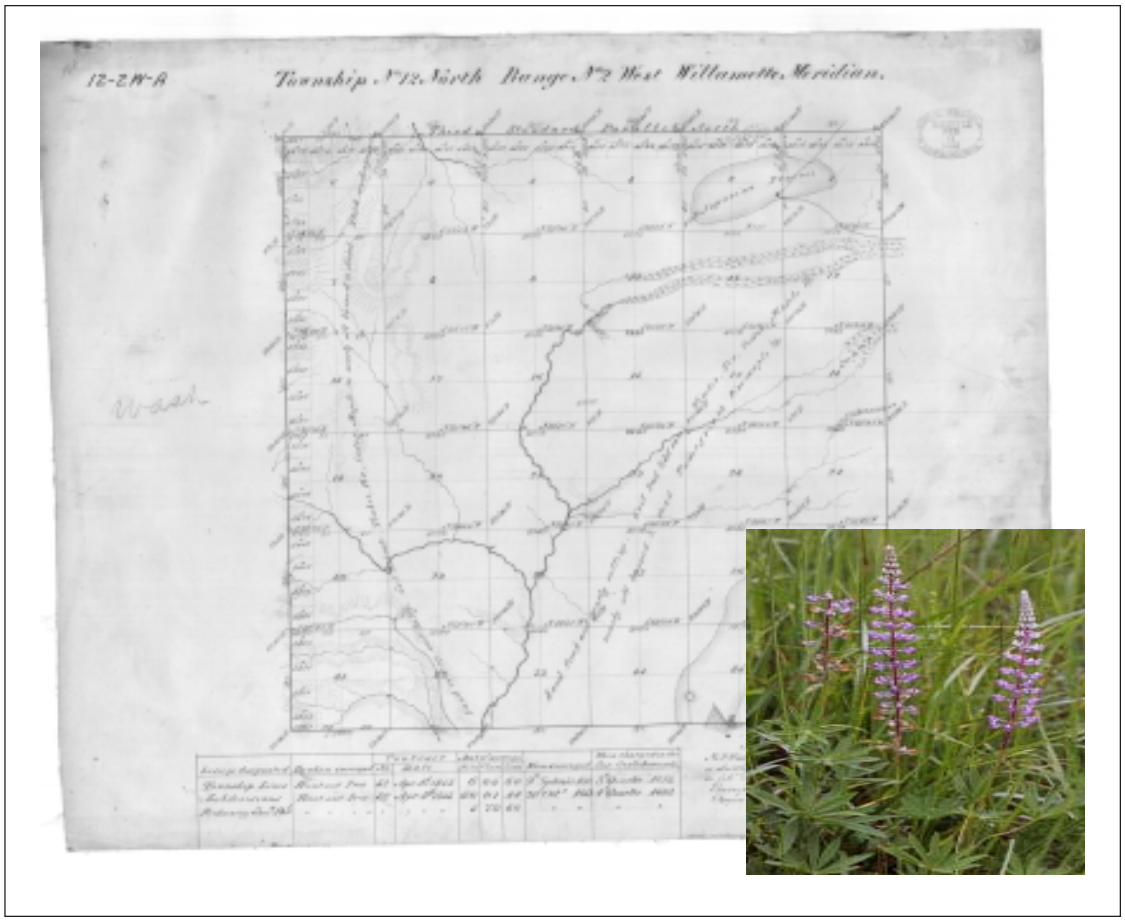
WASHINGTON NATURAL HERITAGE PROGRAM



Southwestern Washington Prairies: using GIS to find rare plant habitat in historic prairies

Prepared for the U.S. Fish and Wildlife Service Region 1, Section 6 funding

Prepared by
Florence Caplow and Janice Miller

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WASHINGTON STATE DEPARTMENT OF
Natural Resources
Doug Sutherland - Commissioner of Public Lands

Southwestern Washington Prairies:

using GIS to find remnant prairies and rare plant habitat

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December 2004

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through Endangered Species Act Section 6 funding
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Executive Summary

More than 99% of the grasslands of southwestern Washington (Clark, Lewis, and Cowlitz Counties) have been converted to agriculture and other uses. Remnant grasslands of southwestern Washington support, or did support, four federally listed species and two federal Species of Concern: Nelson's checker-mallow (*Sidalcea nelsoniana*), Bradshaw's lomatium (*Lomatium bradshawii*), Kincaid's lupine (*Lupinus sulphureus* ssp. *kincaidii*), golden paintbrush (*Castilleja levisecta*), pale larkspur (*Delphinium leucophaeum*), and thin-leaved peavine (*Lathyrus holochlorus*). These grassland areas ("prairies") also support 12 other species of plants that are considered rare in Washington State.

GIS analysis for inventory and possible re-introduction sites was done using available GIS data layers: soils data derived from the Private Forest Land Grading system (PFLG), USGS GNIS names containing "prairie" or "plain", the oak/grasslands layer developed by Chris Chappell of WNHP, elevation (below 1500 feet), georeferenced General Land Office (GLO) TIFF files of historical survey cadastral surveys, and digitized delineated prairie areas from the cadastral survey maps.

The identified prairie areas were used as a basis for reconnaissance fieldwork in the summer of 2004. We performed an initial reconnaissance in thirty-two separate prairie areas in Lewis, Cowlitz, and Clark counties. Bicycle surveys were used in portions of the area. Nine prairies supported no visible native prairie vegetation. Twenty-three prairies had at least some remnant prairie species, generally along the roadsides. Ten populations of five rare species were found in the course of the survey, including two new populations of Kincaid's lupine. Most of the populations were found on roadsides or along fencerows.

In addition, the maps produced through GIS analysis were used to identify potential habitat for rare grassland butterflies (results not included in this report), and will be used in 2005 and 2006 as a basis for further rare plant inventory.

ACKNOWLEDGMENTS

Chris Chappell, plant ecologist for the WNHP, participated in the project development, visited the Lewis and Clark prairie, and provided a very helpful review of the report. Nathan Reynolds of Washington State University demonstrated this particular GIS methodology, which he has used in his research on historical prairies in Clark County. Ann Potter and Robin Woodin, Washington Department of Fish and Wildlife, helped to field-check maps and orient me to Lewis County. Rachael Holler and Rebecca Rothwell volunteered in the field, and Peter Morrison of Pacific Biodiversity Institute, Phil Gaddis of Clark County, and Keith Karoly of Reed College provided valuable leads. All of your efforts are appreciated!

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1. INTRODUCTION

"Prairies," i.e., native grasslands on gentle topography and deep soils, are a little-known component of the pre-settlement vegetation of western Washington and Oregon. These grasslands were underlain by a variety of soil types, from the hydric soils in the wet prairies of the Willamette Valley and Clark County to the very gravelly soils in the southern Puget Sound area. They were historically maintained by frequent fires ignited by Native Americans (Norton 1979). Native grasslands are imperiled ecosystems in western Washington and have declined to less than 3% of the their pre-settlement extent (Crawford and Hall 1997, Chappell et al. 2001).

Earlier studies of native grasslands of southwestern Washington, in Clark, Cowlitz, and Lewis counties, found fairly large areas of prairie soil, but no extant untilled grasslands larger than five acres (Chappell et al. 2001). This suggests a greater than 99% loss of native grasslands (prairies) in southwestern Washington. The soils of southwestern Washington prairies range from wetland soil types to deep, well-drained soils, but gravelly soils are uncommon. This contributed to their early conversion to agricultural use.

There is, however, a strong correlation between historical prairies and historical or current rare plant populations. Remnant grasslands of southwestern Washington support, or historically supported, four federally listed species: Nelson's checker-mallow (*Sidalcea nelsoniana*), Bradshaw's lomatium (*Lomatium bradshawii*), Kincaid's lupine (*Lupinus sulphureus* ssp. *kincaidii*), and golden paintbrush (*Castilleja levisecta*), and two federal Species of Concern: pale larkspur (*Delphinium leucophaeum*) and thin-leaved peavine (*Lathyrus holochlorus*). These prairies also support or did support 12 other species of plants that are considered rare in Washington State, most of which are state Threatened or Endangered (Table 1).

In many cases, there are only one or two extant populations known for these very rare species, and many of the populations are on private land, along roadsides, or are too small to be viable. Several are disjunct by more than 100 miles from the nearest known population, and so may preserve unique alleles or other genetic differences from the main range of the species. Finding more populations, viable or not, can help bolster the populations that we have.

This project was undertaken by the Washington Natural Heritage Program (WNHP), with Section 6 funding from Region 1 of the USFWS. The intention of this project was to develop a GIS based map of historical prairies for southwestern Washington, and then to perform a reconnaissance to test the predictive power of the various map layers used in the project. If the reconnaissance showed that the map layers were useful for predicting either remnant prairie vegetation or rare plant populations, then the maps could be used within WNHP and by other agencies to identify potential rare plant habitat, potential restoration areas, potential rare butterfly habitat, and other uses.

Table 1. Potential rare plant species of Lewis/Cowlitz/Clark County Prairies

Species	common name	Bloom time	State/fed status
Aster curtus	white-topped aster	late	S
Aster hallii	Hall's aster	late	T
Balsamorhiza deltoidea	Puget balsamroot	mid	R1
Cardamine penduliflora	Willamette Valley bittercress	early	T
Castilleja levisecta	golden paintbrush	mid	E/T
Delphinium leucophaeum	pale larkspur	mid	E/SC
Eryngium petiolatum	Oregon coyote thistle	late	T
Lathryus holochlorus	thin leaved peavine	mid	E/SC
Lathryus vestitus ssp. bolanderi	Bolander's pea	mid	E
Lomatium bradshawii	Bradshaw's lomatium	early	E/E
Lupinus suphureus ssp. kincaidii	Kincaid's lupine	mid	E/T
Polemonium carneum	Great polemonium	late	T
Perideridia oregana	Oregon yampah	late	R1
Scutellaria antirrhinoides	Snap-dragon skullcap	?	X
Sidalcea hirtipes	hairy-stemmed checker-mallow	mid	E
Sidalcea malviflora var. virgata	rose checker mallow	mid	E
Sidalcea nelsoniana	Nelson's checker-mallow	mid	E/E

2. MAP DEVELOPMENT AND FIELD METHODS

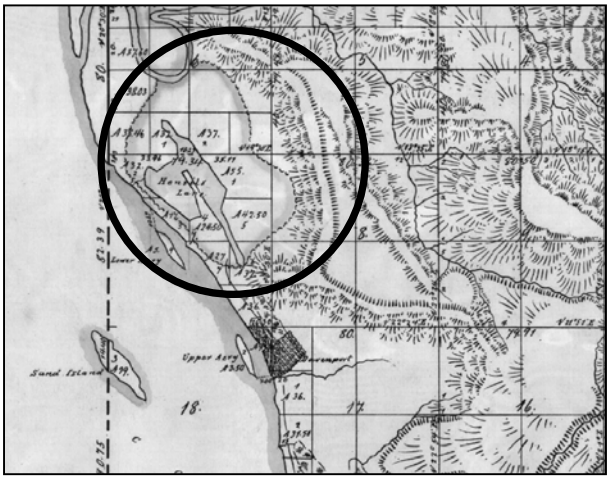
2.1. Development of GIS maps

Lewis, Cowlitz, and Clark counties, and very small portions of Thurston County and Skamania County were the boundaries of the study area (Figure 1). The study area was further refined by selecting 1) appropriate soil types from DNR soils data, 2) elevations less than 1500 feet and under from USGS 10-Meter DEM data, and 3) GNIS prairie names. This resulted in 25 target townships.

Figure. 1. Study area (in orange)

The next step was to digitize prairie areas from GLO Cadastral Survey maps that were drawn in the late 1800s. These are available online (http://landprx.pdxproxy.blm.gov/). An example of a prairie area on the GLO Cadastral Survey maps is shown in Figure 2. The maps were georeferenced using DNR's cadastral survey data and "georeference" tools in ArcGIS ArcMap.

Figure 2. A prairie area on a GLO Cadastral Survey Map



For Clark County we utilized shapefiles provided by Douglas Wilson, the archaeologist for the Vancouver National Historical Reserve. These are digitized boundaries of prairies and open wetlands from GLO Cadastral maps (see above). The layers were digitized as part of the Clark County archaeological predictive model project (Ellis and Wilson 1995; Updated by Wilson 2001) which the County converted to Washington State Plane South, NAD 83.

Table 2. Data sets used for GIS project to identify historical prairie areas

Historical prairie areas identified on:
Cadastral survey maps showing prairies or open wetlands
GNIS place names containing 'prairie' or 'plain'
Prairie soil series
Doty
Mossyrock
Nisqually
Sifton
Spanaway
Winlock
1500 feet maximum elevation, using USGS DEM data
Existing vegetation layer:
Oak/Grasslands layer developed by Chris Chappell of WNHP

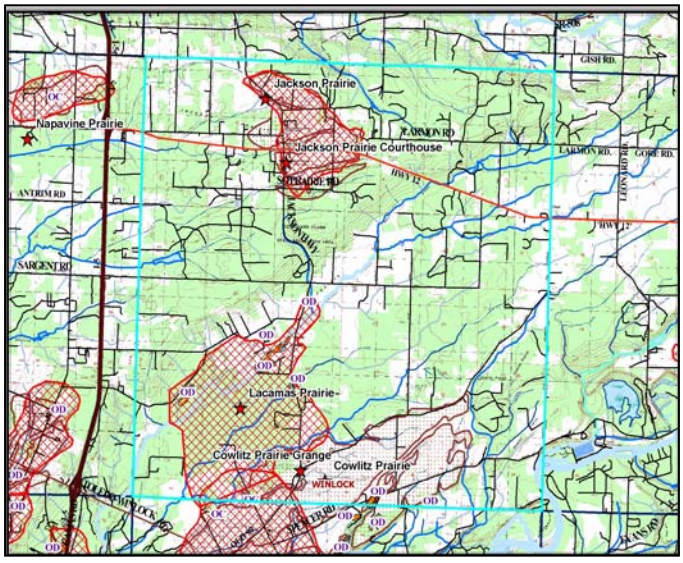
The prairie soils layer was assembled from those soil series reported in the county soil surveys to have historically supported grassy vegetation (Fowler and Ness 1954, McGee 1972, Call 1974). These did not include wetland prairies which were not well documented in the soil surveys.

The final maps for field use included prairie soils layers, GNIS prairie names, prairies (and historical mapped open wetlands in Clark County) identified on GLO Cadastral Survey maps, an oak/grassland layer developed by WNHP (Chappell et al. 1999), major and minor highways and roads, active and abandoned railroads, Natural Heritage Element Occurrence data, and Major Public Lands ownership. The most relevant layers for predicting historical prairies are in Table 2.

The maps were printed in color at one township per 11" X 14" page. This was an ideal size for fieldwork (Figure 3). Although some orthophotos were printed, they were not particularly helpful in the identification of remnant prairie vegetation, since pastures dominated by non-native grasses and remnant prairie could not be differentiated on the orthophotos.

2.2. Driving reconnaissance

Figure 3. An example of a township field map



We took the GIS maps into the field in 2004 and checked for remnant prairie species, through driving and examining roadside vegetation and adjacent fields. Two people were needed: one to drive and one to scan the roadside and fields. Binoculars and spotting scope were also used. When remnant vegetation was seen, we stopped and examined the roadside more carefully.

The reconnaissance was focused in areas that were identified as potential historical prairie, but included other areas between as well. There were two reconnaissance periods: one in late April through early May, and one in late May through early June.

The early season reconnaissance (late April and early May) was focused on camas (*Camassia* spp.) as an indicator of remnant prairie vegetation. The bright blue color of camas and its capacity to withstand considerable disturbance and grazing make it a good

indicator of the potential for other prairie species. This assumption was born out by the 2004 fieldwork.

The later season (mid May through mid June) reconnaissance was focused on the possible rare species, most of which, with the exception of *Cardamine penduliflora* and *Lomatium bradshawii*, bloom later in the season. *Delphinium nuttallii* was also a good indicator for other prairie species during the later season reconnaissance, due to its bright blue color, tolerance for disturbance, and relatively tall growth form.

We drove over 224 miles during the driving reconnaissance, most of which was focused on Lewis County. Figures 9 and 10 show driving reconnaissance routes.

2.3. Survey by bicycle

In considering the logistical aspects of this project, we felt that a bicycle might be an ideal tool for more detailed survey work. Many county roads have limited shoulders for parking, and driving speeds are too fast to identify more than the most obvious species. Bicyclists also draw little attention in rural areas, while idling vehicles can be cause for concern.

Bicycle reconnaissance was very successful. Potentially significant prairie areas were identified during the driving reconnaissance. We then transported bicycles to the area and rode as a team of two along roads in the area. Approximately 10 miles were ridden and surveyed in this way, and several rare plant populations were found through bicycle surveys.

2.4. Other surveys

Although the 2004 fieldwork was focused on reconnaissance and experimentation with road-based field methods, there were a few opportunities to work on foot on public lands and private lands when there was some willingness from the landowner. Lewis and Clark State Park, Matilda Jackson County Park, and two parcels west of Boistfort were surveyed for rare species on foot. We found rare plant populations through walking surveys as well, and hope to expand this method in 2005 and 2006, especially on private lands with willing landowners.

3. RESULTS OF FIELDWORK

3.1. Identification of extant prairie remnants

Sixty-six areas of prairie soil and/or mapped historical prairie were identified through GIS within the study area (Table 3 and Figures 9 and 10), totaling 46,531 acres.

Table 3. Prairies of southwestern Washington

Prairie	Township	Range	County	Date	Date #2	Bike date	Rare species	Return?	Comments
Adna Prairie	13N	3W	Lewis	5/17				No	All agriculture
Alpha Prairies	13N	1E	Lewis	4/26				Moderate	Some Thermopsis
Battle ground wetlands	4N	2E	Clark						
Bear Prairie	2N	5E	Clark	5/5				High	Thermopsis. Looks like a good place for Sidalcea
Beaver Creek Prairie	13N	4W	Lewis	5/17				No	Not much there
Berwick Creek Prairie	13N	2W	Lewis	4/26				Moderate	Prairie, oaks, snowberry
Boistfort Prairie	12N	4W	Lewis	5/17	6/2		Kincaid's lupine, thin leaved peavine, pale larkspur	High	Many rare species
Brush Prairie	3N	2E	Clark						
Bunker Creek Prairie	13N	3W	Lewis	5/17				No	All agriculture
Burnt Ridge Road Prairies	13N	1E	Lewis						
Calvin Road Prairie	13N	2E	Lewis						
Camp Bonneville	2N	3E	Clark						
Centralia Prairie	14N	2W	Lewis						
Ceres Hill Road Prairie	13N	4W	Lewis	5/17				Moderate	Lots of manroot
Chehalis Prairie	14N	2W	Lewis						
Chelatchie Prairie	5N	4E	Clark						
Cinebar Prairie	13N	2E	Lewis						
Claquato Prairie	13N	3W	Lewis						
Cowlitz Prairie	12N	1W	Lewis	4/29	5/21			High	Camas, also balsamroot and camas at east end
Cowlitz River Prairie	12N	1E	Lewis	5/21			Bolander's peavine	Moderate	Peavine and other dry forest species, no prairie species seen…more by bike perhaps.
Curtis Prairie	13N	4W	Lewis	5/17				High	Not really looked at. Manroot and camas north of Curtis
Doty Prairie	13N	5W	Lewis						
Doty Prairie	13N	5W	Lewis						
Drews Prairie	11N	2W	Lewis	5/18		6/3	Kincaid's lupine, hairy stemmed checkermallow	High if can access land	Camas, delphinium, oregon ash, wet prairie
Fern Hill Prairie	13N	2W	Lewis	4/26				Low	Mostly converted, oak in cemetery, interesting field at Labric (no camas)
Fern Prairie	2N	3E	Clark	5/5				High	Camas, delphinium
Fords Prairie	14N	2W	Lewis	4/26				Low	Some camas, native veg.
Frost Prairie	15N	1W	Thurston			6/2	Bolander's peavine	Moderate	Dry forest species, some prairie species at north end
Gore Rd Prairies	12N	1E	Lewis	5/21				No	No prairie species seen
Grand Prairie	11N	2W	Lewis	4/29				Low	Oaks, dry woodland species, checked twice, camas on Ross rd.
Halfway Creek meadows	12N	4W	Lewis	6/4			Nelson's checkermallow, hairy stemmed checkermallow, great polemonium	High	Small meadows in otherwise forested habitat, but high potential for more Nelson's checkermallow
Jackson Prairie	12N	1W	Lewis	5/17	6/16	6/17	Bolander's peavine	Low	Camas, columbine. Well examined by bike.
Jorgensen Road Prairie	12N	1E	Lewis	5/21				No	No prairie species seen
Kennedy Rd. Prairie	12N	1E	Lewis						
King Corner wetlands	4N	2E	Clark						
Klaber Prairie	12N	4W	Lewis	5/17				Low	Plowed on one side of road, lots of manroot on other.
Kruger Prairie	13N	1W	Lewis	4/26				Moderate	Native dry forest species, interesting spot at MP 6, also in S20. Thermopsis montana

Table 3. Prairies of southwestern Washington

Prairie	Township	Range	County	Date	Date #2	Bike date	Rare species	Return?	Comments
Lacamas Prairie	2N	3E	Clark	5/5			Many	High	Need to check roadsides and properties in vicinity - bike.
Lacamas Prairie	12N	1W	Lewis	4/29	6/3		Kincaid's lupine, hairy stemmed checkermallow (taxonomic issues)	High	Camas, lots of wet areas, lead on Frost Road for Eryngium, oregon ash/oak on frost Rd, wet prairie
Layton Prairie	11N	1W	Lewis	5/18				Low	Tiny bit of lupine and camas - mostly hayfields
Lewis and Clark Prairie	12N	1W	Lewis	4/29	6/16		Bolander's peavine	Low	Camas, Danthonia californica, Fragaria, Lupinus polyphyllus, other natives. Well searched by me and Peter Morrison.
Lewisville wetlands	4N	2E	Clark						
Longview Prairie	8N	2W	Cowlitz						
Lucas Valley Prairie	13N	1W	Lewis	4/26				Low	Converted to ag to roadside
Middle Fork Road Prairie	13N	1E	Lewis						
Mill Plain	1N	2E	Clark						
Mossyrock Prairie	12N	2E	Lewis						
Mud Creek	3N	2E	Clark						
Napavine Prairie	12N	2W	Lewis					No	Nothing left, ag, mowed.
Newaukum Prairie	13N	1W	Lewis	4/26				High	Cursory
Onalaska Prairie	13N	1E	Lewis						
Oppelt Road Prairie	13N	1E	Lewis	4/26				Moderate	Some Thermopsis
Orchards Prairie	2N	2E	Clark						
Pe Ell Prairie	13N	5W	Lewis						
Pe Ell Prairie	13N	5W	Lewis						
Pleasant Valley Road Prairie	13N	3W	Lewis	5/17				No	All agriculture
Salkum Prairie	12N	1E	Lewis	5/21				No	No prairie species seen
Salmon Creek	3N	1E	Clark						
Salzer Valley Road Prairie	14N	2W	Lewis						
Silver Lake Prairies	10N	1W	Cowlitz					No	Forest
Stearns Creek Prairie	13N	3W	Lewis						
Stillman Prairie	12N	4W	Lewis						
Toutle Prairie	10N	1W	Cowlitz						
Twin Oaks Prairie	13N	3W	Lewis						
Waunch Prairie	15N	2W	Lewis						
Yacolt Prairie	4N	3E	Clark						

Some portion of thirty-two of these areas (48%) were visited in the course of the reconnaissance, and of those, twenty-three had some remnant prairie species. Nine were entirely converted to cropland or may have been mis-mapped. Nine supported at least one, and often several, rare plant species. No large areas of prairie vegetation were found, with the exception of several acres within Lewis and Clark State Park (described below).

The mapping and reconnaissance were quite successful in differentiating completely converted prairie areas from those that still supported some remnant vegetation and had some potential for rare species. In some cases the entire former prairie area could be seen from the road, and in other cases there may still be remnant prairie vegetation on private land that was not visible from the road.

The maps were also quite accurate in predicting the presence of remnant prairie vegetation. In many cases, the mapped boundary corresponded to the edge of the camas or larkspur populations. The Lewis and Clark State Park area was the only prairie area seen in the course of the reconnaissance that was not predicted from the maps.

Most surprising was the incidence of rare species even in remnant prairie areas that had been nearly entirely converted to agricultural uses. Nearly all of the rare plant populations found in the course of the survey were found along fencerows, and in most cases the vegetation on either side of the fence was dominated by non-native species. Some rare plants were seen in fields that were completely dominated by non-native species. No rare plants were found outside the boundaries of mapped historical prairies and/or historical prairie soils, despite reconnaissance work in these areas.

3.2. Historical prairies with remnant prairie species

3.2.1. Lewis and Clark State Park, Lewis County

The remnant prairie in the open, southwestern portion of the state park (which was not mapped as prairie on either GLO maps or soils maps) supported *Danthonia californica, Fragaria virginiana, Potentilla gracilis, Solidago canadensis, Ranunculus flammula, Lupinus polyphyllus, Camassia quamash, Plagiobothrys figuratus,* and *Eriophyllum lanatum,* all of which are associated with wet and/or dry prairie. There are large ditches in several areas, and plowed strips that do not support native vegetation. Most of the area appears to have been plowed and/or ditched and its surface is unnaturally uneven as a result, with linear strips of higher and lower ground. It seems likely that this portion of the state park was once wet or at least mesic prairie, but the area has been extensively altered and invaded by non-native grasses and forbs, including *Holcus lanatus* and presumably non-native *Festuca rubra*. It may have once been contiguous with the very large Lacamas Prairie.

The entire area is about 50 acres, but the total area with some native vegetation at this point is probably less than 3 acres. Nonetheless, this is the largest known area of public land in Lewis County that supports a suite of native prairie species, and it would be an excellent area for restoration. No rare species were found, although other, drier forest-edge areas in the park support *Lathyrus vestitus* spp. *bolanderi*.

3.2.2. Lacamas and Cowlitz Prairies, Lewis County

The Lacamas and Cowlitz Prairies are north of the Cowlitz River, near the present-day town of Toledo. Portions of Lacamas Prairie are on the floodplain of Lacamas Creek. The areas of prairie soil and GLO prairie comprise more than 5,000 acres, but the mosaic of wet prairie, dry prairie, Oregon ash wetland, and

oak woodland may have been much larger, and may have been as large as 10,000 acres.

Both prairies are named on USGS maps. At one time there may have been two prairie areas separated by a more forested area, but at this point it would be difficult to identify boundaries between the two prairies. The area is nearly entirely privately owned, with the exception of the Toledo Girls Softball Field (owned by the Toledo School District). Access is limited in many areas.

There are large areas of *Camassia quamash* var. *maxima* scattered throughout the former Lacamas and Cowlitz Prairies, most notably on the low flood plains, and generally in pastures that are otherwise nearly dominated by non-native grasses.

Other prairie species that were seen on the Lacamas and Cowlitz Prairies included *Lupinus polyphyllus, Plagiobothrys figuratus, Iris tenax, Eriophyllum lanatum,* and *Balsamorhiza* spp.. Although most of the area has been converted to agriculture, other, less disturbed portions of the wet prairie are rapidly becoming dominated by shrubs and Oregon ash.

A population of Kincaid's lupine, *Lupinus sulphureus* ssp. *kincaidii,* and a population of a *Sidalcea* that may be *S. hirtipes* (see discussion in Section 3.3.4) were found on Lacamas Prairie. There are also older occurrences of *S. hirtipes* from Lacamas Prairie. A number of other native wet prairie species from a parcel on Lacamas Prairie on Frost Road: *Downingia* spp., *Helenium autumnale, Sisyrhinchium* spp., and the rare *Eryngium petiolatum* (S. Erickson, pers. comm.. 2004).

These former prairies should be the focus of more survey and inventory in future years. It seems likely that further work will reveal other rare plant populations, and perhaps larger remnants of wet or dry prairie and/or Oregon ash wetlands.

3.2.3. Drews Prairie, Lewis County

Drews Prairie is mostly west of Lacamas Creek and is bisected by Coon Creek, which runs parallel to Lacamas Creek before joining it to the south. A number of tributaries to Coon Creek also flowed through the prairie, and the topography, hydrology, and current vegetation suggest that at least the central and northern portions of Drews Prairie would have been wet prairie. Drews Prairie is now bisected by Interstate 5, and there is remnant prairie vegetation on both sides of the freeway.

The mapped GLO prairie was approximately 900 acres, but the USGS map suggests that the prairie may have continued to the south beyond its mapped boundary. Portions of Drews Prairie are farmed, but Drews Prairie has more non-farmed grassland and shrubland than most of the historical prairies. There is also

a large Oregon ash wetland at the north end of the former prairie, that probably developed after fire suppression. Drews Prairie is entirely private, and access is limited. The northern portion of the Drews Prairie is for sale, and development seems likely.

A number of wet and dry prairie (but primarily dry prairie) species were seen on Drews Prairie: *Camassia quamash* var. *maxima, Delphinium nuttallii* (relatively large numbers in fencerows on both sides of the freeway), *Eriophyllum lanatum*, *Aquilegia formosa*, and *Lupinus bicolor*. Two rare species occur in very low numbers on Drews Prairie: one plant of Kincaid's lupine (*Lupinus sulphureus* ssp. *kincaidii*) and approximately 5 plants of a *Sidalcea* that may be *S. hirtipes.*

Drews Prairie still supports significant undeveloped areas of former prairie, remnant prairie species, and possibly other, larger populations of rare species. No additional road surveys are necessary (given the limited access), but it is an area that could benefit from further inventory away from road edges on private land and possible acquisition for conservation.

3.2.4. Lacamas Prairie, Clark County

Lacamas Prairie in Clark County lay within and east of the present-day town of Orchards, within the floodplain of Lacamas Creek. The GLO maps show a large area of prairie comprising nearly 3,400 acres, west of Proebstel. However, based on current vegetation, we know that the prairie continued to the east along the floodplain at least as far as the northwest end of present-day Lacamas Lake, where the floodplain began to narrow. This would increase the size of the historical prairie to at least 4,600 acres. Based on current vegetation, at least the southern portion of the prairie was wet prairie.

Lacamas Prairie is currently considered the only example of an intact remnant wet prairie in Washington. It is the only prairie in the study area that supports an element occurrence of a wet prairie community type: 11 acres of the tufted hairgrass-California oatgrass community.

Lacamas Prairie also supports three rare prairie species: Bradshaw's lomatium (*Lomatium bradshawii*), hairy-stemmed checkermallow (*Sidalcea hirtipes*), and Oregon coyote-thistle (*Eryngium petiolatum*).

The southern portion of Lacamas Prairie has been extensively inventoried in the last decade, and was not a focus in this study. However, other areas on Lacamas Prairie could be more carefully examined for rare species or other prairie remnants.

3.2.5. Boistfort Prairie, Lewis County

Boistfort Prairie in Lewis County was in the Boistfort Valley, to the west of the South Fork of the Chehalis River. There is a description of Boistfort Prairie from 1859 by J.G. Cooper (Anderson 1994). It was described as being 2 ½ miles long by 1 mile wide, and "one of the most beautiful of the little prairies we meet". The GLO maps and prairie soil polygons suggest that the prairie may have been approximately 1,200 acres of deep, generally well drained soil, with scattered wet swales.

Nearly all of the Boistfort Valley is now farmed, and was converted to agricultural use from the 1850s to the 1880s. Cathy Maxwell, a local botanist, has been exploring the Boistfort Valley since the late 1980s, and made many of the significant finds in the valley.

The most significant feature of the Boistfort Valley is a conical mound about 50 feet high that was used as a pioneer cemetery from the 1850's, and was never plowed. This mound, a few roadsides, and one pasture, are the only accessible areas that still support some remnant prairie vegetation.

The Boistfort Cemetery mound supports a remarkable diversity of native prairie species in a matrix of exotic grasses, including tall oatgrass. The native species include *Festuca roehmeri, Apocynum androsaemifolium, Aster subspicatus, Brodiaea coronaria, Camassia leichtlinii, Eriophyllum lanatum, Ranunculus occidentalis, Lupinus bicolor, Viola adunca,* and *Ligusticum apiifolium.* A small swale to the south of the mound also supports a few native wet prairie species, including *Plagiobothrys figuratus* and *Mimulus guttatus*.

Remnants within Boistfort Prairie support known populations of the following rare species: Kincaid's lupine *(Lupinus sulphureus* ssp. *kincaidii*), pale larkspur (*Delphinium leucophaeum*), and thin-leaved peavine (*Lathyrus holochlorus*). An additional population of thin-leaved peavine was found during 2004 bicycle surveys of the valley.

A butterfly survey in 2004 found the following unusual species at the Boistfort Cemetery: Arctic skipper, which is uncommon in lowland southwestern Washington, and Ranchman's tiger moth, which is declining and almost entirely restricted to wetland prairie environments (Ross 2004).

It is unlikely that further survey work along roads in the Boistfort Prairie area will identify other rare plant populations, although there may be rare plant populations on private land in the valley. A multi-agency group is working on developing a conservation plan for the Boistfort Prairie, in an effort led by the Washington Natural Heritage Program.

3.2.6. Halfway Creek Meadows, Lewis County

The Halfway Creek meadows are on several private parcels along the Pe-Ell-McDonald Road, west of the Boistfort Valley. None of these areas were identified through GLO maps or prairie soils polygons, but must have been historically open, since they support one known population of the federally listed Nelson's checkermallow (*Sidalcea nelsoniana*) and one population found in 2004 of a *Sidalcea* that may be *S. hirtipes*. These meadows were probably always small openings associated with creek bottoms or burned areas. We suspect that there could be additional populations of both species on other properties.

3.2.7. Jackson Prairie, Lewis County

Jackson Prairie is just north of the present-day Lewis and Clark State Park. It was settled in 1845 by one of the earliest settlers in Washington, and was known as Highland Prairie at that time (perhaps to distinguish it from the lower and wetter Lacamas Prairie nearby). GLO maps and prairie soils suggest that the prairie was about 1,000 acres. Most of the Jackson Prairie area is now dry second-growth coniferous forest, pasture, or hayfields

A number of prairie species persist on roadside or in pastures in Jackson Prairie, including *Camassia* spp., *Aquilegia formosa, Delphinium nuttallii, Lilium columbianum, Fragaria virginiana,* and *Eriophyllum lanatum*.

One rare species was found on Jackson Prairie: Bolander's peavine (*Lathyrus vestitus* ssp. *bolanderi*). Several clusters of this rhizomatous species were found along roadsides in otherwise forested habitats.

The roadsides of Jackson Prairie and Matilda Jackson County Park have been surveyed by bicycle and on foot. There may be small prairie remnants or other populations of rare species on private land on Jackson Prairie.

3.3. Rare plants found in 2004 surveys

Ten populations of five rare plant species were found on historical prairies during the 2004 reconnaissance surveys (Table 2). Each is described in detail below.

Table 4. Rare plant populations found in 2004

Scientific name	Common name	Federal status	Washington status	New populations found
Lupinus sulphureus ssp. *kincaidii*	Kincaid's lupine	Endangered	Endangered	Drews Prairie (1). Lacamas Prairie (1)
Lathyrus vestitus ssp. *bolanderi*	Bolander's peavine	N/A	Endangered	Cowlitz River Prairie (1), Lewis and Clark State Park, (1), Jackson Prairie (1).
Lathyrus holochlorus	Thin-leaved peavine	Species of Concern	Endangered	Boistfort Prairie (1)
Sidalcea sp.	Checker-mallow	N/A	N/A	Drews Prairie (1),Lacamas Prairie (1), Halfway Creek Meadows (1)
Polemonium carneum	Great polemonium	N/A	Threatened	Halfway Creek Meadows (1)

3.3.1. Kincaid's lupine

Kincaid's lupine (*Lupinus sulphureus* ssp. *kincaidii*) is federally endangered and Washington State Endangered. Its range is primarily in the Willamette Valley of Oregon, and in Oregon it is the host plant for Fender's Blue butterfly, a federally endangered species. Prior to this work it was known by the WNHP from one site on Boistfort Prairie, more than 100 miles north of its primary range.

Two small populations were found in Lewis County historical prairies in 2004: one on Drew's Prairie and one on the Lacamas Prairie. Only one plant was seen on Drew's Prairie, but a population of more than 40 plants was found in a fencerow on Lacamas Prairie. Both populations are extremely vulnerable to management activities, particularly herbicide use to maintain the fenceline. We hope to find more plants in the vicinity of this population in 2005. These additional populations may provide seed and greater genetic diversity for a potential reintroduction project for Kincaid's lupine in southwestern Washington.

3.3.2. Bolander's peavine

Bolander's peavine *(Lathyrus vestitus* ssp. *bolanderi*) is a Washington State Endangered species. Its historical range was from King County south to central California (Broich 1987). Prior to 2004 it was only known from Washington from one extant site in Thurston County and several historical collection sites that no longer support populations. Its habitat is dry, open to wooded sites, and the Thurston County population was known from an historical prairie.

The Thurston County population was relocated and three other populations were found in or near historical prairie areas during the 2004 surveys: one on the Cowlitz River Prairie, one on Jackson Prairie, and one within Lewis and Clark State Park. In all cases, populations were found along roadsides or other edges (river bluffs, forest edges) of otherwise dry, wooded habitats, and plants did not continue into more heavily forested habitats. The number of plants is difficult to ascertain, since the species is rhizomatous, but all populations had hundreds of stems and the populations seemed robust. However, 90% of the populations were along roadsides, and therefore vulnerable to roadside management activities. There may be more populations in southwestern Washington in similar habitats.

3.3.3. Thin-leaved peavine

Thin-leaved peavine (*Lathyrus holochlorus*) is a Washington State Endangered species and a federal Species of Concern. It is endemic to the Willamette Valley and southwestern Washington, and is also considered to be declining in Oregon. The species grows mostly along roadsides or fencerows, in grasslands, in partially cleared land, or climbing in low scrubby vegetation. The "roadside or fencerow" description may reflect the destruction of its more characteristic prairie edge habitat. Prior to this work it was known by the WNHP from one site on Boistfort Prairie, more than 100 miles north of its primary range.

One small population was found on Boistfort Prairie in a roadside fencerow, approximately one mile north of the known population. The land on the other side of the fencerow was plowed. This population is vulnerable to roadside maintenance and fencerow maintenance, and is probably too small to be viable. Seed should be collected from it for seed-banking. Other populations may be found in Lewis County.

3.3.4. Checker-mallow

Until the 2004 surveys, 9 small populations of what was believed to be hairy-stemmed checker-mallow (*Sidalcea hirtipes*) were known from Washington. Most were known from Lewis County historical prairies.

None of the previously known populations were relocated in 2004, but three new populations were found in Lewis County during the 2004 reconnaissance: one on Drews Prairie, one on Lacamas Prairie, and one in the Halfway Creek Meadows.

Collections were sent to Steve Gisler of the Institute for Applied Ecology. He felt that they did not have the characteristics of *S. hirtipes*, but could not assign them with assurance to any other taxon. Given their close proximity to known populations of what has been considered *S. hirtipes* by the WNHP, it casts some doubt on the identification of the other Washington populations. However, all of the species of *Sidalcea* that occur in the prairies of the Willamette Valley and western Washington have some degree of rarity, so we assume that this entity is also rare. We plan to make more collections in 2005, and to send them to the author of *Sidalcea* for the Flora of North America.

3.3.5. Great polemonium

Great polemonium (*Polemonium carneum*) is a Washington State Threatened species. Its range is from western Washington to central California. In Washington it is known entirely from coastal or southwestern counties. Its habitat is prairies and woodlands from low to moderate elevation.

One population of great polemonium was found on private land in the Halfway Creek Meadows, along the edge of a meadow and second growth forest.

4. APPLICATIONS AND RECOMMENDATIONS

4.1. *Applications*

The 2004 reconnaissance showed that the GLO maps, combined with prairie soils maps, can be a powerful tool for identifying rare prairie plant populations. There is a suite of rare animals also associated with prairies, and these maps may be helpful in identifying remnant populations of prairie-dependent butterflies and other animals. The Boistfort

Prairie remnant supported two uncommon Lepidoptera species, despite its small size (Ross 2004).

The GLO maps and soil layers can also be used by agencies and conservation districts working with private landowners. By identifying areas that may have once supported prairie vegetation, and/or being aware of the possibility of prairie remnants within historical prairie areas on private land, conservation districts may be able to help landowners conserve or restore prairie vegetation on their land.

Although no large prairie remnants were found during the 2004 reconnaissance, it is possible that there may be significant prairie remnants in southwestern Washington. If found, these areas would be a high priority for conservation and/or acquisition. The reconnaissance showed that the combination of GLO maps and prairie soils layers are good predictors of remnant prairie vegetation.

4.2. Additional surveys

The prairie maps generated through this project will be used for USFWS funded rare plant surveys in 2005 and 2006, and may also be used by WDFW for rare butterfly surveys.

4.3. Significance of findings and conservation recommendations

Prior to 2004, several rare prairie species (Kincaid's lupine, Bolander's peavine, thin-leaved peavine) were only known from one extant population in Washington. Although the populations that were found during the reconnaissance were small, they are significant by what they suggest about the former range of these species. We now know, for instance, that Kincaid's lupine probably occurred on at least three prairies, rather than on one, isolated prairie far from other populations.

None of the populations found during the reconnaissance are, when considered separately, highly viable populations. All of them are small, occur in a fragmented, degraded landscape, and are vulnerable to management and road maintenance activities. However, the seed from these populations could be critical for future reintroduction of these rare species to one or more viable, more intensively managed and protected sites.

Conservation recommendations from this project include:

- Collect seed for seed banking from all roadside rare plant populations. Given the low viability of the populations, seed collection could be at a higher level than is generally recommended.
- Contact and work with landowners where rare plants occur on or near private property.

- Contact and work with State Parks and the Toledo School District to explore restoration and maintenance of prairie remnants.
- Share maps, this report, and rare plant fact sheets with conservation district and WDFW biologists, who may be working on private land in southwestern Washington.
- Continue surveys for remnant prairies and rare plant populations in historical prairie areas.
- Contact and work with county road crews to prevent spraying in the vicinity of rare plant populations.
- Consider conservation possibilities at Drews Prairie, Lacamas Prairie, Boistfort Prairie.

5. REFERENCES

Anderson, A.R., ed. 1994. *Plant Life of Washington Territory: Northern Pacific Railroad Survey, Botanical Report 1853-1861* (with map). Papers by James G. Cooper and Nelsa M. Buckingham. Washington Native Plant Society, Occasional Papers Vol. 5, Seattle, Washington.

Broich, S.L. 1987. Revision of the *Lathyrus vestitus-lactiflorus* complex (Fabaceae). Systematic Botany 12: 139-153.

Call, W. A. 1974. Soil survey of Cowlitz area, Washington. U.S. Department of Agriculture, Soil Conservation Service.

Chappell, C. B., M. S. Mohn Gee, B. Stephens, R. Crawford, and S. Farone. 2001. Distribution and decline of native grasslands and oak woodlands in the Puget Lowland and Willamette Valley ecoregions, Washington. Pages 124-139 in Reichard, S. H., P.W. Dunwiddie, J. G. Gamon, A.R. Kruckeberg, and D.L. Salstrom, eds. *Conservation of Washington's Rare Plants and Ecosystems.* Washington Native Plant Society, Seattle, Wash. 223 pp.

Chappell, C. B., M.S. Gee, and B. Stephens. 1999. A geographic information systems map of existing grasslands and oak woodlands in the Puget Lowland and Willamette Valley ecoregions, Washington. Washington Natural Heritage Program, Dept. of Natural Resources, Olympia, Wash.

Crawford, R.C. and H. Hall. 1997. Changes in the south Puget Sound prairie landscapes. Pages 11-15 *in* Dunn, P. and K. Ewing, editors. 1997. *Ecology and Conservation of the South Puget Sound Prairie Landscape.* The Nature Conservancy of Washington, Seattle, Washington.

Ellis, David V., and Douglas C. Wilson. 1995 Protecting Clark County's archaeological heritage: a database and predictive model. Archaeological Investigations

Northwest, Inc., Report No. 85. Prepared for Heritage Trust of Clark County, Vancouver, Washington.

Fowler, R. H., and A. O. Ness. 1954. Soil survey of Lewis County, Washington. U.S. Department of Agriculture, Soil Conservation Service.

McGee, D. A. 1972. Soil survey of Clark County, Washington. U.S. Department of Agriculture, Soil Conservation Service.

Norton, H.H. 1979. The association between anthroppgenic prairies and important food plants in western Washington. Northwest Anthropological Research Notes 13:199-219.

Ross, D. 2004. Butterfly surveys for Taylor's checkerspot (*Euphydryas editha taylori*) and Fender's/Puget blue (*Icaricia icarioides* ssp.) at Boistfort Prairie, Lewis County, Washington. Report submitted to the Washington Natural Heritage Program, Olympia, Washington.

Wilson, Douglas C. 2001 Assessment and update of Clark County, Washington's archeological predictive model and database. Report prepared for Clark County Community Development. Archaeology Consulting Report No. 14, Portland, Oregon.