

**A GEOGRAPHIC INFORMATION SYSTEM MAP  
OF EXISTING GRASSLANDS AND OAK WOODLANDS  
IN THE PUGET LOWLAND AND WILLAMETTE VALLEY ECOREGIONS, WASHINGTON**

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## INTRODUCTION

The objective of this project, covering the Puget Lowland and Willamette Valley ecoregions within Washington state, was to create a unified digital map of: (1) untilled grasslands now existing in landscapes that formerly supported native dry grasslands, and (2) oak dominated or co-dominated canopies. The map's scale and level of detail are designed to be appropriate for both regional-level conservation planning and county-level planning and development screening.

Native grasslands and oak woodlands are some of the most imperiled ecosystems in western Washington (Dunn and Ewing 1997). For example, native grasslands in the south Puget Sound area have declined to less than 3% of their pre-settlement areal extent (Crawford and Hall 1997). Factors contributing to the decline and degradation of these ecosystems include fire suppression and associated conifer tree invasion, invasion of non-native species, grazing, and urban and agricultural conversion (Giles 1970, Agee 1993, Clappitt 1993, Crawford and Hall 1997).

Many species of flora and fauna associated with these unique habitats are of conservation concern due to declines in population, local extirpation, or close associations with the declining habitat. These include the western gray squirrel (*Sciurus griseus*), Mazama pocket gopher (*Thomomys mazama*), Lewis' woodpecker (*Melanerpes lewisii*), white-breasted nuthatch (*Sitta carolinensis aculeata*), streaked horned lark (*Eremophila alpestris strigata*), western meadowlark (*Stunella neglecta*), Oregon vesper sparrow (*Poocetes gramineus affinis*), western bluebird (*Sialia mexicana*), racer (*Coluber constrictor*), mardon skipper (*Polites mardon*), Puget blue (*Plebejus icaroides blackmorei*), whulge checkerspot (*Euphydryas editha taylori*), zerene fritillary (*Speyeria zerene bremnerii*), white-topped aster (*Aster curtus*), golden paintbrush (*Castilleja levisecta*), common bluecup (*Githopsis specularioides*), and rose checkermallow (*Sidalcea malviflora* spp. *virgata*) (Dunn and Ewing 1997).

Native grasslands and oak woodlands in the Puget Lowland and Willamette Valley ecoregions (Omernik 1987) are found in dry environments formerly strongly influenced by frequent fires, many if not most of which were ignited by Native Americans (Norton 1979). Oak woodlands may be dominated by Oregon white oak (*Quercus garryana*), or co-dominated by that species and Douglas-fir (*Pseudotsuga menziesii*), Oregon ash (*Fraxinus latifolia*), bigleaf maple (*Acer macrophyllum*), or Pacific madrone (*Arbutus menziesii*). They range from open savannas of scattered trees to dense-canopied forests, with a range of herbaceous or shrubby understory types (Agee 1993, Chappell and Crawford 1997). They occur on relatively dry sites or moist riparian environments within prairie, or formerly prairie, landscapes.

Native grasslands are dominated primarily by Roemer's fescue (*Festuca idahoensis* var. *roemeri*), red fescue (*Festuca rubra*), or California oatgrass (*Danthonia californica*), but also harbor a wide variety of forbs that sometimes co-dominate with the grasses (Chappell and Crawford 1997). Three broad categories of grasslands can be distinguished based on the type of environment in which they grow. "Prairies" are located on flat to rolling or mounded plains that formed from deep soil deposits, most often consisting of coarse glacial outwash. They can be extensive in area. Most prairies are now located in the southern Puget Sound area. "Balds" are located on

shallow-soiled moderate to steep slopes that most often face south or west. Rock outcrops are typically present within or adjacent to balds. Balds are typically naturally smaller in extent than prairies and surrounded by forest. Most balds are located in the northern Puget Lowland. Grasslands can also be located on coastal bluffs of the northern Puget Lowland, where soils are derived from sandy glacial deposits. Many formerly native grasslands are now dominated or co-dominated by non-native grasses, or have been invaded by shrubs, especially Scot's broom (*Cytisus scoparius*), Nootka rose (*Rosa nutkana*), and common snowberry (*Symphoricarpos albus*). A now-rare fourth major type of native grassland, "wet prairies", was not mapped as part of this project.

Prior to this project, digital maps of oak woodlands or grasslands existed for specific geographic areas of western Washington, including Fort Lewis, McChord Air Force Base, and Thurston County (Kessler 1990, Macklin and Thompson 1992, Crawford et al. 1995, Rolph and Houck 1996). A map of oak woodlands in the remainder of Pierce County was completed in 1999. In addition, the Washington Natural Heritage Program has been compiling locations of high-quality native grasslands and oak woodlands for many years. A single ecoregion-wide digital cover of oak woodlands and grasslands was envisioned by multiple cooperating partners as a valuable tool for biological conservation and resource planning. The first iteration of such a comprehensive digital cover was completed in 1999 and summarized by Chappell et al. (2001). The product described herein is an updated version of the 1999 cover.

## METHODS

This project drew on several previous mapping efforts covering specific geographic areas and then filled in remaining unmapped areas. Other maps used (referred to hereafter as source maps) were of oak woodlands in Thurston County (Kessler 1990), oak woodlands on Fort Lewis (Macklin and Thompson 1992), prairies on Fort Lewis (Crawford et al. 1995), oak woodlands on McChord Air Force Base (Rolph and Houck 1996), and occurrences of high-quality native plant communities recorded in the Washington Natural Heritage Information System. Mapping of oak woodlands in Pierce County outside the military reservations began in 1993 with help from Tahoma Audubon Society volunteers. The Pierce County map was completed in early 1999 and work on the remaining gaps in coverage was started and completed in 1999. The mapped area consisted of the Puget Lowland and Willamette Valley Level III ecoregions as defined by Omernik (1987), plus the Chehalis River valley in Grays Harbor and Lewis counties.

A standard methodology for mapping was developed and applied to the Pierce County oak woodlands and all subsequent mapping of gaps in coverage. The mapping involved a combination of aerial photography interpretation and field verification. Polygons were mapped on 1:12,000 orthophotos. All polygons were assigned a cover type designation and an initial confidence rating (see Appendix 1).

Soil surveys and previous field knowledge were used to determine geographic areas in which to concentrate survey efforts. Native dry to mesic grasslands now occur, or were known to historically occur, almost exclusively on the following soil series or types: Spanaway, Nisqually, Carstairs, San Juan, Guemes, Doty, Winlock, Coupeville, Ebeys, Sequim, Sifton, Pondilla, Snakelum, Townsend, Rock Outcrop, Rock Land, Lithic Haploxerolls, Dystric Xerochrepts 70-90% slope, Rough Broken Land, or complexes involving one of these types. Mapping of grasslands was confined to these soil types or complexes. Previous field surveys had located geographic areas where the abundance of Oregon white oak was sufficient to allow development of stands that met our minimum mapping criteria. A few additional isolated oak stands were located through word of mouth.

Within the areas identified above for concentrated mapping effort, we reviewed the most recent available black-and-white and color aerial photos and identified areas that appeared to meet the criteria for one of our cover types (Appendix 1). Many of these sites had been visited previously during Natural Heritage Program inventories or by Tahoma Audubon Society volunteers who mapped oak woodlands on street maps. Many polygons could be verified with the existing field information. Others could be verified with a combination of nearby fieldwork and aerial photos where oaks were clearly distinguishable. Many polygons were marked as needing field verification. Of these, oak woodland polygons that could be seen from roads were field verified. Oak polygons needing field verification that were not seen from roads were given a low confidence rating. Grassland polygons were placed in the "unsurveyed grassland" cover type category if they had not been previously visited.

Other map sources were evaluated for their consistency with these standard mapping criteria. If cover type categories were similar to those in the standards, then the other map was incorporated "as is" with a confidence rating of 2

(moderate). If cover type categories deviated from those in the standards, then a judgement was made with regard to cross-walking the cover types of the source map with the standard cover types. Some source map cover types or polygons were dropped completely from the coverage if they did not meet the minimum standards criteria. Other source map cover types were retained but with a low confidence rating, indicating uncertainty about meeting the minimum criteria for mapping. The initial coverage was dated 1999.

In 2003, the coverage was updated using an assortment of methods. Additional ground truthing resulted in modifications to the 1999 coverage. Additional air-photo review also resulted in some modifications to, additions, or deletions of polygons. Two new cover type categories were added: urban oak canopy and airport grasslands. Urban oak canopies were separated out from areas previously mapped as one of the other cover types. Airport grasslands were added to the coverage to incorporate these heavily-modified grasslands that provide some habitat for rare animal species. The Fort Lewis mapping was modified to better incorporate areas of scattered tree canopy ("savanna"), most of which had been missing from the previous 1999 coverage. Cover types on some of the Fort Lewis prairies (Johnson, Weir, 13<sup>th</sup> Division) were updated based on recent intensive surveys of vegetation condition conducted in 1999 and 2001 by the Land Condition Trend Analysis in DPTM - Range Control.

In addition, for the most recent cover the confidence criteria were removed. In most cases, the dynamism of these types in the landscape due to land use changes and exotic species invasions means that in practical terms, there is not high confidence in the cover type designation of any one location. Many of the low confidence polygons were upgraded to moderate or removed from the coverage with recent air-photo review or ground-truthing. The overwhelming majority of polygons are now considered moderate confidence.

## RESULTS AND LIMITATIONS

The primary product of this work is the associated digital ARCINFO file OAKGRS03.

The user of this product should keep the following points in mind. The product is not 100% accurate and does not indicate the exact extent of these cover types for specific small areas. Site-specific protection or management will require additional field mapping or ground truthing of the product in order to accuracy on a particular site. Reasons for these limitations include the following. The product is a combination of several data layers with somewhat differing mapping standards. Mapping with 1:12,000 orthophotos does not ensure exact precision when looking at smaller scales. Some of the source data layers are over 10 years old now and there have undoubtedly been changes to oak woodlands and grasslands during that time. Some of these changes have been incorporated into the product, but others have not. Also, changes may have occurred in the landscape since the aerial photos used to create the product were taken. Wet prairies were not mapped as part of this project.

The map is intended to be a dynamic product that will be refined in the future as more information is gathered from the field and as changes occur on the landscape. If you know of additional significant stands of oak woodland or semi-native or native grasslands that meet our criteria (Appendix 1), please notify:

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## Appendix 1. Data Dictionary for ArcInfo OAKGRS03

### GIS File Format:

OAKGRS03 GIS data is available as an ArcInfo 7.2+ export file format.

### Map Projection parameters for OAKGRS03:

Projection name: Lambert Conformal Conic  
Coordinate System: Washington State Plane South Zone (5626)  
(North Zone converted to South Zone)  
Projection spheroid: Clarke 1866  
Horizontal datum: NAD27  
Coordinate Units: Feet

### Changing Projections:

Tools to change geographic projections are found in most full-featured GIS software packages (including ArcView 3.0+ and ArcInfo). If you are using a different projection, you must re-project OAKGRS03 data to meet your needs. At this time, the Washington Natural Heritage Program cannot provide OAKGRS03 data in other projections.

### Map Scale and Appropriate Use

While manuscripting and digitizing of the coverage was performed at 1:12,000 scale, much the data was compiled from previously existing sources which may not meet 1:12,000 scale map accuracy standards. The appropriate scale for general use of OAKGRS03 GIS data is 1:24,000, or 1 inch = 2,000 feet.

### Polygon Attribute Table Information: Data Field Descriptions and Valid Codes for OAKGRS03.PAT

#### COV\_TYPE (60, 60, C)

A descriptive cover type label which describes the dominant vegetation classes.

#### Values and definitions:

##### OAK-DOMINANT FOREST OR WOODLAND CANOPY

Description: Greater than 25% crown cover of Oregon white oaks in the main and upper canopy layers *and* <25% crown cover of conifers in the main and upper canopy layers. Broadleaf trees (e.g. ash, maple, madrone) other than oak *may or may not* be co-dominant with oak. In addition to native, undisturbed conditions, this type can include stands on agricultural lands, rural residential lands, or undeveloped stands within urban/suburban landscapes. Minimum map unit approximately 1 acre.

##### OAK-CONIFER FOREST OR WOODLAND CANOPY

Description: Main and upper canopy layers are composed of a mix of Oregon white oak and conifer with each constituting at least 25% crown cover; may also be co-dominated by other broadleaf trees. In addition to native, undisturbed conditions, this type can include stands on agricultural lands, rural residential lands, or undeveloped stands within urban/suburban landscapes. Minimum map unit approximately 1 acre.

##### SCATTERED OAK CANOPY

Description: 5-25% total tree cover of which at least half is Oregon white oak. In addition to native, undisturbed conditions, this type can include stands on agricultural lands or rural residential lands. Minimum map unit approximately 3 acres.

#### URBAN OAK CANOPY

Description: Urban or suburban yards, gardens, developed parks, cemeteries, golf courses, etc., that have a minimum of 10% crown cover of Oregon white oak. Minimum map unit approximately 3 acres.

#### SHRUBLAND POTENTIALLY RESTORABLE TO GRASSLAND

Description: Shrub-dominated (native or non-native) vegetation located on soil survey map units that supported pre-settlement grasslands. Minimum map unit approximately 20 acres unless contiguous with other grassland polygons.

#### UNSURVEYED GRASSLAND

Description: Herbaceous vegetation (<25% cover shrubs or conifer trees and <10% cover oak) located on soil survey map units that supported pre-settlement grasslands *and* identified from aerial photographs with no field survey *and* no sign of plow lines on air photo. Minimum map unit approximately 20 acres for prairies on glacial outwash landforms, 5 acres for balds on rock outcrop landforms or grasslands on coastal bluff landforms. May be smaller if contiguous with other grassland cover types.

#### NATIVE GRASSLAND

Description: Herbaceous vegetation (<25% cover shrubs or conifer trees and <10% cover oak) dominated by native species (>50% relative cover of natives) and located on glacial outwash, rock outcrop or coastal bluff landforms; verified in the field. Minimum map unit approximately 5 acres for prairies on glacial outwash landforms, 1 acre for balds on rock outcrop landforms or grasslands on coastal bluff landforms. May be smaller if contiguous with other grassland cover types.

#### SEMI-NATIVE GRASSLAND

Description: Herbaceous vegetation (<25% cover shrubs or conifer trees and <10% cover oak) that is a mixture of native and exotic species (10-50% relative cover of natives) *and* is located on glacial outwash, rock outcrop or coastal bluff landforms; verified in the field. Non-native species may visually dominate the community, but significant component of natives also present. Minimum map unit approximately 20 acres for prairies on glacial outwash landforms, 5 acres for balds on rock outcrop landforms or grasslands on coastal bluff landforms. May be smaller if contiguous with other grassland cover types.

#### EXOTIC (NON-NATIVE) GRASSLAND

Description: Herbaceous vegetation (<25% cover shrubs or conifer trees and <10% cover oak) that is completely dominated by non-native species (<10% relative cover of natives) *and* is located on soil survey map units that supported pre-settlement grasslands; verified in the field. Minimum map unit approximately 20 acres for prairies on glacial outwash landforms, 5 acres for balds on rock outcrop landforms or grasslands on coastal bluff landforms. May be smaller if contiguous with other grassland cover types.

#### AIRPORT GRASSLAND

Description: Herbaceous vegetation that is located on and adjacent to airport runways *and* on soil survey map units that supported pre-settlement grasslands. These short-stature grasslands are regularly mowed and in some cases have remnant native grassland plant species. Some provide habitat for rare animal species. Minimum map unit approximately 20 acres.

0

Description: A value of zero indicates a void that does not meet cover type criteria.

ACRES (8, 116, f)

Areal extent of polygon in US Acres.

COV\_CD (2, 2, C)

A two character cover type code describing the dominant vegetation classes.

Code values and definitions:

OD	Oak-dominant forest or woodland canopy
OC	Oak-conifer forest or woodland canopy
SO	Scattered oak canopy
UO	Urban Oak Canopy
SH	Shrubland potentially restorable to grassland
UG	Unsurveyed grassland
NG	Native grassland
SG	Semi-native grassland
EG	Exotic (non-native) grassland
AG	Airport Grassland
0	void (does not meet cover type criteria)

VOID (1, 1, I)

Denotes polygons that are voids.

Values and definitions:

1	Polygon is a void, does not meet cover type criteria, but is surrounded by polygons that do.
0	Polygon meets cover type criteria.

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The Willamette Valley has nearly level to gently sloping floodplains bordered by dissected high terraces and hills. The climate is generally mild throughout the year, with moderate rainfall reaching its maximum in winter. Prior to cultivation, the valley had abundant swamp or bog communities in addition to the grasslands and oak savannas. Types and Severity of Threats So little natural habitat remains in the Willamette Valley that there are few conversion threats to the ecoregion. Degradation of the remaining fragments continues to be a problem, and there are still moderate levels of wildlife exploitation. Suite of Priority Activities to Enhance Biodiversity Conservation. A "valley-following" approach that uses the relative brightness of individual pixels as values of "elevation" has also been applied to this problem, with varying degrees of success (Leckie et al., 2005; Chen et al., 2006). The latter illustration depicts the extensive development typical of the Puget Trough lowland ecoregion, which encroaches up to the installation boundary. The savanna and woodland communities present on Fort Lewis include both conifer and deciduous (e.g., oak) tree species, both in pure and mixed stands. occur in the Fort Lewis mapping area. In open tree canopies, such as in savanna and woodland communities, there is often confusion between tree canopy and background elements if both are green during the time of image acquisition. In the Willamette Valley, oaks were originally found in a mosaic of prairies, oak savanna, and riparian habitats throughout the valley floor and low-elevation slopes. Oaks were most common on flat to moderately rolling terrain, usually in drier landscapes, and often between prairie remnants and conifer forests. Today, oak woodlands generally are found in small, isolated pockets surrounded by other land uses, such as development or agriculture. Conservation Overview. Particularly in the Willamette Valley and Klamath Mountains ecoregions, oak woodlands continue to be converted to agricultural (especially vineyards), rural residential, and urban uses. Recommended Approach. Go to the Map. Willamette Valley-Puget Trough-Georgia Basin Ecoregion. Home Explore Places and Topics Natural Geographies Ecoregions Willamette Valley-Puget Trough-Georgia Basin. Also present were a mix of riparian habitats, oak woodlands, and prairies. The vegetation in most of the ecoregion's landscapes has now been altered. Cities, suburbs, and industrial lands are common. The earliest archaeological evidence of people in the Puget Trough ecoregion dates to about 8,000 years before present, at the mouth of the Fraser River in British Columbia and along the lower Columbia River. The ancestors of the Salish or Salishan-speaking peoples flourished in the region and developed into eighteen or more linguistic traditions. WNHP Geographic Information System (GIS) Data Set Spatial and tabular information on rare plants can be found in files located on the "O" drive. OaksGrasses2005\_1083 existing grasslands and oak woodlands in the Puget Lowland and Willamette Valley Ecoregions, Washington OakGrasses2005\_DD\_809.doc a description of the OaksGrasses2005 data. The WNHP data sets contain the most authoritative information available for Washington's rare plant species populations and endangered ecosystems. However, absence of information in WNHP for any location does not indicate that a location lacks significant natural features. The WNHP data set represents an ongoing and incomplete inventory of the state and does not eliminate the need for field surveys.