vegetation is a mixture of herbaceous and shrub species.
Managed Tree Plantation	Land cover is apparently modified and appears as a managed tree plantation.
Recently Logged Timberland	Land cover is apparently modified and appears as logged timberland.
Modified/Managed Wetland Vegetation	These areas include created and obviously managed wetlands of varying size resulting from water diversion. Artificial Wetlands will be mapped where obvious built structures may be distinguished from imagery.

Sonoran and Mojave Desert Ecological Systems and Target Alliances

This key is intended to identify Ecological Systems of the Mojave and Sonoran Desert regions (Mapping Zones #13 and #14). Additional alliance couplets are to proposed mappable or target alliances and are not intended to be comprehensive.

Please note the following conventions used to designate the systems and alliances:

***** indicates NS ecological system that has been grouped into a broader LANDFIRE Map Unit (wetland, riparian, and sparsely vegetated circumstances). Included to help clarify key, but crews need to record broader LANDFIRE Map Unit (**)

****** indicates broader LANDFIRE Map Unit.

******* typically a small patch ecological system type not being mapped by LANDFIRE.

******** the alliance is not considered to be mappable for LANDFIRE purposes.

1a. Total woody canopy cover 10% or more (If stand is dominated by *Larrea tridentata* and *Ambrosia dumosa* use 2% woody cover or greater) ..... **GO TO KEY A: Woodland or Savanna Shrubland Systems and Alliances**

1b. Total woody canopy cover generally less than 10% **2**

2a. Total herbaceous canopy cover generally 10% or more and is dominated by perennial vegetation. ..... **GO TO KEY B: Herbaceous Systems and Alliances**

2b. Total canopy cover generally less than 10% or annual herbaceous cover dominates vegetation. ..... **Sparse Vegetation (3)**

3a. Land cover is restricted to bottomland or drainages **4**

3b. Land cover is upland dune, mudstone or shale badlands, volcanic rock outcrop or cinder sites **5**

4a. Land cover is a barren to sparsely vegetated playa ..... (**North American Warm Desert Playa*)** ..... **North American Warm Desert Sparsely Vegetated Systems****

4b. Land cover is a restricted intermittently flooded drainages with a variety of sparse or patchy vegetation including *Sarcobatus vermiculatus, Ericameria nauseousa, Fallugia paradoxa, Artemisia cana ssp. cana* or *Grayia spinosa.* Herbaceous vegetation such as perennial grasses, *Distichlis spicata* or *Sporobolus airoides*, may also dominate wash ..... (**North American Warm Desert Wash*)** ..... **North American Warm Desert Sparsely Vegetated Systems****

5a. Land cover is volcanic in origin (includes lava, cinder, ash deposits) ..... (**North American Warm Desert Volcanic Rockland*)** ..... **North American Warm Desert Sparsely Vegetated Systems****

5b. Land cover is not volcanic in origin **6**

6a. Land cover is unconsolidated material **7**

6b. Land cover is non-volcanic consolidated rock (cliffs, outcrops, barren mountain tops) ..... (**North American Warm Desert Bedrock Cliff and Outcrop *)** ..... **North American Warm Desert Sparsely Vegetated Systems****

7a. Land cover is active sands or partially vegetated dunes or sand sheets ..... (**North American Warm Desert Active and Stabilized Dune*)** ..... **North American Warm Desert Sparsely Vegetated Systems****

7b. Land cover is not sand dunes **8**

8a. Land cover is eroded shale or clay hills (may not occur in Sonoran Desert) ..... (**North American Warm Desert Badland*)**

.....**North American Warm Desert Sparsely Vegetated Systems****

8b. Land cover is wind swept plains and flats with a surface layer of pebbles. Total vegetation cover is low (<10%) excepting ephemeral annual cover following wet year precipitation events **9**

9a. Stand is co-dominated by *Larrea tridentata* and *Ambrosia dumosa* with less that 2% cover..... ..... (**North American Warm Desert Pavement *)** .....**North American Warm Desert Sparsely Vegetated Systems****

9b. Land cover is not as above **10**

10a. Stand is co-dominated by *Larrea tridentata* and *Ambrosia dumosa* with 2% or more woody cover..... ..... **go to Key A: Couplet #9**

10b. Land cover is barren, but not as above (review land use and disturbed classes)..... .....**(Undifferentiated Barren*)** .....**North American Warm Desert Sparsely Vegetated Systems****

KEY A (Sonoran – Mojave): Woodland or Shrubland Systems and Alliances
(Woody cover > 10% cover present)

1a. Land cover is restricted to drainages, semi-riparian flats, springs or seeps.....**2**
1b. Land cover is **upland** vegetation **7**

2a. Small patch woodlands dominated or codominated by *Washingtonia filifera* .....**Sonoran Fan Palm Oasis*****

2b. Woodlands and shrublands NOT dominated by *Washingtonia filifera*.....**3**

3a. Land cover is restricted to intermittently flooded drainages with vegetation forming an intermittent to continuous linear band along the sides of the wash ..... (**North American Warm Desert Wash*)** .....**North American Warm Desert Sparsely Vegetated Systems****

3b. Land cover is not restricted to intermittently flooded drainages.....**4**

4a. Woodlands and shrublands restricted to drainages and semi-riparian flats that are dominated by species of *Prosopis.*.....(**North American Warm Desert Riparian Mesquite Bosque*)** .....**North American Warm Desert Riparian Systems ****
4b. Woodlands and shrublands restricted to drainages and semi-riparian flats that are NOT dominated by species of *Prosopis*.....**5**

5a. Woodlands and shrublands that occur in mountain canyons and valleys of southern Arizona and New Mexico, and adjacent Mexico and consist of mid- to low-elevation (1100-1800 m) riparian corridors along perennial and seasonally intermittent streams. Dominant trees include *Populus angustifolia, Populus deltoides ssp. wislizeni, Populus fremontii, Platanus wrightii, Juglans major, Fraxinus velutina,* and *Sapindus saponaria*. Shrub dominants include *Salix exigua, Prunus* spp., *Alnus oblongifolia,* and *Baccharis salicifolia*. ..... (**North American Warm Desert Lower Montane Riparian Woodland and Shrubland*)** ..... **North American Warm Desert Riparian Systems **(6)**
5b. Woodlands and shrublands of low-elevation (<1200 m) riparian corridors along medium to large perennial streams throughout canyons and the desert valleys of the southwestern United States and adjacent Mexico. The vegetation is a mix of riparian woodlands and shrublands. Dominant trees include *Acer negundo, Fraxinus velutina, Populus fremontii, Salix gooddingii, Salix lasiolepis, Celtis laevigata var. reticulata,* and *Juglans major*. Shrub dominants include *Salix geyeriana, Shepherdia argentea,* and *Salix exigua*. ....(**North American Warm Desert Riparian Woodland and Shrubland*)** ..... **North American Warm Desert Riparian Systems **(6)**

6a. Woodlands restricted to drainages and semi-riparian flats that are dominated by introduced *Elaeagnus angustifolia*..... ***(Elaeagnus angustifolia* Semi-Natural Woodland Alliance*)** ..... **Invasive Riparian Woodland and Shrubland****
6b. Woodlands and shrublands restricted to drainages and semi-riparian flats that are dominated by *Tamarix* spp .....(***Tamarix* spp. Semi-Natural Temporarily Flooded Shrubland Alliance*)** ..... **Invasive Riparian Woodland and Shrubland****

7a. **Upland** desert scrub without a tall shrub layer. Common in basins and lower to middle bajadas **8**
7b. Upland shrubland and desert scrub with tall, typically xeromorphic shrub/tree layer (>2 m tall) (elephant tree, ironwood, mesquite, paloverde, saguaro). **13**

8a. Desert scrub is dominated by an open shrub layer of one or more species of *Atriplex.* Species of *Allenrolfea, Salicornia, Suaeda,* or other halophytic plants are often present to codominant. Commonly occurs on saline/alkaline plains and basins, sometimes encircling playas or on stream terraces. ....**Sonora-Mojave Mixed Salt Desert Scrub**
8b. Desert scrub is not dominated by species of *Atriplex.*.....**9**

9a. Upland desert scrub widespread in lower Colorado River Valley of the Sonoran Desert and the Mojave Desert. Stands are typically dominated by an open shrub canopy of *Larrea tridentata* and *Ambrosia dumosa* without a xeromorphic wooded layer. This system includes stands with as little as 2% woody cover and typically occurs below 750 m. elevation. ..... **Sonora-Mojave Creosotebush-White bursage Desert Scrub**

9b. Not as above..... **10**

10a. Upland mixed desert scrub widespread in the Chihuahuan Desert and likely present in the western transition into the Sonoran Desert. This *Larrea tridentata* dominated or codominated desert scrub is characterized by the lack of *Ambrosia dumosa* and the presence of Chihuahuan Desert species such as *Flourensia cernua* and *Parthenium incanum* or thornscrub (*Acacia constricta, A. neovernicosa,* or *Prosopis* spp). ..... **Chihuahuan Mixed Desert and Thorn Scrub**

10b. Highly variable vegetation that occurs in transition zone between higher elevation desert scrub and foothill shrubland and woodlands. **11**

11a. This upland shrubland is transitional from Sonoran Paloverde-Mixed Cacti Desert Scrub; occurring at higher elevation (650-1500 m) and lacking characteristic xeromorphic wooded layer of saguaro and paloverde. *Larrea tridentata* is often present to dominant, often with scattered chaparral species. Common associates include *Ericameria linearifolia*, or *Eriogonum fasciculatum* with taller shrub such as *Fouquieria splendens, Canotia holacantha* (limestone or granite) or *Simmondsia chinensis* (rhyolite), and occasionally *Prosopis* spp ..... **Sonoran Mid-Elevation Desert Scrub**

11b. This upland shrubland is transitional from Sonoran-Mojave Creosotebush-White bursage Desert Scrub; occurring at higher elevation (700-1800 m) in central and eastern Mojave and the northern transition into the Great Basin. The vegetation is quite variable. Codominants and diagnostic species include *Coleogyne ramosissima, Eriogonum fasciculatum, Ephedra nevadensis, Grayia spinosa, Menodora spinescens, Nolina* spp., *Opuntia acanthocarpa, Salazaria mexicana, Viguiera parishii* or *Yucca schidigera*. Stands may have a xeromorphic wooded layer of joshua tree (*Yucca brevifolia*) or scattered *Juniperus* spp. Perennial desert grasses are important is some stands. ..... **Mojave Mid-Elevation Mixed Desert Scrub (12)**

12a. *Coleogyne ramosissima* dominates or co-dominates the short shrub layer without a xeromorphic wooded layer of *Yucca brevifolia*. Often occurs on sandy soils..... ***Coleogyne ramosissima* Shrubland Alliance**

12b. Vegetation has an open xeromorphic wooded layer dominated by *Grayia spinosa*..... ***Grayia spinosa* Shrubland Alliance**

13a. Subtropical xeromorphic vegetation restricted in US to the extremely arid, granite mountains found in southwest corner of Arizona and adjacent California. Vegetation is sparse to open desert scrub growing on rocky mountain slopes. Characteristic species include *Bursura microphylla, Jatropha cuneata, Nolina bigelovii, Parkinsonia microphylla* and *Rhus kearneyi* ..... **Sonoran Granite Outcrop Desert Scrub**

13b. Other upland desert scrub..... **14**

14a. Xeromorphic wooded desert scrub common in plains of Sonora in Mexico, but limited to southern boundary in US, if present. Vegetation is a sparse to moderately dense layer of small xeromorphic trees and microphyllous and broad-leaved evergreen shrubs, dominated by *Olneya tesota* and *Encelia farinosa* with *Parkinsonia microphylla* and *Prosopis* spp., but *Carnegia gigantea* is NOT present..... **Sonoran Brittlebrush-Ironwood Desert Scrub**

14b. Not as above..... **15**

15a. Widespread xeromorphic wooded desert scrub found on in the Arizona Upland portion of the Sonoran Desert, but restricted to upper bajadas, hillsides, mesas and finally washes in the more arid Lower Colorado River Desert. Elevation is typically below 1200 m. Vegetation is typically *Larrea tridentata – Prosopis* species mixed desert scrub with emergent *Carnegia gigantea* and/or *Parkinsonia microphylla* as diagnostic species. There is typically a high diversity of cacti. ..... **Sonoran Paloverde-Mixed Cacti Desert Scrub**

15b. Foothill-Montane vegetation within the Sonoran and Mojave desert region **16**

16a. Upland chaparral vegetation of desert foothill and mountains..... **17**

16b. Upland forest, woodland and savanna vegetation that occurs in desert foothill and mountains. **20**

17a. Upland chaparral occurs in foothills, mountain slopes and canyons in dryer habitats below the encinal (evergreen oak) and Pinyon-Juniper woodlands (1000-2200 m elevation) in central and southern Arizona, southern New Mexico, southeast Nevada, and southwest Utah. Vegetation is composed of evergreen broadleaved shrubs with a moderate to dense shrub canopy; dominated by shrubs such as *Quercus turbinella, Quercus toumeyi, Cercocarpus montanus, Canotia holacantha, Ceanothus greggii, Forestiera pubescens (= Forestiera neomexicana), Garrya wrightii, Juniperus deppeana, Purshia stansburiana, Rhus ovata, Rhus trilobata,* and *Arctostaphylos pungens* and *Arctostaphylos pringlei* at higher elevations. .... **Mogollon Chaparral (18)**

17b. Upland chaparral occurs in foothills, mountain slopes and canyons in dryer habitats below Juniper woodlands transitioning from low-elevation desert landscapes up into woodlands of the western Mojave and Sonoran deserts extending from down into Baja Norte. Associated species include *Quercus john-tuckeri, Quercus cornelius-mulleri, Quercus berberidifolia, Arctostaphylos patula, Arctostaphylos pungens, Arctostaphylos glauca, Rhus ovata, Cercocarpus montanus var. glaber (= Cercocarpus betuloides), Ceanothus greggii, Garrya flavescens, Juniperus californica,* and *Nolina parryi.* .... **Sonora-Mojave-Baja Semi-Desert Chaparral**

18a. Upland chaparral vegetation dominated by the shrub *Cercocarpus montanus* .... ***Cercocarpus montanus* Shrubland Alliance**

18b. Upland chaparral vegetation Not dominated by the shrub *Cercocarpus montanus*... ..... **19**

19a. Upland chaparral vegetation dominated by the shrub *Quercus turbinella*... .... ***Quercus turbinella* Shrubland Alliance**

19b. Upland chaparral vegetation dominated by the shrub *Arctostyphylos patula* .... ***Arctostyphylos patula* Shrubland Alliance**

20a. Savannas with 10-25% cover of trees (generally >3 m tall with a single main stem) over a perennial grassland (25% or more herbaceous cover)..... **21**

20b. Forests and woodlands generally with over 25% cover of trees. Tree canopy may be less if stand lacks significant perennial grass (<25% perennial herbaceous cover)..... **22**

21a. Open tree layer is typically dominated by *Juniperus osteosperma* with a strong perennial grass layer (>20% cover). In the northern Mojave transition zone with the Great Basin *Juniperus scopulorum* may codominate or dominate at higher elevations. ..... **Inter-Mountain Basins Juniper Savanna**

21b. Open tree layer is dominated by *Juniperus coahuilensis, Juniperus pinchotii*, and/or *Juniperus deppeana* with a strong perennial grass layer (>20% cover) is diagnostic. *Juniperus monosperma* may be present to co-dominant. This Madrean system is common in hills in southern Arizona extending into the extreme southern part of the Colorado Plateau. ..... **Madrean Juniper Savanna**

22a. Broadleaf forests and woodlands or matrix/large patch mixed conifer-aspen forests and woodlands **23**
22b. Conifer forests and woodlands (small patch inclusion mixed conifer-broadleaf forests and woodlands may be present) **25**

23a. Mixed conifer-broadleaf forests and woodlands co-dominated by *Populus tremuloides* and conifer trees (both broadleaf and conifer tree cover over 25% total tree canopy cover) ..... **Inter-Mountain Basins Aspen - Mixed Conifer Forest and Woodland**
23b. Broadleaf forest or woodlands typically with less than 25% total tree canopy cover of conifers.....**24**

24a. Broadleaf forest or woodland typically dominated by *Populus tremuloides* with possible inclusions of other broadleaf tree species and less than 25% relative tree cover of conifers. It may occurs at upper elevations in Sky Island mountains. .....**Rocky Mountain Aspen Forest and Woodland**
24b. Broadleaf evergreen woodlands dominated by Madrean oaks such as *Quercus arizonica, Q. emoryii, Q. gravesii, Q. grisea, Q. hypoleucoides, Q. mohriana, Q. oblongifolia,* and *Q. rugosa*.....**Madrean Encinal**

25a. Subalpine conifer forests and woodlands.....**26**
25b. Montane and Foothill forests and woodlands.....**28**

26a. Conifer forests and woodlands dominated or co-dominated by *Pinus longaeva* and/or *P. flexilis* (restricted to mountains of Utah, including the Uinta Mtns., Nevada and California. Possibly occurs in the extreme northern portion of the Sonoran- Mojave desert map zone).....**Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland**
26b. Subalpine conifer forests and woodlands NOT dominated or co-dominated by *Pinus longaeva* and/or *P. flexilis* **27**

27a. Widespread matrix subalpine conifer forests and woodlands of dryer environments that are dominated or co-dominated by *Abies lasiocarpa* and/or *Picea engelmannii.* Possibly occurs in the extreme northern portion of the Sonoran- Mojave desert map zone & in the Spring Mountain of Nevada .....**Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland**
27b. Large and small patch subalpine conifer forests and woodlands of mesic environments (north aspect toeslopes) that are dominated or co-dominated by *Abies lasiocarpa* and/or *Picea engelmannii* with mesic understory species such as *Actaea rubra, Amelanchier alnifolia, Erigeron eximius, Rubus parviflorus, or Trifolium dasyphyllum* .....**Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland**

28a. Montane conifer forests and woodlands.....**29**
28b. Foothill conifer forests and woodlands **34**

29a. Matrix *Pinus ponderosa* dominated woodlands with inclusions of *Pseudotsuga menziesii* woodlands on cool aspects. *Pinus edulis, Juniperus* spp., or *Populus tremuloides* may be also be present..... **Southern Rocky Mountain Ponderosa Pine Woodland**
29b. Conifer forests and woodlands dominated by *Abies concolor* or *Pseudotsuga menziesii,* and sometime co-dominated by *Pinus ponderosa* and/or *Populus tremuloides* **30**

30a. Conifer forests and woodlands typically with Madrean species in the tree canopy and/or other conifers with understory of Madrean oaks such as *Quercus hypoleucoides* and *Quercus rugosa*. Common Submogollon and Sky Island mountain vegetation, but may extend to the extreme southern end of the Colorado Plateau **31**
30b. Widespread conifer forests and woodlands that range from Rocky Mountain Cordillera into central New Mexico and Arizona generally above the Mogollon Rim. Stands are dominated by *Pseudotsuga menziesii, Abies concolor* WITHOUT Madrean oaks such as *Quercus hypoleucoides* and *Quercus rugosa*. **32**

31a. Conifer forests and woodlands composed of Madrean pines (*Pinus arizonica, Pinus engelmannii, Pinus leiophylla* or *Pinus strobiformis*) and evergreen oaks (*Quercus arizonica, Quercus emoryi,* or *Quercus grisea*) intermingled with patchy shrublands on most mid-elevation slopes (1500-2300 m elevation). Includes *Pinus ponderosa* stands with Madrean pines or oaks. Other tree species include *Cupressus arizonica, Juniperus deppeana, Pinus cembroides, Pinus discolor,* and *Pseudotsuga menziesii*. Subcanopy and shrub layers may include typical encinal and chaparral species or have moderate cover of perennial graminoids.. ..... **Madrean Pine-Oak Forest and Woodland**

31b. Conifer forests and woodlands dominated by *Pseudotsuga menziesii, Abies coahuilensis,* or *Abies concolor* and Madrean oaks such as *Quercus hypoleucoides* and *Quercus rugosa*. Common Submogollon and Sky Island mountain vegetation, but may extend to the extreme southern end of the Colorado Plateau .... **Madrean Upper Montane Conifer-Oak Forest and Woodland**

32a. Matrix montane conifer forests and woodlands of dryer environments that are dominated or co-dominated by *Abies concolor* or *Pseudotsuga menziesii*, and sometimes co-dominated by *Pinus ponderosa* or *P. contorta* and/or *Populus tremuloides* .... **Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland (33)**

32b. Large and small patch montane conifer forests and woodlands of relative mesic environments (north aspects, toeslopes). Dominated or co-dominated by *Abies concolor* or *Pseudotsuga menziesii* and *Picea pungens.*..... **Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland**

33a. Conifer forests dominated or co-dominated by *Abies concolor*. Other trees species such as *Pseudotsuga menziesii, Pinus ponderosa* and/or *Populus tremuloides* may be present. Significant *Abies concolor* understory is present if mature *Abies concolor* are not codominant in tree canopy .... ***Abies concolor* Forest Alliance**

33b. Conifer forests dominated or co-dominated by *Pseudotsuga menziesii* with *Abies concolor* absent..... ..... ***Pseudotsuga menziesii* Forest Alliance******

34a. Foothill conifer woodlands dominated or co-dominated by *Pinus edulis, Pinus monophylla* and/or *Juniperus* spp. with *Pinus ponderosa* codominant .... **Southern Rocky Mountain Ponderosa Pine Woodland**

34b. Foothill conifer woodlands dominated or co-dominated by *Pinus edulis* and/or *Juniperus* spp. If present *Pinus ponderosa* is restricted to mesic microsites.. ..... **35**

35a. This Madrean Woodland may extend into the extreme southern part of the Colorado Plateau. The presence of *Pinus cembroides, Pinus discolor,* or other Madrean trees and shrubs is diagnostic. *Juniperus coahuilensis, Juniperus deppeana, Juniperus pinchotii, Juniperus monosperma,* and/or *Pinus edulis* may be present to dominant. Madrean oaks such as *Quercus arizonica, Quercus emoryi, Quercus grisea* or *Quercus mohriana* may be codominant. *Pinus ponderosa* is absent or sparse. If present, understory layers are variable and may be dominated by shrubs or graminoids..... **Madrean Pinyon-Juniper Woodland**

35b. Foothill conifer woodlands and shrubland NOT dominated or co-dominated by Madrean tree species..... **36**

36a. Foothill conifer woodlands dominated or co-dominated by *Pinus monophylla* and/or *Juniperus osteosperma*. Widespread in the Great Basin and may extend to mountains in the extreme northern portion of the Mojave Desert ..... **Great Basin Pinyon-Juniper Woodland**

36b. Foothill conifer woodlands dominated or co-dominated by *Pinus edulis* and/or *Juniperus osteosperma.* Common on Colorado Plateau or above the Mogollon "Rim" (usually above 2000 m. elevation). May be present in the extreme northeast corner of the Mojave Desert in transition area with the Colorado Plateau. .... **Colorado Plateau Pinyon-Juniper Woodland**

KEY B (Sonoran – Mojave): Herbaceous Ecological Systems and Alliances
(Herbaceous vegetation dominant > 20% cover with low woody cover < 10%)

1a. Land cover is restricted to drainages, semi-riparian flats, springs, seeps or intermittently flooded basins and swales **2**
1b. Land cover is upland vegetation..... **4**

2a. Wetlands restricted to drainages, springs or seeps **3**
2b. Relatively mesic lowland sites occurring in depressions on broad mesas and plains, and valley bottoms that receive runoff from adjacent uplands where water generally infiltrates or drains off relatively quickly and lacks defininig wetland soil characteristics. Vegetation is typically dominated by *Pleuraphis mutica* (tobosa swales) or other mesic graminoids such as *Pascopyrum smithii, Panicum obtusum, Sporobolus airoides*, or *Sporobolus wrightii.* ..... (**Chihuahuan-Sonoran Desert Bottomland and Swale Grassland*)** ..... **North American Warm Desert Riparian Systems****

3a. Low elevation desert herbaceous wetlands typically fed by alkaline springs or seeps..... ..... **North American Warm Desert Cienega*****
3b. Middle to lower elevation herbaceous wetlands (lower montane to valley floor) often associated with rivers and streams..... **North American Arid West Emergent Marsh*****

4a. Herbaceous cover dominated by annual graminoids or annual and biennial forbs **5**
4b. Herbaceous cover dominated by perennial species..... **6**

5a. Herbaceous cover dominated by annual species of brome grass (typically *Bromus tectorum,* but including *Bromus japonicus, Bromus rubens, Bromus hordeaceus, Bromus rigidus*) .... **Invasive Annual Grassland**
5b. 5a. Herbaceous cover dominated by introduced annual and biennial forbs (including *Ceratocephala testiculata, Halogeton glomeratus, Kochia scoparium, Lepidium perfoliatum, Salsola kali,* etc.) .... **Invasive Annual and Biennial Forbland**

6a. Herbaceous cover dominated by introduced perennial grasses and forbs (including *Agropyron cristatum, , Bromus inermis, Cenntareau sp, Cirsium arvense, Eragrostis lemmanii, Penesetum spp., Euphorbia esula, Lepidium latifolium, Melilotus spp., Thinopyrum intermedium, Poa pratensis, Phleum pratense,* and other introduced forage species ..... **Invasive Perennial Grassland and Forbland**
6b. Herbaceous cover dominated by native species..... **7**

7a Montane – subalpine grasslands found desert mountains between 2200-3350 m elevation. Vegetation is dominated by bunch grasses such as *Danthonia* spp., *Festuca* spp., *Muhlenbergia filiculmis, M. montana* or *Pseudoroegneria spicata.* Heavily grazed stands may be dominated by grazing-tolerant species, but usually have some montane grasses present ..... **Southern Rocky Mountain Montane-Subalpine Grassland**
7b. Foothill and basin vegetation **8**

8a. Widespread dry foothill and lower elevation grasslands found on sandy plains, and mesas on the intermountain western US and may be present in the northern Mojave Desert transistion. Typicially dominated or codominated by *Bouteloua gracilis, Achnatherum hymenoides, Pleuraphis* rigida, *P. jamesii*, and *Hesperostipa comata* and may include scatter shrubs and dwarf-shrubs..... ..... **Inter-Mountain Basins Semi-Desert Grassland**
8b. Desert grasslands that are restricted to the deserts and southernmost portions of the Colorado Plateau **9**

9a. Broadly defined desert grassland that may include an open mixed shrub-succulent or xeromorphic tree layer and is common of the Borderlands of Arizona, New Mexico and northern Mexico [Apacherian region], but extends out into the Chihuahuan and Sonoran deserts, and north into Mogollon Rim Area of central Arizona and may extend into the southernmost portion of the Colorado Plateau. It found on gently sloping bajadas, mesas and steeper piedmont and foothill slopes. It is characterized by lush (>20% cover) and typically diverse desert grasses, but may have a significant woody component of shrubs, trees and cacti

(10-25% cover). Common grass species include *Bouteloua eriopoda, B. hirsuta, B. rothrockii, B. curtipendula, B. gracilis, Eragrostis intermedia, Muhlenbergia porteri, M. setifolia, Pleuraphis jamesii, P. mutica*, and *Sporobolus airoides*, succulent species of *Agave, Dasylirion*, and *Yucca*, and tall shrub/short tree species of *Prosopis* and various evergreen oaks (e.g., *Quercus grisea, Q. emoryi, Q. arizonica*). .... **Apacherian-Chihuahuan Semi-Desert Grassland and Steppe**

9b. Not as above.....**10**

10b Dry grasslands found on sandy plains and mesas above the Chihuahuan desertscrub elevations. Stands are typically dominated or codominated by *Achnatherum hymenoides, Bouteloua eriopoda, B. hirsuta, Hesperostipa neomexicana, Pleuraphis*. *jamesii*, *Sporobolus cryptandrus*, and *S. flexuosus* often with scattered shrubs and stem succulents such as *Ephedra torreyana, E. trifurca, Fallugia paradoxa, Yucca elata*, and *Y. torreyana* ..... **Chihuahuan Sandy Plains Semi-Desert Grassland**

10b. Basins grasslands that may occasionally flood, but lack wetland soil characteristics. Vegetation is typically dominated by *Pleuraphis mutica* (tobosa swales) or other mesic graminoids such as *Pascopyrum smithii, Panicum obtusum, Sporobolus airoides*, or *Sporobolus wrightii*..... ..... (**Chihuahuan - Sonoran Desert Bottomland and Swale Grassland*)** .....**North American Warm Desert Riparian Systems****