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Natural Resource Stewardship and Science

Vegetation Classification and Mapping

Crater Lake National Park

Natural Resource Report NPS/CRLA/NRR—2018/1663





ON THIS PAGE
View looking west with Mount Scott, the highest peak in the park (elevation 2,721 m, 8,928 ft), in the foreground and Crater Lake caldera in the background. The long buff-colored scar descending to the left apparently was formed by snow avalanche(s). Forests near the summit are stunted whitebark pine (*Pinus albicaulis*), a species about which there is much concern. Downslope from the summit, forests are increasingly composed of mountain hemlock (*Tsuga mertensiana*) and Shasta red fir (*Abies magnifica* var. *shastensis*). Photograph by Charles R. Bacon. Accessed from the United States Geologic Survey, April 6, 2015.

ON THE COVER
Crater Lake and Wizard Island from Discovery Point. Llao Rock is in the background to the left of Wizard Island. NPS/Dominic DiPaolo.

Vegetation Classification and Mapping

Crater Lake National Park

Natural Resource Report NPS/CRLA/NRR—2018/1663

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[3]This report is dedicated to Daniel A. Sarr (1964-2015). Daniel was the first Klamath Network Inventory and Monitoring Program Manager. He served in this capacity for 13 years, and one of his many contributions was initiating this vegetation inventory for Crater Lake National Park.

June 2018

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

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All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

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Executive Summary

Crater Lake National Park is best known because it contains one of the world's deepest, clearest, and thus, most iconic lakes. However, the great majority of the park is terrestrial, and there are considerable vegetative resources within the 73,775 ha (182,303 acre) Crater Lake National Park. To classify and map the vegetation at Crater Lake National Park, the Vegetation Mapping Inventory of the National Park Service funded an effort, beginning in 2010. Southern Oregon University staff performed the inventory work, while the Klamath Network Inventory and Monitoring Program coordinated the effort and provided additional funding along with computers, software, and other resources.

To classify the vegetation, we sampled 499 plots (relevés) throughout the terrestrial portions of the park, and we included data from an additional 101 plots sampled during a wetland study conducted in 2006 (Adamus and Bartlett 2008). In each plot, all species present and their percent cover were enumerated. For safety and accessibility reasons, we excluded from sampling the steep, unstable Crater Lake caldera and areas outside the caldera where slopes were above 30%, or where roads or trails were nearby. We identified 387 vascular plant species in the relevé plots. We classified the relevé data into 80 plant associations. Forty seven plant associations were equivalent to associations in the U.S. National Vegetation Classification (USNVC). Twenty plant associations were being peer reviewed for inclusion in the USNVC at the time of the completion of this project. Thirteen of these associations were not equivalent to associations in the USNVC, and hence these were regarded as provisional associations. Most of the associations were not distinct enough on the imagery to be mappable. Instead, we mapped 28 broader vegetation/landcover types (map units) that were visible on the imagery that we used: 2011 National Agriculture Imagery Program (NAIP) true color and infrared imagery, as well as Light Detection and Ranging (Lidar) imagery. The 600 relevé data points, as well as 803 on the ground validation plots, were instrumental to the mapping process. Google Earth imagery, which provides oblique viewing angles, and online Environmental Systems Research Institute (ESRI) imagery were also consulted. For each polygon we labeled the map unit and one or two floristic associations that occurred within the polygon. We describe the map units in detail in Appendix A. Our final map product is a geographic information system (GIS) database of vegetation structure and composition across the Crater Lake National Park terrestrial landscape, including wetlands. The database includes photos we took at all relevé, validation, and accuracy assessment plots, as well as the plots that were done in the previous wetlands inventory. We conducted an accuracy assessment of the map by evaluating 698 stratified random accuracy assessment plots throughout the project area. We intersected these field data with the vegetation map, resulting in an overall thematic accuracy of 86.2 %. The accuracy of the Cliff, Scree & Rock Vegetation map unit was difficult to assess, as only 9% of this vegetation type was available for sampling due to lack of access. In addition, fires that occurred during the 2017 accuracy assessment field season affected our sample design and may have had a small influence on the accuracy.

There have been several fires that occurred since 2011 when the imagery used for mapping was produced. The portion of these fires that burned at high severity (i.e., where above ground vegetation was mostly killed) have experienced dramatic change that could not be documented using our

imagery, and therefore are not captured by our mapping. Many of these areas are now early successional forms of the preburn vegetation, however that cannot be determined from our map. Thus, the user is advised that our vegetation map be used in concert with an overlay of high severity burned patches that have occurred since 2011.

To complete this vegetation inventory project we produced the standard deliverables as described and presented herein, including:

- This final report that includes plant association descriptions (Appendix B), the key to the plant associations (Appendix C), descriptions of the map units and their photo-signatures (Appendix A), accuracy assessment information, and project methods and results.
- A GIS database containing the attributed vegetation polygons, classification plots, and accuracy assessment points.
- Digital photographs characterizing the relevé, validation, and accuracy assessment plots.
- Federal Geographic Data Committee-compliant metadata for all of the spatial data.

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Acronyms and Abbreviations

List of Acronyms and Abbreviations

Abbrev.	Definition
A.D.	Anno Domini
AA	Accuracy Assessment
ac	Acre(s)
CA	California
CEGL	Community Element Code--Global
CES	Ecological System Code
°C	Degrees Celsius
cm	Centimeter(s)
CNPS	California Native Plant Society
CEGL	Community Element Global
CEPP	Community Element Proposed
CO2	Carbon dioxide
CRLA	Crater Lake National Park
DOGAMI	Oregon Department of Geology and Mineral Industries
DVD	Digital Video Disk
e.g.	for example (exempli gratia)
ESRI	Environmental Systems Research Institute
et al.	and others (et alia)
°F	Degrees Fahrenheit
FGDC	Federal Geographic Data Committee
FIPS	Federal Information Processing
FSA	United States Department of Agriculture, Farm Services Agency
ft	Foot/Feet
GIS	Geographic Information System
GPS	Global Positioning System Receiver
ha	Hectare(s)
I&M	Inventory and Monitoring Program
in	Inch(es)
IR	infrared
KLMN	Klamath Inventory and Monitoring
km	Kilometer(s)
Lidar	Light Detection and Ranging
MMU	Minimum Mapping Unit
m	Meter(s)
m^2	Square Meters
NAD83	North American Datum of 1983

List of Acronyms and Abbreviations (continued)

Abbrev.	Definition
N/A	Not Applicable
NAIP	U.S. Department of Agriculture, National Agriculture Imagery Program
NBII	National Biological Information Infrastructure
NPS	National Park Service
NRC	Natural Resources Challenge
NVCS	National Vegetation Classification Standard
ODFW	Oregon Department of Fish and Wildlife
Ph.D.	Doctor of Philosophy
STD	Standard
St.	Saint
SOU	Southern Oregon University
TNC	The Nature Conservancy
TWIN-SPAN	Two-Way Indicator Species Analysis
sp./spp.	Species (singular/plural)
U.S.	United States
U.S.A.	United States of America
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
USNVC	U.S. National Vegetation Classification
UTM	Universal Transverse Mercator
VMI	Vegetation Mapping Inventory
WASO	Washington Area Service Office

1. Introduction

Crater Lake National Park was established in 1902 and encompasses 73,775 ha (182,303 acres). The park is known for containing the iconic, eponymous lake, which is the world's clearest, and among the world's deepest, characteristics that lend it its distinctive indigo color. However, this only accounts for 5,333 ha of Crater Lake National Park. The remaining terrestrial area contains outstanding vegetative resources, ranging from old-growth montane forests composed of very large conifers, to wind and snow sculpted subalpine forests, as well as lush wet meadows. This vegetation has been less altered by human activities than most of the vegetation elsewhere in the region. The vegetation colonized on fresh volcanic substrata created by the cataclysmic eruption of Mount Mazama about 7,700 years ago. The influence of the resulting volcanic substrata is evident in many areas today. Scrutiny of air photos also reveals spatial patterns in vegetation that were caused by past fires. The purpose of this report is to describe the vegetation of Crater Lake National Park based on extensive field data collection and to map the vegetation based on analysis of aerial imagery. We have completed this mapping under the auspices of, and in accordance with, the Vegetation Mapping Inventory of the National Park Service (NPS).

1.1 Background (National Mapping and Data Protocols)

In 1994, the NPS and U.S. Geological Survey (USGS) formed a partnership to map the vegetation in national park service units, (then known as the USGS-NPS Vegetation Mapping Program). Since 2010, the program has been managed by the National Park Service solely under a new program name, the NPS Vegetation Mapping Inventory (VMI) program. The NPS VMI Program classifies, describes, and maps existing vegetation of national park units with significant natural resources. The objectives of the inventory are to provide basic vegetation data for park resource managers, obtain vegetation data that can be examined in a regional and national context, and provide opportunities for future inventory, monitoring, and research activities (FGDC 2008, Grossman et al. 1998). The products from this effort provide the structure for addressing critical science-based questions about vegetation communities on the landscape of national park service units.

At its inception, the VMI adopted the USNVC as a basis for the definition of vegetation units. This was developed by The Nature Conservancy and Environmental Systems Research Institute (TNC and ESRI 1994, Grossman et al. 1998). This national classification was intended to be a standardized and complete taxonomic treatment of vegetation communities in the United States at eight levels of thematic resolution. The eight levels were organized in a hierarchy, with the top or upper levels comprising broadly distributed vegetation types defined by structure (physiognomy), not floristics. The lower levels are composed of more narrowly distributed types defined by floristics (alliances and associations).

The Vegetation Subcommittee of the Federal Geographic Data Committee (FGDC) requires that federally-funded vegetation classification studies collect data in a manner that enables crosswalking the data to the U.S. National Vegetation Classification (USNVC) and sharing among agencies (FGDC 2008). In 2008, the FGDC formally endorsed the revised version of the National Vegetation Classification Standard and the U.S. National Vegetation Classification (FGDC 2008). The review of

content remains active currently, with the most recent classification treatment available online through the U.S. National Vegetation Classification and NatureServe websites.

The content of the USNVC hierarchy is currently maintained via collaboration between the Ecological Society of America, the FGDC, and NatureServe (formerly a division within The Nature Conservancy). The floristically-based alliances and associations are used as classification and mapping units by the Vegetation Mapping Inventory whenever feasible. The federal standard (FGDC 2008) is denoted as the National Vegetation Classification Standard (NVCS) while the classification hierarchy is referred to as the U.S. National Vegetation Classification (USNVC). The latest information is available from the U.S. National Vegetation Classification website.

Use of the USNVC as the standard vegetation classification system is central to fulfilling the goals of the Vegetation Mapping Inventory. This system:

- is vegetation based;
- uses a systematic approach to classify vegetation along gradients of change;
- emphasizes existing, natural vegetation;
- uses a combined physiognomic-floristic hierarchy;
- identifies vegetation units based on both qualitative and quantitative data; and
- is appropriate for mapping at multiple scales.

The initial and current Vegetation Mapping Inventory protocols and standard documents are available on the NPS-National Vegetation Mapping Inventory Program website.

The use of the national vegetation mapping protocols helps facilitate effective resource stewardship by ensuring compatibility and widespread use of the information throughout the Park Service. It also facilitates use of the information by other federal agencies, states, academia, and private citizens. The vegetation maps, associated classification data, and accuracy information support a wide variety of resource assessment, park management, and planning needs. In addition, the data/information can be used to provide a structure for framing and answering critical scientific questions about vegetation and species' patterns and their relationship to environmental conditions and ecological processes across landscapes.

1.2 NPS Natural Resource Challenge and the Vegetation Mapping Inventory Program

The NPS approved a program called the Natural Resource Challenge in 1999. The purpose of this ongoing program is to encourage National Parks to focus on the preservation of the nation's natural heritage through science, natural resource inventories, and expanded resource monitoring (NPS 1999). To implement the Natural Resource Challenge, NPS organized 270 parks into 32 networks to facilitate collaboration and sharing in natural resources management and to perform inventory and monitoring of natural resources. The Natural Resource Challenge identified 12 basic inventories needed to facilitate natural resources management, and vegetation mapping and inventory is one of

these twelve. The Vegetation Mapping Inventory works closely with the networks to inventory, map, and describe vegetation communities, and document unique plant species and associations. The vegetation inventory helps park managers conserve biodiversity; manage challenges such as invasive species, insect outbreaks, and diseases; and understand resources and processes such as wildlife habitat relationships and wildland fires.

A complete vegetation mapping project for a park includes, at a minimum, the following products:

- Detailed vegetation report
- Digital vegetation map
- Vegetation classification of relevé plot data
- Map accuracy assessment data and analysis
- Dichotomous vegetation key
- Map photo-interpretation key

Maps are produced in Universal Transverse Mercator (UTM) coordinates 1983 North American Datum (NAD 83) with a 1:24,000 scale and a minimum mapping unit (MMU) of 0.5 hectares (1.24 acres). The vegetation maps must meet the 2010 FGDC map accuracy standards (which specify horizontal errors of less than 12.2 meters (40.0 ft.) on the ground for 1:24,000 scale maps). The maps also must target a minimum class accuracy goal across all vegetation and land cover classes of 80%. Digital vegetation products are accompanied by FGDC compliant metadata, which describe the content, quality, condition, and other characteristics of the spatial dataset and are critical elements that expedite the interpretation and exchange of information among users.

A high resolution pdf of the vegetation map is available for printing at poster (24” x 36”) or other sizes. All final Vegetation Mapping Inventory products are made available at the NPS Vegetation Mapping Inventory Products webpage.

1.3 Klamath Network

The Klamath Network Inventory and Monitoring Program (‘Klamath Network’; Figure 1) encompasses six parks managed by the NPS in northern California and southern Oregon: Crater Lake National Park, Lassen Volcanic National Park, Lava Beds National Monument, Oregon Caves National Monument, Redwood National and State Parks, and Whiskeytown National Recreation Area. Collectively, the six parks comprise nearly 200,000 ha (494,211 acres) and range considerably in size from 1,844 to 73,775 ha (4,556 to 182,303 acres). They contain dramatic vistas, mountains, volcanoes, lakes, caves, and considerable topographic relief and biodiversity.

The Klamath Network has completed the natural resource inventories, selected its vital signs for monitoring (Odion et al. 2005), and has been monitoring these vital signs for several years. Vegetation is one of these vital signs (Sarr et al. 2007). With the completion of the mapping project herein, the vegetation mapping inventory will have been completed for all parks in the Klamath

Network. The Southern Oregon University team that mapped Crater Lake National Park's vegetation previously mapped the vegetation of Oregon Caves National Monument and Lava Beds National Monument (Odion et al. 2013, DiPaolo et al. 2015), and completed field work and association descriptions for the Vegetation Mapping Inventory Project for Lassen Volcanic National Park (in prep. https://science.nature.nps.gov/im/inventory/veg/project.cfm?ReferenceCode=2177185).

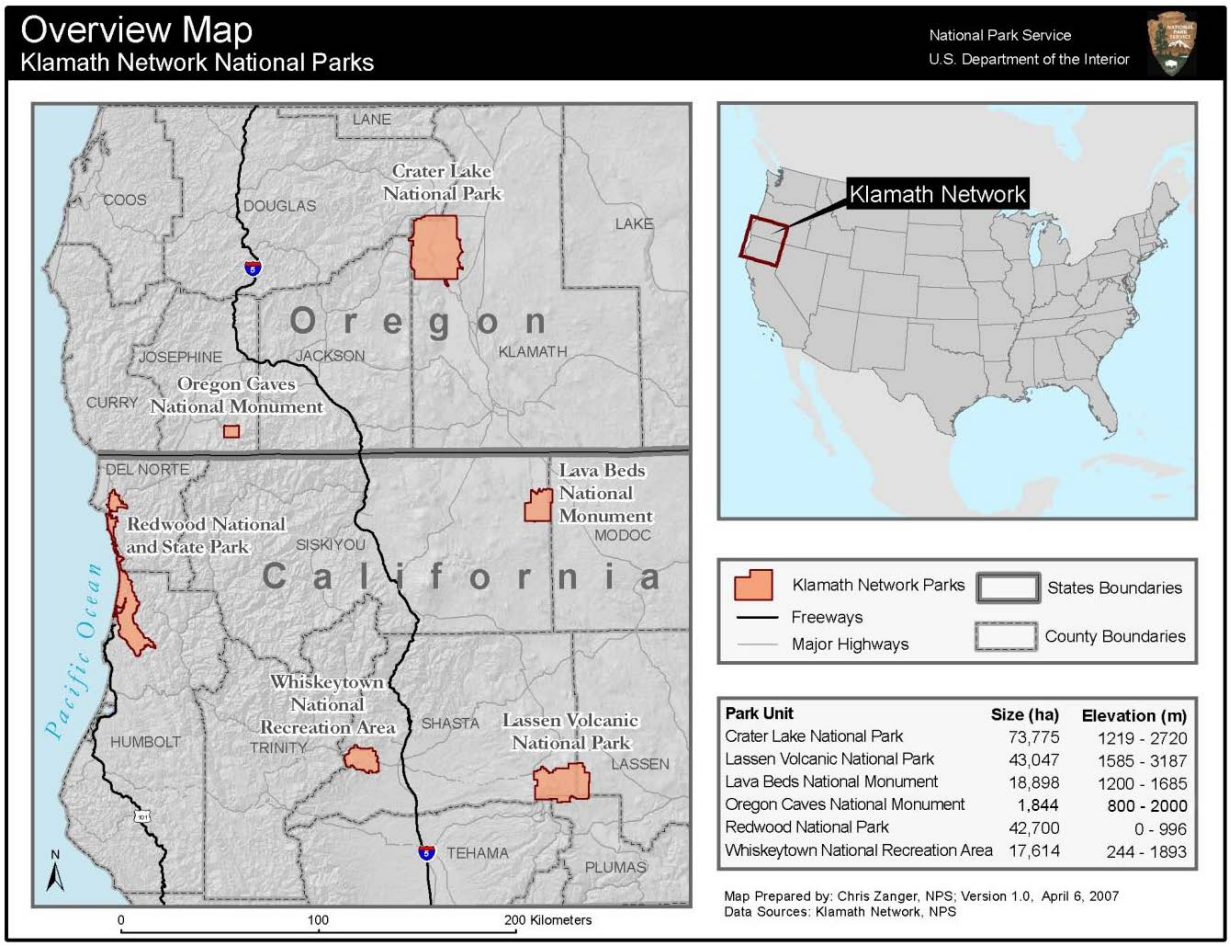


Figure 1. National Park Service units of the Klamath Network of southern Oregon and northern California.

1.4 Crater Lake National Park

1.4.1 Location and Resource Setting

Crater Lake National Park in southwest Oregon encompasses 73,775 ha (182,303 ac) in the south-central portion of the Cascade Range (Figures 1, 2, 3, 4). Elevations in the park range from about 1,219 m (4,000 feet) in the park's southwest corner to just over 2,720 m (8,920 feet) at Mount Scott to the east of the Crater Lake caldera rim (Figures 3, 4). The park is surrounded by U.S. Forest Service lands (Rogue River-Siskiyou National Forest towards the west, and Fremont-Winema towards the east) and the Sun Pass State Forest owned by the State of Oregon to the southeastern part of the park.

Near the center of the park is its most scenic and renowned resource, Crater Lake. With a depth of 1,943 feet, it is the deepest lake in the United States. The lake is in a caldera which was formed when the top of a 12,000-foot volcano, Mount Mazama, erupted and collapsed about 7,700 years ago. Over the centuries, the caldera has collected water from rain and snow to form the lake. It is about 5 miles in diameter and is surrounded by the jagged, steep-walled cliffs of the caldera left by the climactic eruption and collapse. The cliffs surrounding the lake rise from 500 to 2,000 feet above the lake's surface. Crater Lake holds the world record for clarity among lakes. The lake has no inlets or outlets. Evaporation and seepage prevent it from accumulating water and becoming deeper. Crater Lake is considered a youthful lake with a high level of purity, attributable to the lack of inflowing streams that otherwise would introduce minerals and other debris. The lack of stream inflow prevents nutrient input, resulting in an oligotrophic lake with very restricted phytoplankton (free floating, single cell plants). The absence of sufficient carbonates inhibits the development of aquatic invertebrate animals. The result is a high level of light penetration that exceeds the level found in other alpine lakes.

The park's land slopes gradually downward in all directions outward from the Crater Lake caldera rim. Generally, the vegetation of Crater Lake National Park reflects a mosaic of densely forested and open nonforested areas typical of mainly-unaltered natural areas of the Southern Cascades. Much of the park is heavily forested, but there are also a variety of wetlands, montane grasslands, and extensive pumice-covered flats that are sparsely vegetated by numerous herb and grass species. Forests range from montane mixed conifer, dominated by Sierra white fir (*Abies lowiana*), Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*) at the lowest elevations; to subalpine forests of Shasta red fir (*Abies magnifica* var. *shastensis*), Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) and mountain hemlock (*Tsuga mertensiana*) at moderate to high elevations; to whitebark pine (*Pinus albicaulis*) woodland at highest elevations around the Crater Lake caldera rim. There are also burned forests with standing dead trees as well as patches of shrub vegetation dominated by greenleaf manzanita (*Arctostaphylos patula*) and snowbrush ceanothus (*Ceanothus velutinus* var. *velutinus*). Springs, as well as runoff from large amounts of snow, help form streams originating on the slopes of the caldera. On the west side of the park, at Boundary Springs, a large amount of spring water issues forth, forming the beginning of the Rogue River. Other streams that flow from the west side of the park and into the Rogue River include Bybee Creek and Castle Creek, while Annie and Sun Creeks flow southward into the Klamath Basin, forming some of the headwaters of the Klamath River. Most of these creeks form steep-walled, deeply incised gullies in pumice/tuff, contributing to the ruggedness of the terrain. The pumice sides of these canyons are steep, barren, unstable and difficult to access in many areas. Extensive areas of cliffs, scree slopes, and rock also occur, due in part to an active and tumultuous geologic history within Crater Lake National Park.

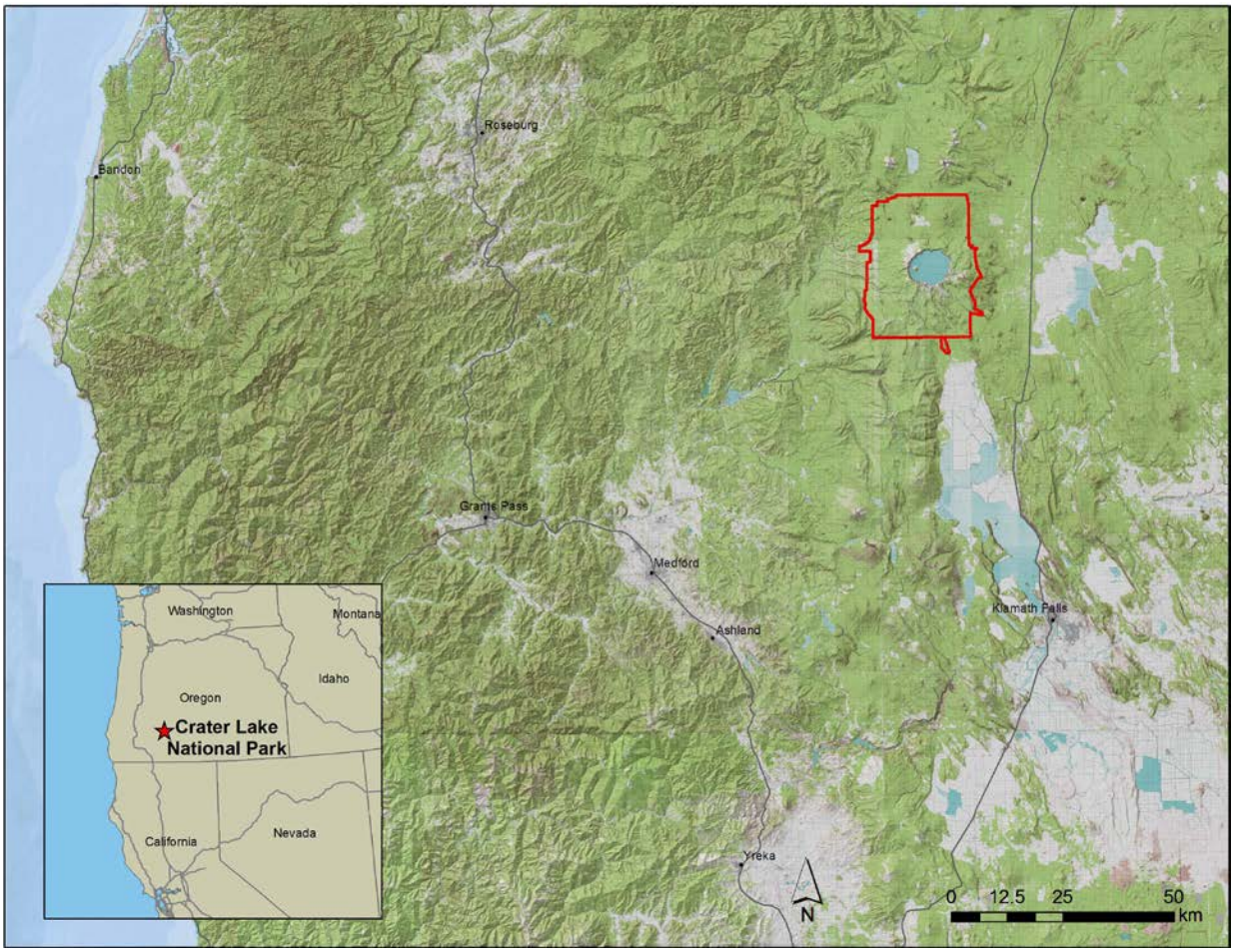


Figure 2. Crater Lake National Park and surrounding region.

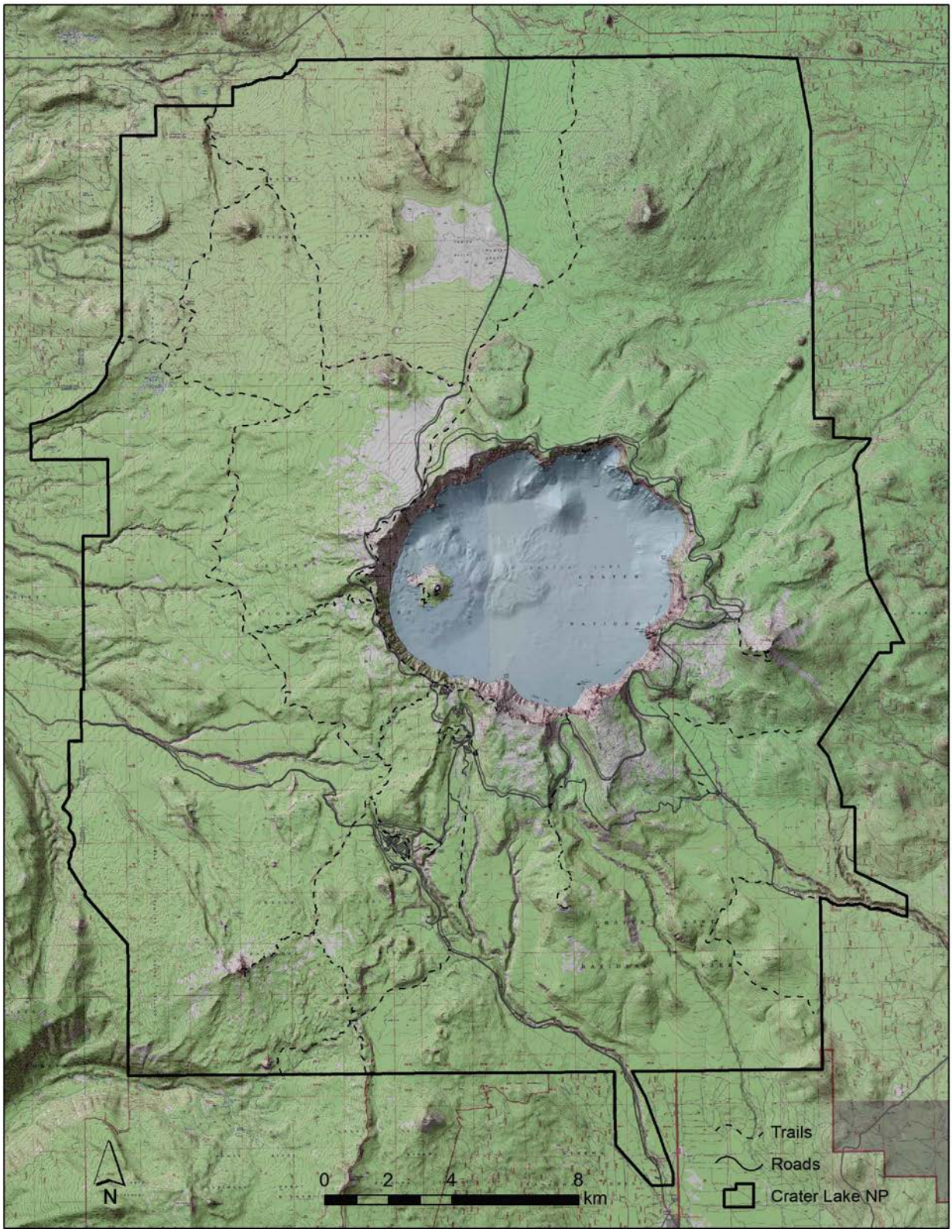


Figure 3. Crater Lake National Park topographic map with roads and trails.

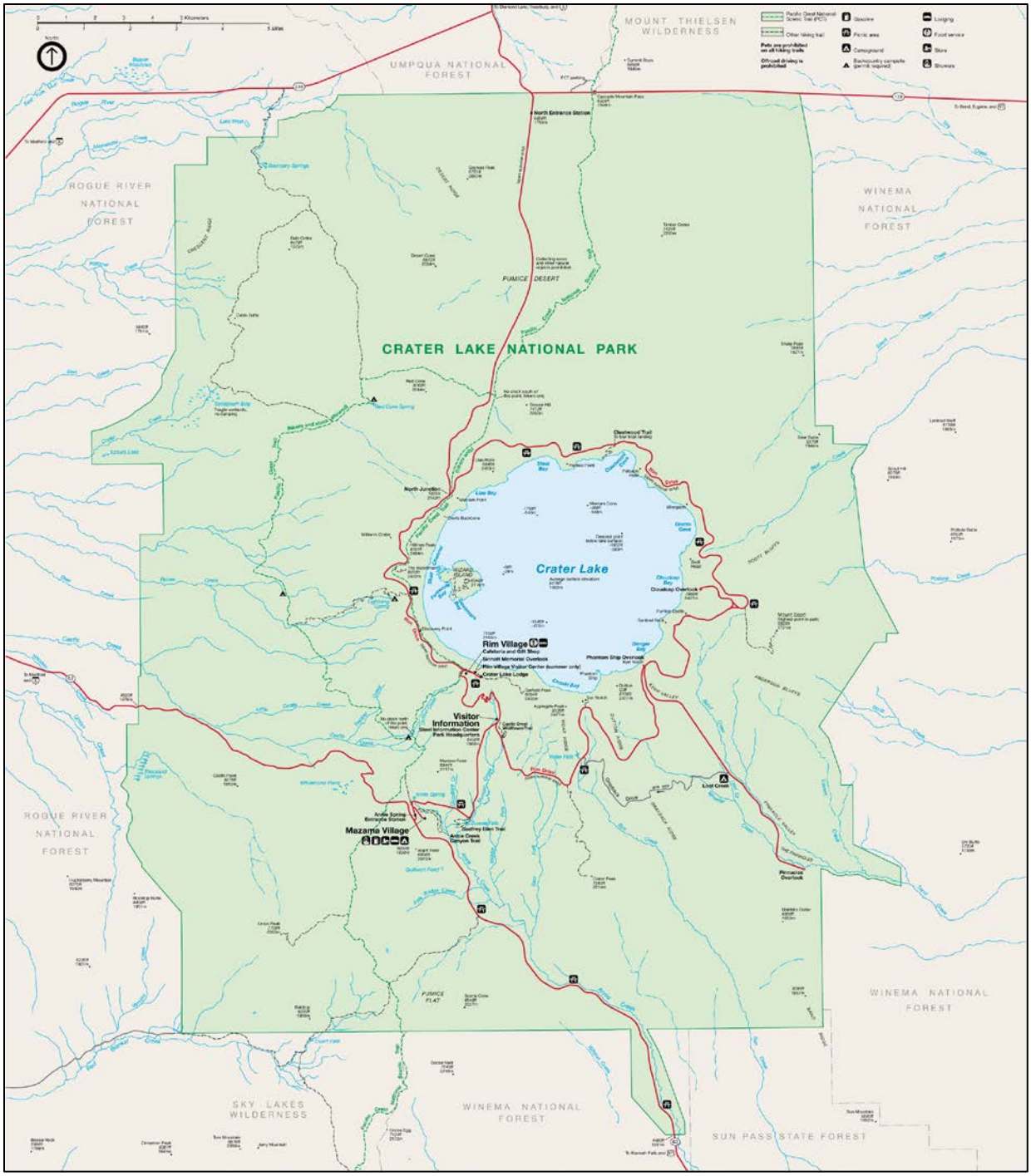


Figure 4. A Crater Lake National Park map labeling most of the park's important features and locations, many of which are mentioned in this report.

1.4.2 Geology

The dynamic geological history of Crater Lake National Park, most notably the various volcanic substrata that were produced as a result of the eruption of Mount Mazama, have had profound influences on the vegetation we see in the park today. Mount Mazama, prior to its cataclysmic

eruption that formed the caldera that holds Crater Lake, was a massive volcanic edifice, not unlike Mt. Shasta to the south and Mt. Rainier to the north. Mount Mazama consisted of a succession of overlapping shield and stratovolcanoes built upon lava flows older than 400,000 years (KellerLynn 2013). An artist's rendition of the mountain at the start of its climactic eruption ~7,700 years ago is shown in Figures 5a-b.



Figure 5a. Mount Mazama at the onset of its climactic eruption. Scene depicted by artist Paul Rockwood in the 1940s, under the guidance of geologist Howell Williams. Image courtesy of NPS. Original in the Crater Lake Museum and Archives Collections.



Figure 5b. Mount Mazama immediately after caldera formation. Scene depicted by artist Paul Rockwood in the 1940s, under the guidance of geologist Howell Williams. Image courtesy of NPS. Original in the Crater Lake Museum and Archives Collections.

As described in the Crater Lake National Park *Geologic Resources Inventory Report* (KellerLynn 2013), the climactic eruption of Mount Mazama, about 7,700 years ago lasted only a few days. Nonetheless, it ejected a massive amount of magma (~50 km^3 (12 mi^3)). The eruption took place in two phases: a single-vent phase that produced a towering column of pumice and ash, called a "Plinian eruption," (Figures 5a-b), and a ring-vent phase that started as the volcano began to collapse in upon itself, creating circular cracks that opened up around the peak. During the Plinian eruption, ash blanketed an area of about 1.7 million km^2 (656,000 mi^2) across western North America. The ash and pumice affect plant growth both inside and outside the park boundary. The ring-vent phase of the eruption produced pyroclastic flows—rapidly moving, chaotic mixtures of lava, rock fragments, gas, and ash, at temperatures greater than 800°C (1,470°F)—fed by vents that circumscribed the upper part of Mount Mazama. The substrata created by these flows also affects plant growth.

Pyroclastic-flow deposits of the climactic eruption of Mount Mazama, more than 60 m (200 ft.) thick in some places, form the Pumice Desert (Figure 6), a flat, open area in the northern part of the park. It contrasts conspicuously with the surrounding forest of Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) (KellerLynn 2013). These deep deposits overlay many other valleys and low lying areas in the park.



Figure 6. Pumice Desert is a broad, mostly barren flat in the northern part of Crater Lake National Park. Its thick layer of pumice and ash, more than 60 m (200 ft.) in some places, was deposited during the climactic eruption of Mount Mazama. Reproduced from KellerLynn (2013).

Shield volcanoes and cinder cones partly surround Mount Mazama and are representative of the magma input to the Mazama system over time. These small, individual volcanoes are a manifestation of regional volcanism.

Since the climactic eruption, volcanic activity in the area has been restricted to the inside of the Crater Lake caldera (KellerLynn 2013). As the lake began to fill with water, lava and pyroclastic material created the central platform and Wizard Island (see cover photo) within a few hundred years of caldera formation (Bacon et al. 2002). Wizard Island is the only post-caldera volcano to breach the surface of Crater Lake. The last eruptions of Wizard Island about 4,800 years ago took place when Crater Lake was about 80 m (260 ft.) lower than today (Bacon et al. 2002).

The geologic setting of Crater Lake National Park is also noted for many glacial features (Figure 7, KellerLynn 2013). Ice occupied valleys and the higher parts of Mount Mazama at least six times during the volcano's history (Bacon 2008, Bacon and Lanphere 2006). A seventh glaciation is recorded in the caldera walls. Repeated glacial advances carved the deeper valleys in the park such as Munson, Sun, and Kerr (Bacon and Lanphere 2006). The slopes of Mount Mazama show classic

glacial features, including U-shaped valleys that were carved by repeated advances of glacial ice. Munson, Sun, Kerr, Sand, and Annie Creek valleys exemplify this.

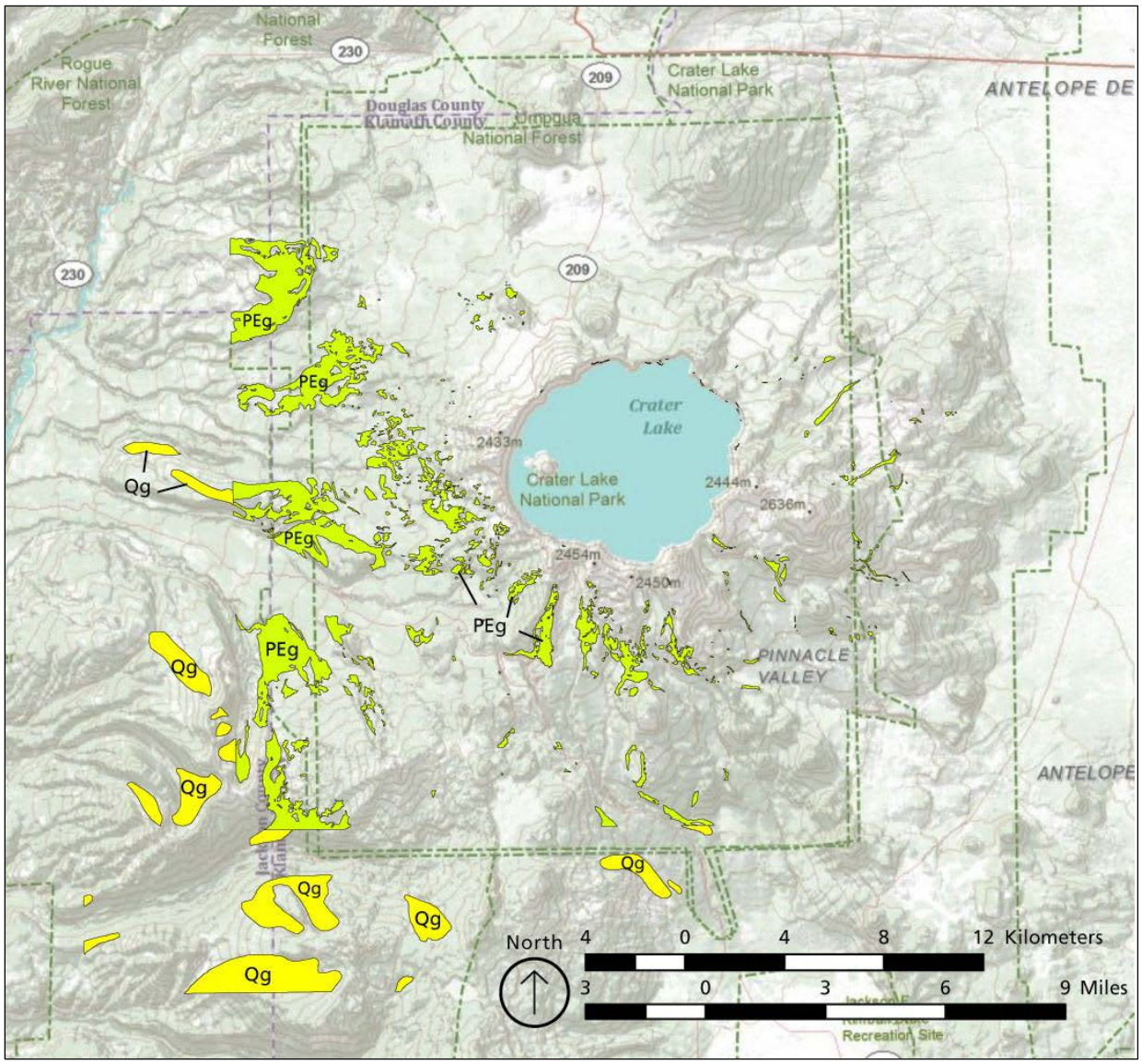


Figure 7. A reproduction of Figure 32 from KellerLynn (2013) showing the extent of glaciation at Crater Lake National Park. At present no glaciers occur within the park. Glacial deposits mapped by Smith et al. (1982) and Bacon (2008)—map unit symbols PEg and Qg, respectively—show the general distribution and extent of past glacial activity on the landscape. However, deposits of the caldera-forming (climactic) eruption probably buried glacial deposits. Graphic by Rebecca Port (NPS Geologic Resources Division).

Another classic glacial form is the cirque—a bowl-shaped hollow eroded into the side of a mountain. Mount Scott has a cirque on its northwestern side (Figure 8), and Union Peak was once surrounded by glaciers that carved cirques on all sides.

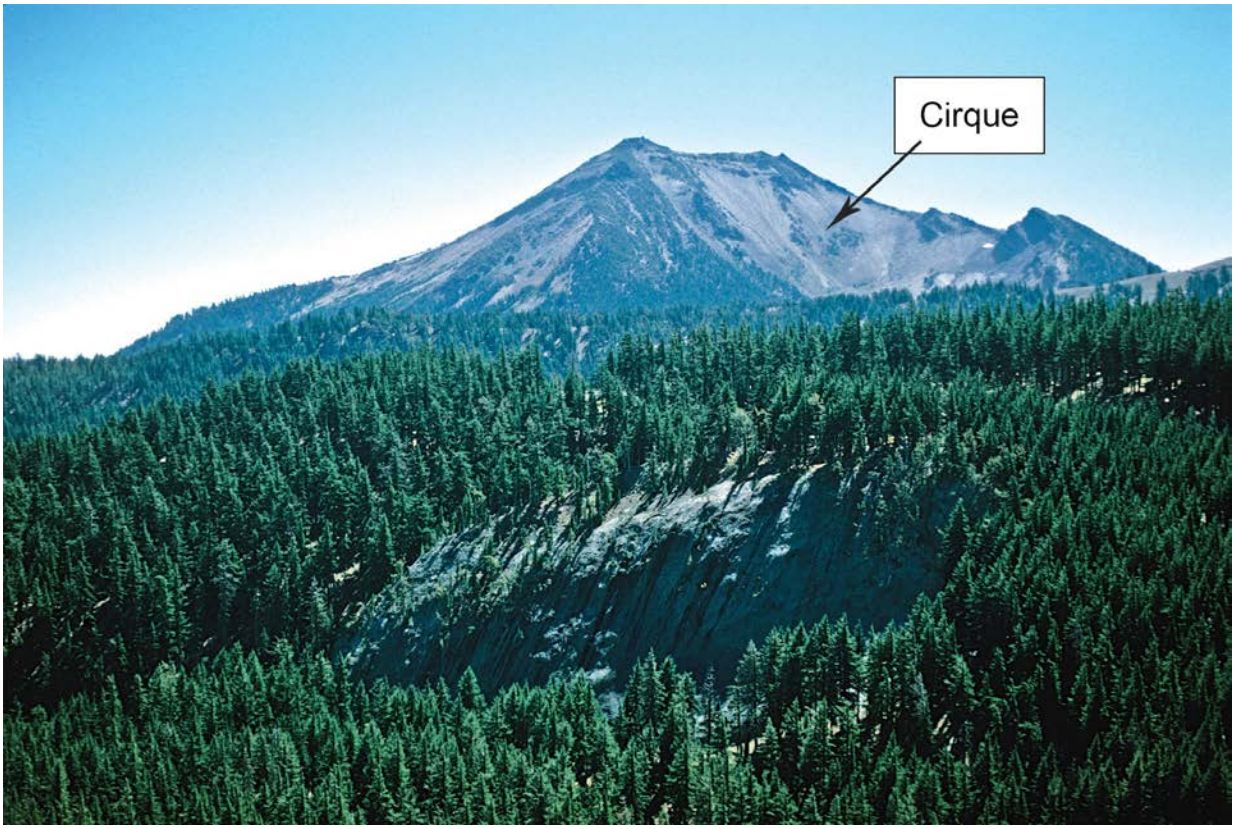


Figure 8. Mount Scott. The highest peak in Crater Lake National Park, Mount Scott, consists entirely of Dacite that erupted from low lava fountains about 420,000 years ago. The peak's hydrothermally altered interior is exposed in the cirque on the right. US Geological Survey photograph by Charles R. Bacon (Bacon 2008). Available from the United States Geologic Survey (accessed October 10, 2017), annotation by Jason Kenworthy (NPS Geologic Resources Division).

A generalized map of the surface geology of Crater Lake National Park is shown in Figure 9. How surface geology and glaciation are related to vegetation patterns is a question that can be addressed with the vegetation database produced herein, and the detailed geologic mapping by renowned volcanologist Charles R. Bacon that may be found at: https://pubs.usgs.gov/sim/2832/.

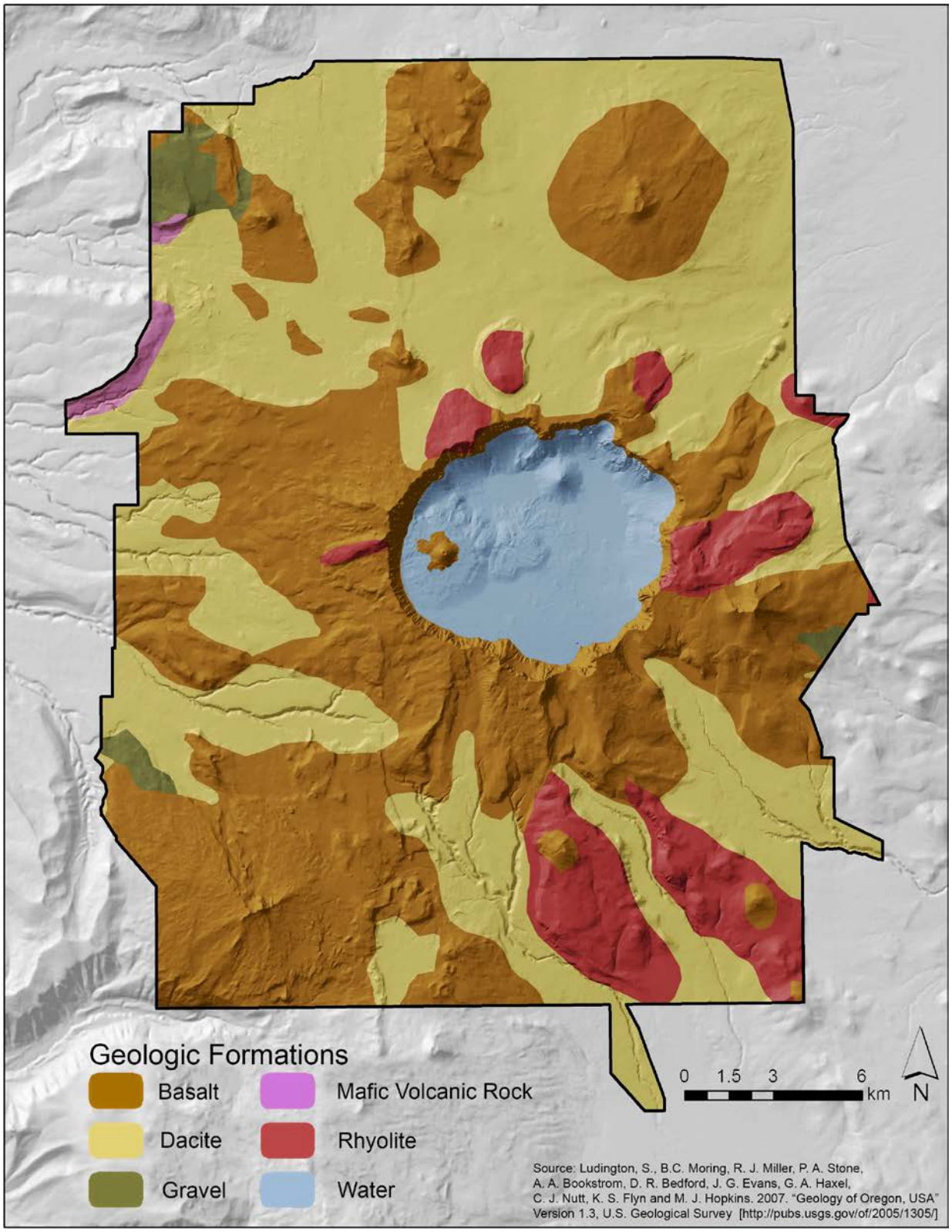


Figure 9. Geologic map of Crater Lake National Park.

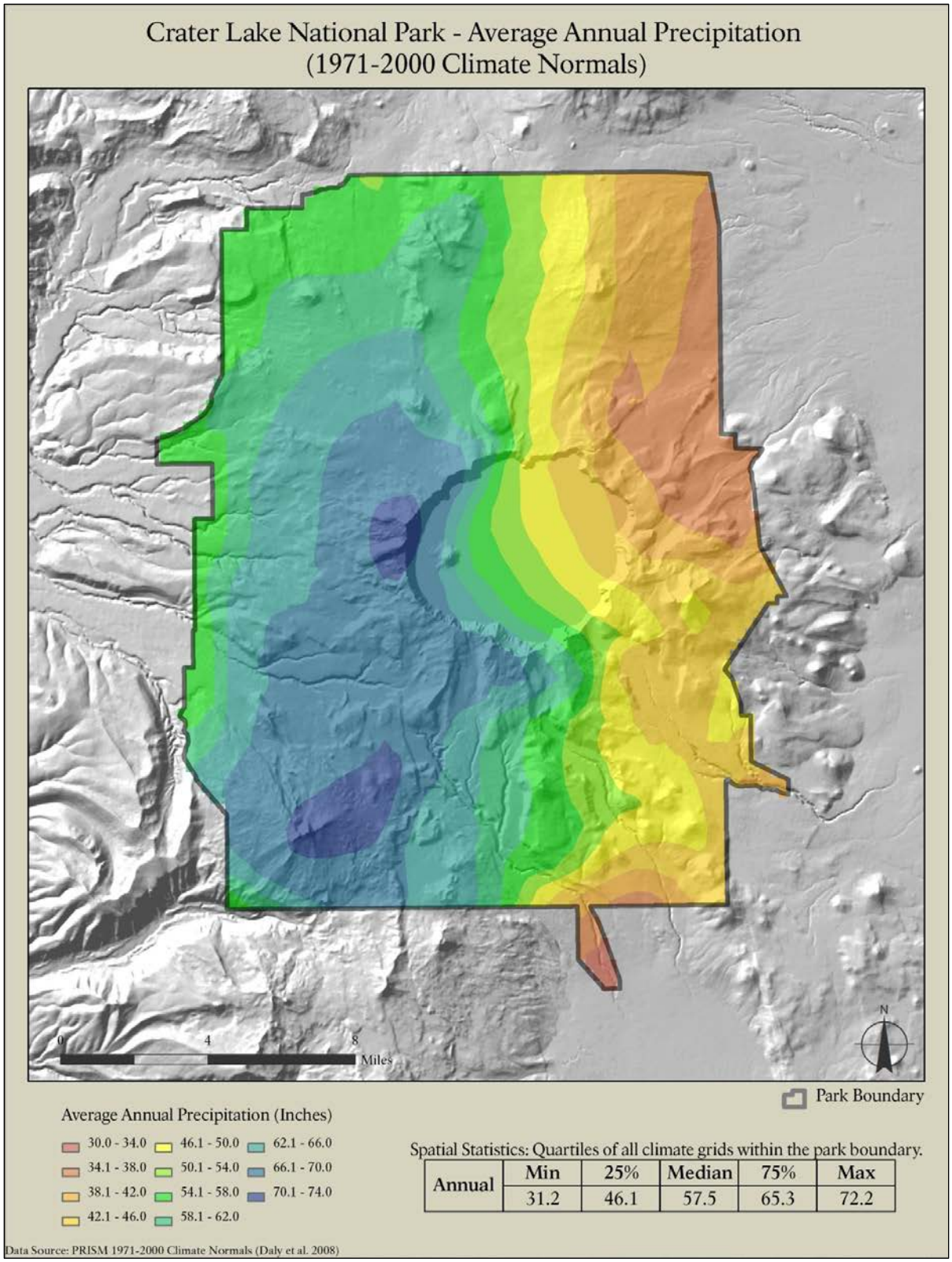
1.4.3 Climate

Precipitation: About 70 percent of the annual precipitation in the park falls from November through March. Precipitation and temperatures within the park vary greatly depending on elevation and the rain shadow configuration of the Cascade crest. Annual precipitation amounts interpolated across the park are shown in Figure 10. There is a gradient of increased precipitation with elevation in the western half of the park, and a gradient of decreased precipitation with elevation in the east half of the park. The highest annual precipitation (70-74 in.; 178-188 cm) occurs on the west side of the Crater Lake caldera rim. The lowest precipitation amounts (30-34 in.; 762-864 cm) occur in the Panhandle area, due in part to low elevations (1,240 m; 4068 ft.), and along the park's northeast boundary where the rain shadow effects of the caldera are most pronounced. Comparable elevations to the Panhandle occur in Red Blanket Creek canyon in the southwest corner of the park which receives almost double the precipitation as the Panhandle even though only ~15 km separate the two areas.

The effective precipitation in the park is influenced by the park's geology and hydrology. The coarse pumice soils with very low water holding capacity in the east part of the park enhance the effects of lower precipitation there resulting in lower biomass forests. In contrast, on the western side of the park there are copious springs and many areas with saturated soils. This likely enhances the effect of the already high precipitation in this area, promoting dense, statuesque forests. The net effect is to sharpen gradients in vegetation structure.

Temperature. Figure 11 shows the temperature variability in the park. Average annual temperatures in the park range from 32.0 ^{o}F (0 ^{o}C) to 43.9 ^{o}F (6.6 ^{o}C). The low overall annual temperatures reflect the short summers in the park. The coldest average annual temperatures (32 ^{o}F; 0 ^{o}C) are on the west rim of the caldera, as well as Mount Scott, where the highest elevations occur. A convergence of low temperatures and high precipitation levels around the rim and along the upper flanks of the caldera results in very deep snowpacks that often persist until early July. The average minimum temperatures on the western boundary of the park are 30 – 33 ^{o}F (-1 – 1.1 ^{o}C). This is the warmest part of the park, and the wettest, so it is the most favorable to plant growth. Air masses in this area are more influenced by moist air masses from the Pacific Ocean, whereas the eastern part of the park is subjected to more variable temperatures and lower humidities associated with continental air masses.

A breakdown of precipitation and temperature patterns by season is provided by Adamus et al. (2013).



Spatial Statistics: Quartiles of all climate grids within the park boundary.

	Min	25%	Median	75%	Max
Annual	31.2	46.1	57.5	65.3	72.2

Figure 10. Average annual precipitation in inches interpolated across Crater Lake National Park. From Adamus et al. (2013).

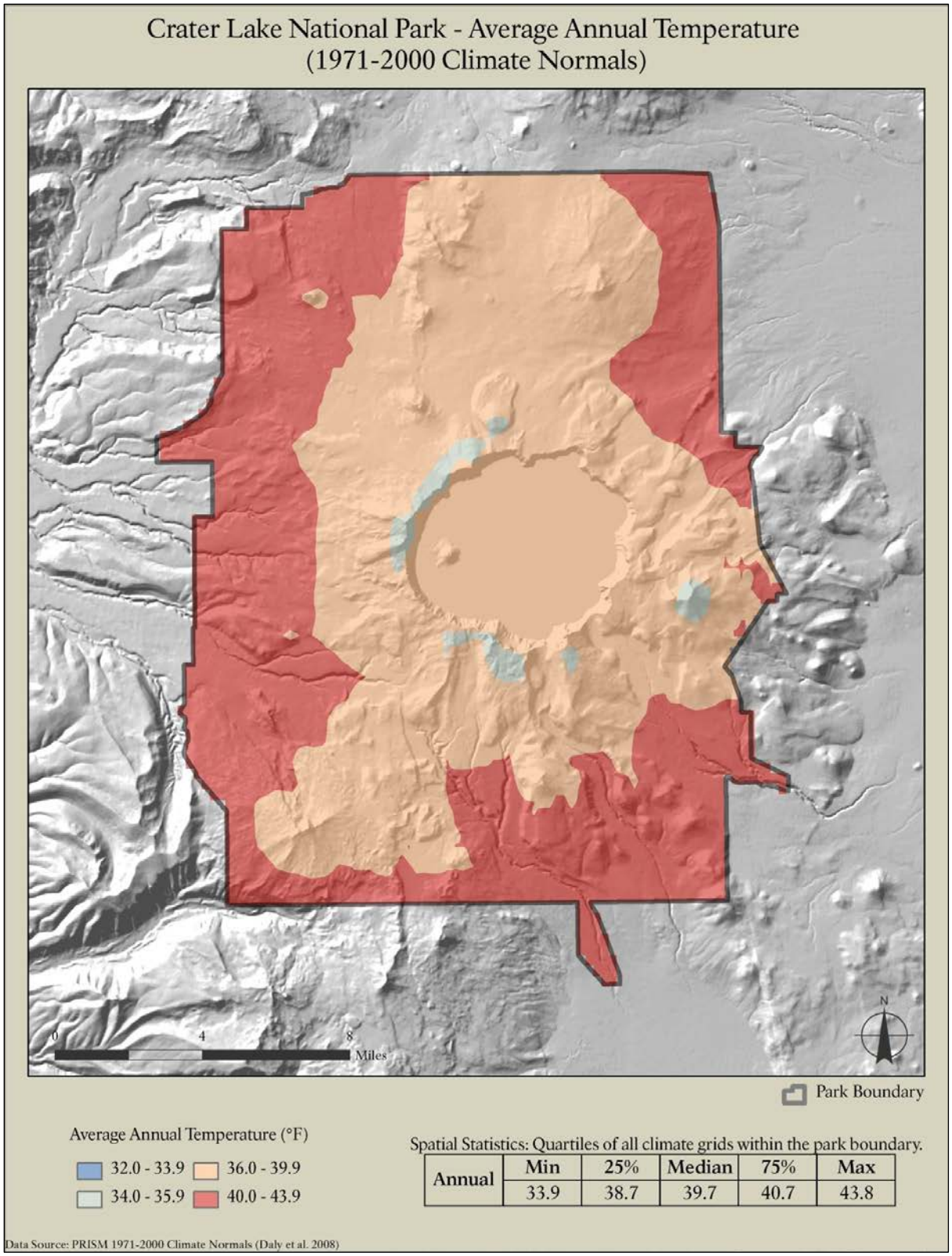


Figure 11. Average annual temperatures in inches interpolated across Crater Lake National Park. From Adamus et al. (2013).

1.4.4 Vegetation

1.4.4.1 Regional Context

The park's terrestrial vegetation is mostly a relatively pristine example of the regional vegetation on young pumice and other volcanic substrata in the central Cascades. Importantly, the park straddles the Cascade crest, encompassing much of the range of variation in vegetation over the west (moister) to east (colder and drier) gradient. Forests range from mixed conifer, dominated by Sierra white fir, Douglas-fir and ponderosa pine at the lowest elevations; to montane and subalpine forests of Shasta red fir, Sierra lodgepole pine and mountain hemlock at moderate to high elevations; to whitebark pine woodland at highest elevations around the Crater Lake caldera rim.

The park also lies in a latitudinal transition zone. To the north in the Cascades, particularly the west side, lush, low to mid-montane forests become co-dominated by western hemlock (*Tsuga heterophylla*), which grows at its southern extent in the Cascades in the Crater Lake region (it occurs farther south along the coast). A similar pattern occurs with silver fir (*Abies amabilis*) and subalpine fir (*Abies lasiocarpa*) in upper montane zones. Occurring slightly to the north and not within the park are western redcedar (*Thuja plicata*) and western larch (*Larix occidentalis*) (Franklin and Dyrness 1988). Conversely, the park lacks a dominant forest tree from the southern Cascades in northern California (e.g., Lassen National Park), Jeffrey pine (*Pinus jeffreyi*).

A number of other upper montane and subalpine areas of the central and southern Cascades have vegetation on relatively young volcanic substrata (e.g., Mt. Lassen, Mt. Shasta). The vegetation of these high elevation non-forested areas share some similarities in species composition with those at Crater Lake National Park, as well as some differences. These high elevation non-forested areas are very restricted in both their size and their location in the regional landscape. Therefore, the large areas of herb-grass vegetation on pumice at Crater Lake National Park are regionally important.

The vegetation of Crater Lake National Park has been studied since the late nineteenth century when Frederick Coville first explored the area and discovered several species of rare, endemic vascular plants. Elmer Applegate completed the park's first comprehensive botanical survey in 1939. In the 1940's, Henry Hansen completed a study of forest succession and climate, and Lyle Wynd observed the botanical features of the life zones found within the park. The Civilian Conservation Corps, undertook a thorough vegetation survey in 1936, which resulted in a detailed map and accompanying report (Anonymous 1936). Later in this report we assess, to the best extent possible, vegetation changes since 1936 that can be ascertained using the information provide in the 1936 map and report. Spatial patterns of the vegetation described herein are illustrated in our map (see Results).

1.4.4.2 Forest Vegetation

Ponderosa Pine Woodland: Ponderosa pine woodlands are relatively uncommon in the park and occur mainly below 1,800 meters (5,900 feet) elevation along the eastern boundary. There they form nearly pure stands, or are occasionally mixed with Sierra lodgepole pine. Tree cover in these forests is generally low, allowing the occurrence of light-demanding shrubs, principally greenleaf manzanita. There are also stands of ponderosa pine on the inside of the caldera at Cleetwood Cove

southward to Palisade Point. Shasta red fir and/or Sierra white fir also occur occasionally in some ponderosa pine woodlands, especially with increasing elevation.

Montane Mixed Conifer Forest: These often tall, dense forests are mostly found on the warmer, usually southfacing slopes and lowest elevations in the park, particularly in the southeast quadrant, along the western boundary, and in the northeast portion of the park on the eastern slopes of Timber Crater and around Bear Butte. Where mixed conifer forests occur on the east side of the park, Sierra white fir is codominant with ponderosa pine in forests that in certain locations also include sugar pine, Douglas-fir and occasionally incense cedar. Shasta red fir also occurs in this area, especially with increasing elevation. On the west side of the park Douglas-fir is more common and sometimes forms nearly pure stands. However it is most often codominant with Sierra white fir and occasionally incense cedar with Shasta red fir and mountain hemlock becoming common with increasing elevation and cold air drainage. Sierra white fir does form pure stands throughout these montane conifer forests and is regularly abundant, however it often occurs mixed with the other conifer species mentioned above.

Shasta Red Fir Forest: True fir (*Abies* spp.) forests comprised mostly of Shasta red fir are the most extensive vegetation type in the park. Shasta red fir forests typically occur, in mixed or pure stands, in relatively mesic areas throughout the park, except at the uppermost elevations. Mountain hemlock is frequently codominant with Shasta red fir, particularly with increasing elevation. Western white pine (*Pinus monticola*) is often present in low amounts. Small stands of subalpine fir forests occur locally. Silver fir is very rare. Sierra lodgepole pine occurs among Shasta red fir forest, forming nearly pure stands in post-fire environments and/or on droughty soils. Shasta red fir occurs inside the Crater Lake caldera on caldera walls and on Wizard Island. Shasta red fir forests are less common in the northeastern quadrant of the park where conditions are drier. There is typically a zone of gradual transition with Sierra white fir with decreasing elevation.

Subalpine Forest: Forests of mountain hemlock and/or Sierra lodgepole pine occupy the higher elevations in the park. Mountain hemlock forests encircle the Crater Lake caldera rim and extend for some distance downslope. They are also abundant along the Cascade crest to the north and south of the lake, as well as on the slopes surrounding Union Peak in the southwest of the park. While mountain hemlock often forms pure stands, it extensively intermixes with Shasta red fir in this zone. Mountain hemlock is also a major component in Sierra lodgepole forests on drier, harsher soils, and with whitebark pine forests at upper elevations.

Like mountain hemlock forests and Shasta red fir forests, Sierra lodgepole pine (*Pinus contorta* ssp. *murrayana*) forests are nearly ubiquitous in the park, including at higher elevations. The relatively flat-bottomed valleys that radiate from the rim of the Crater Lake caldera on all sides support Sierra lodgepole pine forests, not uncommonly in pure stands. They are most abundant on pumice soils having little water holding capacity, especially in the north and east portions of the park. These stands are typically composed of dense, relatively short Sierra lodgepole pine trees. Where soils are more productive, particularly on the west side of the park, Sierra lodgepole forests are taller and often contain mature Shasta red fir and mountain hemlock, as well as dense seedlings and saplings of these species (Forrestel et al. 2017).

Whitebark Pine Woodland: Woodlands of whitebark pine have a limited distribution in the park and only occur in abundance on the rim of the Crater Lake caldera and on Mount Scott. However there are small whitebark pine stands on Union Peak and some of the higher elevation cinder cone buttes in the park. Whitebark pines are also found in mixed forests with mountain hemlock and Sierra lodgepole pine near the Crater Lake caldera, particularly to the northeast of the lake where precipitation amounts are lower.

Other forest vegetation occurs in selective environments. For example, aspen and/or cottonwood (*Populus* spp.), and Engelmann spruce (*Picea engelmannii*) forests occur in some riparian areas and wetlands.

1.4.4.3 Non-Forest Vegetation

Sparse herbaceous vegetation dominates many of the slopes around the Crater Lake caldera rim and the surrounding pumice flats. This more barren "fell field" vegetation is uncommon in the local region and dominated by perennial herbs such as Davis' knotweed (*Polygonum davisiae*), Shasta knotweed (*Polygonum shastensis*), Shasta buckwheat (*Eriogonum pyrolifolium* var. *coryphaeum*), marumleaf buckwheat (*Eriogonum marifolium*), spreading phlox (*Phlox diffusa*), and Crater Lake sandwort (*Arenaria pumicola*). Graminoids such as squirreltail (*Elymus elymoides*) and Brewer's sedge (*Carex breweri*) are also present. At lower elevations surrounding the caldera rim this herbaceous vegetation may consist of montane grassland, which is dominated by western needlegrass (*Achnatherum occidentalis*) and long-stolon sedge (*Carex inops* spp. *inops*) often with Anderson's lupine (*Lupinus andersonii*). These montane grasslands are also common on the slopes surrounding Union Peak and Crater Peak.

Evergreen, leathery leaved (sclerophyll) shrub vegetation is relatively rare in the park, however, sizable patches of this montane chaparral do occur at a few locations. It established mainly following stand-replacing fire in montane conifer and Shasta red fir forests. Dormant seed of the principal species, greenleaf manzanita and snowbrush ceanothus may be present in portions of these forests, where they await fire to germinate and grow when the forest canopy has burned. In the far southwestern corner of the park, there is a small area of unusual chaparral dominated by bearbrush (*Garrya fremontii*) and bush chinquapin (*Chrysolepis sempervirens*) along with greenleaf manzanita.

1.4.4.4 Wetlands

The walls of the Crater Lake caldera plunge directly into the lake at a steep angle. Thus, Crater Lake lacks shoreline wetlands. However, wetland vegetation commonly occurs in permanently saturated environments in the western and southern portions of the park. Wetlands are mainly wet meadows and marshes, and include large fens such as the distinctive Sphagnum Bog. These wetland environments are particularly common in the west of the park and are often associated with springs. Wetland vegetation is also commonly found along all major stream corridors in the park in floodplains, seeps on adjacent slopes, and other areas where ground water intersects the soil surface.

There are also several shallow perennial ponds in Crater Lake National Park. Most of these have an abundance of Rocky Mountain pond-lily (*Nuphar lutea* ssp. *polysepala*), with its floating leaves covering a good portion of the water's surface. Sedges (*Carex* ssp.) are dominant along the shoreline.

1.4.4.5 Submerged Aquatic Vegetation

Large colonies of submerged aquatic moss, *Drepanocladus aduncus* grow between a depth of 26 m and 153 m (85'- 450', McIntire et al. (1994)) in Crater Lake. It is an unusual phenomenon that is actively studied. The moss grows slowly. It has laid down an underwater mat of peat as thick as 9 m and is as old as 4000 years in some areas of the lake. The presence of the peat in shallow areas not currently occupied by living moss suggests that the moss' extent has shrunken. Core samples indicate the moss started growing about 4500 years before present but for unknown reasons stopped growing in some shallow areas about 2000 years ago (Dartnell 2008).

1.4.5 Fauna

This section is taken largely from the Crater Lake National Park Natural Resource Condition Assessment faunal section authored by Paul Adamus (Adamus et al. 2013).

1.4.5.1 Rare and Threatened Species

Crater Lake National Park is home to several threatened, endangered, sensitive, and rare wildlife species. The northern spotted owl (*Strix occidentalis caurina*), listed by the U.S. Fish and Wildlife Service (USFWS) as a threatened species, nests in older stands of conifers in 11-15 locations within the park (as of 2017). The park represents the uppermost elevation limits and eastern edge of the owl's range in Oregon. Overall, both fecundity and annual survival of spotted owls appears to be declining in the southern Oregon Cascades; this decline accelerated between 2003 and 2008 (Dugger 2012). The owl's regional decline is due to habitat loss and fragmentation from timber harvests over the last half of the twentieth century, and, more recently, the invasion of the barred owl (*Strix varia*) from the eastern U.S.A. (Dugger et al. 2011). Bull trout (*Salvelinus confluentus*) were first listed as Threatened under the Endangered Species Act by the USFWS in June 1998 and are currently the subject of rehabilitation efforts in Sun Creek both within and outside of the park.

Gray wolves (*Canis lupus*), currently listed as endangered in the western portion of Oregon, have slowly been making a comeback to the Crater Lake National Park area. Two wolves, designated as OR-7 and OR-25, have been documented on multiple occasions in the Park and several additional observations of wolves by park staff and the public have been noted in recent years. The wildlife team at Crater Lake National Park has documented several rare species such as the Sierra Nevada red fox (*Vulpes vulpes necator*), fisher (*Pekania pennanti*), and black-backed woodpeckers (*Picoides arcticus*) in recent years. These species have been petitioned for listing as Threatened or Endangered but further review by the USFWS has determined listing not to be warranted. American pika (*Ochotona princeps*) is found in about 30 locations within the park's subalpine areas. This small mammal is believed to be disappearing in many areas of the western U.S.A. (Beever et al. 2003), being particularly vulnerable to climate change. American marten (*Martes americana*) is relatively common in the park, though considered "Vulnerable" statewide by the Oregon Department of Fish and Wildlife (ODFW).

Several species of birds that nest (or that may have nested historically) in the park are considered "Vulnerable" by the Oregon Natural Heritage Program (now Oregon Biodiversity Information Center) due to declines in their statewide population or range extent. These are northern goshawk (*Accipiter gentilis*), black-backed woodpecker, white-headed woodpecker (*Leuconotopicus*

albolarvatus), and olive-sided flycatcher (*Contopus cooperi*). Additional bird species that nest in the park and are designated as "Vulnerable" by the ODFW are common nighthawk (*Chordeiles minor*), pileated woodpecker (*Dryocopus pileatus*), and American three-toed woodpecker (*Picoides dorsalis*). Finally, gray-crowned rosy finch (*Leucosticte tephrocotis*), a subalpine-nesting species that nests regularly in small numbers within the park, would be expected to be highly sensitive to regional climate warming. Surveys targeting these species have not been conducted. The park is home to many other ODFW sensitive and strategy species such as Cascade frogs (*Rana cascadae*), flammulated owls (*Psiloscops flammeolus*), pallid bat (*Antrozous pallidus*), Lewis's woodpecker (*Melanerpes lewis*), and American pika. Four of the bat species found in the park—long-legged myotis (*Myotis volans*), California myotis (*Myotis californicus*), silver-haired bat (*Lasionycteris noctivagans*), and hoary bat (*Lasiurus cinereus*)—are listed as "vulnerable" statewide by the ODFW. Bighorn sheep (*Ovis canadensis*), wolverine (*Gulo gulo*), grizzly bear (*Ursus arctos horribilis*), and Canada lynx (*Lynx canadensis*) are suspected to have occurred in the park historically and the park does contain habitat that would likely support these species. However, there are no well-documented records presently, and in some cases, there are also no historical records. The Mazama newt (*Taricha granulosa mazamae*) is found only in Crater Lake. It is a sub-species of rough-skinned newt. The Mazama newt population in Crater Lake is under threat due to predation from crayfish and rainbow trout that have been introduced into the lake.

Another sensitive species that has nested for many years in the park, peregrine falcon (*Falco peregrinus*), was listed for many years by the USFWS as threatened, but has since been delisted due to nationwide population recovery.

1.4.5.2 Mammals

The most frequently seen large mammals in the park are black bear (*Ursus americanus*) and mule deer (*Odocoileus hemionus hemionus*). Other frequently seen large mammal species include elk (*Cervus canadensis*) and black-tailed deer (*Odocoileus hemionus columbianus*). Seventy nine other mammals occur within the park though no population or trend estimates are available. Although rangeland (non-forest) habitat is not extensive in the park, it provides high-quality habitat for grazing ungulates, especially where close to wetlands (wet meadows and fens). American pika is found in about 30 locations within the park's subalpine areas. American marten is relatively common in the park, though considered "vulnerable" statewide by the ODFW. As stated earlier, gray wolves, currently listed as endangered in the western portion of Oregon, have slowly been making a comeback to the Crater Lake National Park area.

Nine species of bats were documented in the park in a 2004-2005 survey that used multiple detection methods (Duff 2005). Duff considered the bat fauna to be "relatively species poor," probably due to the park's relatively cold and wet climate. Bats are a conservation concern. They are being devastated in much of the eastern U.S.A. by the emerging disease, white nose syndrome. It has recently moved into the western U.S.A. Fire creates roosting habitat in dead trees for bats (Buchalski et al. 2013), therefore fires in recent years have likely created new habitat.

1.4.5.3 Birds

Common bird species in the park include the Clark's nutcracker (*Nucifraga columbiana*), mountain chickadee (*Poecile gambeli*), and the dark-eyed junco (*Junco hyemalis*). There are numerous sensitive bird species as discussed above. For a complete list of birds found in the park visit the Crater Lake Institute website.

It appears that at least two species once reported to be fairly common breeders in the park, ruby-crowned kinglet (*Regulus calendula*) and Swainson's thrush (*Catharus ustulatus*), have disappeared as breeders (Adamus et al. (2013). Additional species reported to be fairly common breeders in the park by Farner (1952) but not detected by the Breeding Bird Atlas are MacGillivray's warbler (*Geothlypis tolmiei*), fox sparrow (*Passerella iliaca*), green-tailed towhee (*Pipilo chlorurus*), and lazuli bunting (*Passerina amoena*). All are associated with shrubby forest openings and/or shrublands, so their decline or possible disappearance might be due to succession of shrubland to forest in the absence of wildfire.

1.4.5.4 Reptiles and Amphibians

The Mazama newt, a sub-species of rough-skinned newt, is found only in Crater Lake. Only three lizard species and one snake species have been confirmed to be present in the park. Survey efforts have been limited, so the reptile species total is likely greater. One of those lizard species, the northern sagebrush lizard (*Sceloporus graciosus*), has been designated as "Vulnerable" statewide by the ODFW. Farner and Kezer (1953) found eight amphibian and the four reptile species during their 10 year inventory. Bury and Wegner's 2005 survey of perennial streams relocated nine of these species (Bury and Wegner 2005), including bullfrogs (*Rana catesbeiana*), which are introduced from the eastern USA, and the Cascades frog (*Rana cascadae*), a federally listed Species of Concern also identified as a Strategy Species by the ODFW (Oregon Conservation Strategy 2016).

1.4.5.5 Fish

Crater Lake was originally devoid of fish, but between 1888 and 1947 was stocked with approximately 1.8 million rainbow trout (*Oncorhynchus mykiss*) and kokanee salmon (*Oncorhynchus nerka*). Kokanee are cyclic in abundance, live both near the shore and in open deep water, and feed on zooplankton and small bottom-dwelling insects. Rainbow trout live along the edges of the lake and feed on terrestrial insects, large-bodied bottom fauna, and kokanee. These fish species potentially alter the food webs within open-water and near-shore habitats and thus could affect nutrient cycling within the lake.

Bull trout (*Salvelinus confluentus*) are the only native fish known to inhabit the park currently. Regionally, they represent a remnant population. They once were present throughout Sun Creek starting below Sun Falls, a natural waterfall 3 km below the headwaters, with their distribution continuing downstream across the park boundary (Wallis 1948). But by 1989, hybridization and competition with non-native brook trout threatened the park's bull trout population. Abundance declined to about 100-300 adult fish, and their distribution became limited to a 1.9 km stream reach in Sun Creek. Brook trout inhabited the entire creek, and hybrids with bull trout were also found. Estimated bull trout populations have increased from approximately 200 in 1992 to nearly 2000 in 2005 within the park due to an intensive management effort to exclude brook trout. These efforts are

ongoing along with a project to restore the original Sun Creek channel to the south of the park. Some of the bull trout were transplanted to Lost Creek in 1996, increasing their distribution in the park. Bull trout are protected from public fishing in Sun Creek and Lost Creek.

1.4.5.6 Terrestrial Invertebrates

No systematic, park-wide inventories of terrestrial invertebrates have been conducted. Part of the park's butterfly fauna was described by Tilden and Huntzinger (1977), and additional records might be found in Hinchcliff (1994).

1.4.5.7 Aquatic Invertebrates

Aquatic invertebrates have not been surveyed systematically in the park's streams, ponds, wetlands, or springs. From what little data exist, the invertebrate communities of some of the streams appear to be in good condition, but trends are indeterminate (Adamus et al. 2013).

Data from limited surveys of "fish food organisms" in the park's streams were reported by Wallis (1948). A more taxonomically precise survey was done in 1985-1986 by Gregory et al. (1987) but covered parts of just four streams (Munson, Sun, Dutton, and Goodbye Creeks). Although that study found differences in the primary productivity and invertebrate richness, abundance, and composition of those streams, the authors found no evidence the differences were due to recent or ongoing human activities, and noted that conditions were "not abnormal for high elevation streams in the Cascade Mountains."

Crayfish (*Pacifastacus leniusculus*) were introduced into Crater Lake in 1914. They are a threat to the endemic Mazama newt.

1.4.6 Natural Resource Concerns

The vegetation inventory and map described herein will help address natural resource management concerns. Recent changes in vegetation in relation to climate, fire suppression, natural and human caused disturbance, etc. can be assessed, to the degree possible, by comparing the vegetation mapped in 1936 (Anonymous 1936) with contemporary vegetation. Similarly, future changes in vegetation can be gauged by using this report and map product as a baseline against which to compare to new data.

1.4.6.1 Climate Change

The effects of climate change on vegetation ecology have been evident for well over a decade. As with ecosystems throughout the earth, the vegetation changes and ecosystem trajectories in relation to warming climate at Crater Lake National Park cannot be predicted with a high degree of confidence.

For the western U.S., simulations of future climate indicate that average temperatures will likely increase in both winter and summer (Giorgi et al. 2001). The average warming rate in the Pacific Northwest during the next ~50 years is expected to be in the range of 0.1-0.6°C per decade, with a best estimate of 0.3°C per decade. For comparison, observed warming in the second half of the 20th century was approximately 0.2°C per decade (Mote et al. 2008). Less certainty is associated with projected changes in regional precipitation than those for temperature. For the Klamath Network

region specifically, simulations suggest there may be future decreases in snow (e.g., Leung et al. 2004) and changes in the timing of snowmelt runoff (Stewart et al. 2004, 2005). Fire is likely to increase from current levels due to warming climate. But, there is also conflicting information regarding the effects of climate change on fire. Research has found that fire extent and severity have increased from historic levels in the western U.S.A., except the northern Rockies (Littell et al. 2010, Westerling et al. 2016). Others have found that it has not changed significantly from historic levels (Baker 2015, Doerr and Santin 2016), except in the Southwest U.S.A. (Dillon et al. 2011). Therefore future trajectories are difficult to predict from incipient trends. A further complication is that any ongoing trends that may be due to climate change are confounded by the effects of fire suppression and other management. Regardless, there is widespread concern that fires and fire severity will increase, and significant portions of the park have experienced fire of varying intensity in recent years.

All of these changes will alter vegetation, increasing the utility of a vegetation map that documents the current extent of different vegetation types.

1.4.6.2 Fire Management

Within Crater Lake National Park, evaluating the effects of fire management on vegetation is challenging because, as with climate change, the effects may differ at lower elevations vs. higher elevations. Also, there has been much area burned on the west side of the park in the last decade, and fire may be increasing in other parts of the park, abating the effects of fire suppression. Furthermore, the removal of large pines in mixed conifer stands occurred historically in the Panhandle area and in the lower Sun Creek valley east of Annie Creek ” (Wickman 1990) (Figure 12), complicating the visible effects of fire suppression there. Shasta red fir and white fir, as well as Douglas-fir, are shade-tolerant and recruit in the absence of fire, and these species are abundant in the moister areas of the park. Conversely pines recruit in response to fire, especially Sierra lodgepole pine, and tend to occur in the drier parts of the park. Plot data indicate that recruitment of Shasta red fir is occurring in Sierra lodgepole pine forests on the central west side of the park (Forrestel et al. 2017). In terms of trees that were not recent recruits, Forrestel et al. (2017) found that extant Shasta red fir, white fir, Douglas-fir, and mountain hemlock on the central west side of the park below 1800 m established mainly between 1880 and 1920 and that this area experienced a mixed severity fire regime, through relatively few fires have occurred here since 1920 until very recently. The extent to which fire-related dynamics of firs (*Abies* spp. and *Pseudotsuga menziesii*) and pines have influenced the abundance of different vegetation types in the park is a question that we evaluate later using our vegetation map in concert with the 1936 map.



Figure 12. Photo showing pine removal near the south entrance to the park in 1929. From Wickman (1990).

1.4.6.3 Wildlife

Changes in vegetation due to natural disturbance, succession, and wildland fire suppression also affect the types of habitat available to wildlife, to varying degrees depending on vegetation, wildlife species and location in the park. As mentioned above, vegetation change has occurred and continues to occur in ways that are often unpredictable. Clearly, the first step to understanding how vegetation dynamics have affected wildlife in the park is to understand those dynamics and their underlying causes. Our vegetation map described herein provides a necessary data source for evaluating vegetation dynamics over broad areas.

1.4.6.4 Invasive Species

Non-native, invasive species are a significant threat to native plant communities in virtually all natural areas. Not surprisingly, invasive plants ranked as the top vital sign for monitoring within the Klamath Network Inventory and Monitoring Program of the NPS, a key indication of how critical an issue invasive species have become. In many regions, invasive species are second only to habitat loss

as a threat to native biodiversity (Wilcove et al. 1998). While many invasive species are relatively benign, impacts from select invasive species may include the complete replacement of native vegetation (Tilman 1999), the loss of rare species (King 1985), changes in ecosystem structure (Mack and D'Antonio 1998), alteration of nutrient cycles and soil chemistry (Ehrenfeld 2003), shifts in community productivity (Vitousek 1990), changes in water availability (D'Antonio and Mahall 1991), invasion and permanent establishment of the particularly detrimental cheatgrass (Kerns et al. 2006) and alteration of disturbance regimes (Mack and D'Antonio 1998, Kerns et al. 2006).

Odion et al. (2010) reviewed the physiological tolerances of invasive plants that are present or expected in all Klamath Network parks. They found that Crater Lake National Park may be more vulnerable to ecosystem transforming invasive plants than the current low levels of invasion may suggest. Our relevé sampling documents the occurrence of all vascular plant species present, including invasive plant species, in 600 relevé plots throughout the park, providing a quantitative assessment of the degree to which invasive plants have moved into the parts of the park away from roads and trails, where they are currently being monitored.

1.4.6.5 White Pine Blister Rust

Notwithstanding the serious and legitimate concerns about invasive plants, the invasive species of greatest concern at Crater Lake National Park is a fungus, blister rust (*Cronartium ribicola*). Blister rust is the main factor impacting the condition of the park's subalpine vegetation because of its effects on whitebark pine. This was a top management concern raised by park staff during the resource condition assessment (Adamus et al. 2013). Previously, the Klamath Network had identified whitebark pine as a vital sign of ecosystem health to monitor and subsequently began monitoring populations of this tree.

The rust has been in the park for many decades, but has become a greater concern in recent years as the large, picturesque whitebark pines on the Crater Lake caldera rim have begun to die in seemingly greater numbers. Park staff began formal monitoring of the blister rust in 1999 (Murray 2010, Murray and Rasmussen 2003, McKinney et al. 2012). At monitoring plots, Murray (2010) estimated that pines were dying at a rate of 1% per year, and Smith et al. (2011) reported that about 25% of trees in 20 monitoring plots had blister rust cankers. Blister rust on whitebark pine has been found to be more common in the western portions of the park, and where tree overall density is higher (Smith et al. 2011). On the east side of the park, blister rust is positively associated with the alternate host shrubs *Ribes* spp.

Preliminary assessments of 2012 monitoring data suggest that blister rust infections may be more common than previously believed, both at Crater Lake and at Lassen Volcanic National Parks. Jackson et al. (2015) found that white pine blister rust infected 69% of whitebark pine in ten plots at Crater Lake. Given the concern about whitebark pine, we did additional ground sampling to better map this species' occurrence, and we specifically mapped areas where the tree was scattered at low levels of abundance.

1.5. Crater Lake National Park Vegetation Inventory Project

The Klamath Network initiated a vegetation mapping plan for Crater Lake National Park as part of a larger effort to complete vegetation inventory projects for each of the five parks in the Network that were previously unmapped. An initial multi-year work plan was developed for the Klamath Network by Southern Oregon University (SOU) for three of the park units in the Network, including Crater Lake National Park. Planning between the Klamath Network, the Washington Area Service Office, and SOU project staff was done to complete the plant community classification, digital database, and map products for a component of the Lassen Volcanic National Park Vegetation Inventory Project, as well as the inventory projects at Oregon Caves National Monument and Preserve, Lava Beds National Monument, and Crater Lake National Park. The work plan received approval in 2007 and the Klamath Network contracted with SOU to complete all project components listed below:

- Aerial and orthophotography
- Classification of Crater Lake National Park vegetation into associations
- Dichotomous field key of vegetation associations
- Formal description for each vegetation association
- Ground photographs of each vegetation association and relevé
- Field data in database format
- Map and spatial database of Crater Lake National Park
- Formal description of vegetation map units in relation to associations
- Digital and hardcopy maps of the vegetation of Crater Lake National Park
- Metadata for spatial databases
- Complete accuracy assessment of spatial data

The SOU research team organized the data collection and image acquisition for the Crater Lake National Park vegetation inventory (classification and mapping) project beginning in 2012.

1.6 Scope of Work

Vegetation inventory for the project occurred across the whole park area, excluding inside the Crater Lake caldera due to its steep, dangerous scree slopes (but including Wizard Island, which is within the caldera). Vegetation classes on the caldera walls were assumed during imagery interpretation based on similar imagery signatures of vegetation nearby, though no ground surveys were conducted there.

2. Methods

Protocols for this project as outlined in the following sections can be found in documents at the Vegetation Mapping Inventory Program website (viewed November 21, 2017). In particular the following documents provided valuable guidance: TNC/ESRI (1994), Lea (2011), and Lea and Curtis (2010).

2.1 Planning, Data Gathering and Coordination

We began planning for this project during a scoping meeting held on June 12th and 13th 2006 in Redding, CA with the following participants (Table 1):

Table 1. Participants and their affiliations at the scoping meeting.

Participants	Affiliation	Phone
Leonel Arguello	NPS: Redwood National and State Parks	(707) 464-6101 x5280
Karl Brown	NPS: Vegetation Mapping Inventory Program	(970) 225-3591
Andrew Duff	Southern Oregon University	(541) 552-6253
Julie Evens	California Native Plant Society	(916) 327-0714
Todd Keeler-Wolf	CA Dept of Fish and Game	(916) 324-6857
David Larson	NPS: Lava Beds National Monument (former)	(530) 667-8106
Michael Murray	NPS: Crater Lake National Park (former)	N/A
Dennis Odion	Southern Oregon University	(541) 552-9624
Susan O'Neil	NPS: Klamath Network (former)	(206) 220-4265
John Roth	NPS: Oregon Caves National Monument	(541) 592-2100 x230
Daniel Sarr	NPS: Klamath Network (former)	(541) 552-8575
Ken Stumpf	Geographic Resource Solutions	(707) 822-8005
Chris Wayne	NPS: Crater Lake National Park	(541) 594-3076
Russ Weatherbee	NPS: Whiskeytown National Recreation Area	(530) 242-3442
Robin Wills	NPS: Regional Fire Program	(530) 898-9826

The goals of the scoping meeting were to: (1) provide an overview of the Vegetation Mapping Inventory Program; (2) learn about the Whiskeytown National Recreation Area experience with their recently completed vegetation map; (3) discuss availability of existing data; (4) develop a plan, schedule, and list of cooperators to map the remaining park units in the Klamath Network; and (5) discuss procedural issues and data.

Participants decided at this meeting that the Southern Oregon University research team would classify and map the vegetation within Oregon Caves National Monument and Preserve, Lava Beds National Monument, and Crater Lake National Park. The Klamath Network developed a detailed proposal with input from park staff and Dr. Karl Brown (Vegetation Mapping Inventory Program Manager). The final proposal was presented to the Vegetation Mapping Inventory Program in early January, 2007. The proposal identified the need for relevé sampling of vegetation types and

development of a vegetation classification per the requirements of the Vegetation Mapping Inventory Program. The project was approved by the Vegetation Mapping Inventory Program and the SOU research team entered into a task agreement with the Pacific Northwest Cooperative Ecosystems Studies Unit of the NPS with SOU as the cooperator.

The SOU Crater Lake National Park vegetation mapping inventory team consisted of Dominic DiPaolo as the project lead and Dennis Odion as an assistant. There were numerous field assistants over the course of 5 summers of field work. One of these assistants, E. Seth Keena-Levin independently mapped, via GPS, whitebark pine, a special interest species at the park. Dominic DiPaolo performed most of the GIS work with assistance from Loren Groshong and Jace Ives, and the GIS Coordinator Geographer at Crater Lake National Park, Chris Wayne. Kasey Rolih was a valuable research assistant who helped on many aspects of the project.

2.2 Field Surveys for Vegetation Inventory and Analysis

The field methods that we employed in this project followed National Vegetation Classification and U.S. Geologic Survey-NPS standards (e.g., TNC and ESRI 1994). During the summers of 2011 and 2012, we sampled relevés following the general procedure in the California Native Plant Society relevé sampling protocol (CNPS 2007), as well as the relevé methods described in the Vegetation Mapping Inventory Program 12-Step Guidance (viewed November 21, 2017). Our relevés aimed to capture the full range of vegetation in the park. The relevé sampling area included all of Crater Lake National Park except for on the caldera walls inside the Crater Lake caldera (Figure 13). Relevé plot forms and individual data/field descriptions appear in Appendix D. We recorded the data on laptop computers using a Microsoft Access relational database modified from the NPS Plots v3 database and used paper data sheets in limited circumstances.

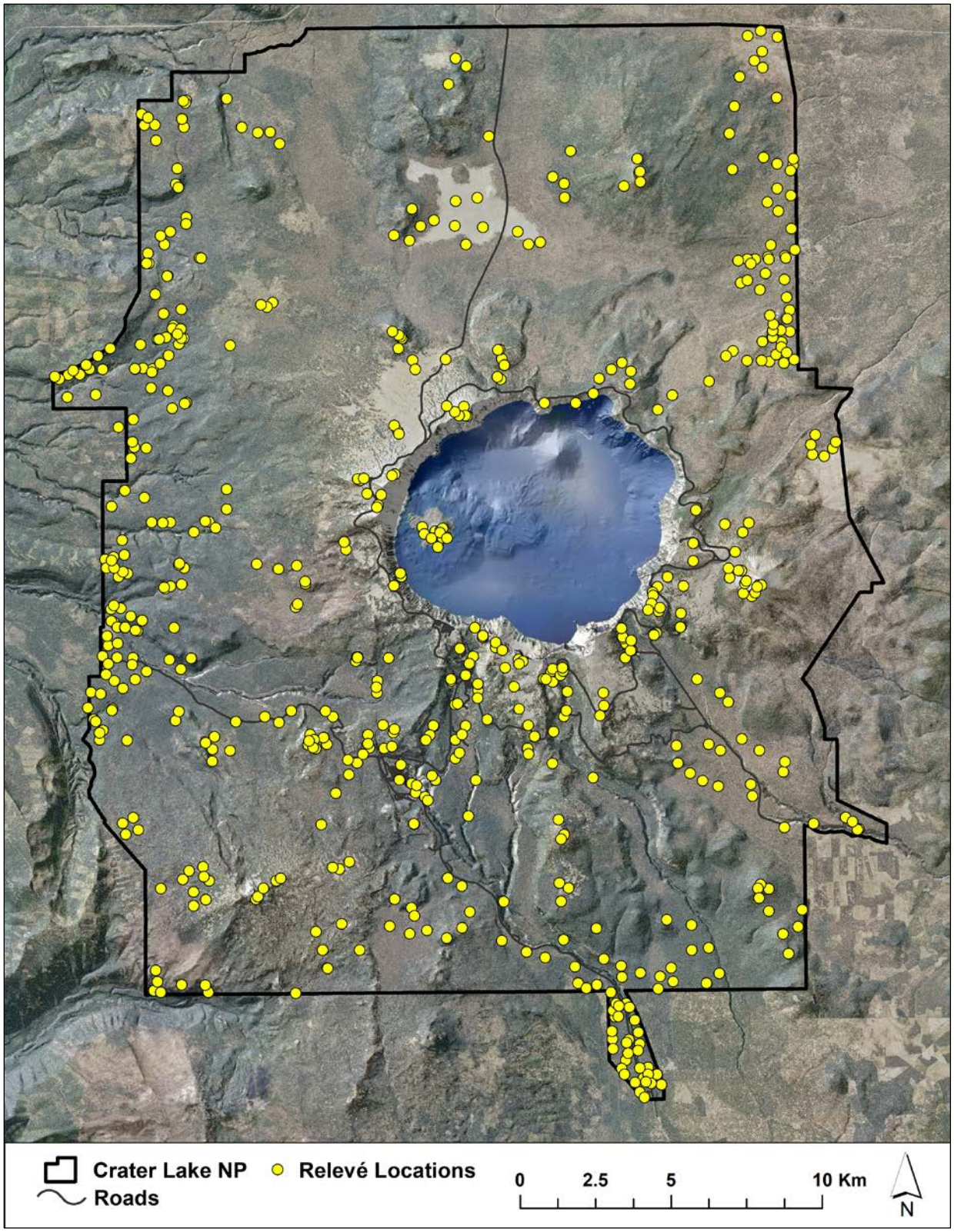


Figure 13. Vegetation classification plot (relevé) locations (n = 600).

Our field crews were led by Dominic DiPaolo and Kristi Mergenthaler. Both had knowledge of the park's flora, strong plant identification skills, and prior experience using the relevé method. Consistent with relevé methods for plot locations, field crews traveled throughout the park and sampled the range of variation in vegetation that was qualitatively observed in the field and identified with the assistance of 2010 LANDFIRE Existing Vegetation Type maps. Once a stand of vegetation was located that appeared to contain a representative plant association, we laid out a relevé macroplot to capture the stand characteristics. In this manner, transitional areas such as ecotones were avoided. We typically located plots in stands that exceeded the standard minimum mapping unit (MMU) of 0.5 ha (1.24 ac).

Some common plant associations were sampled more often and smaller patches of distinctive vegetation or communities of uncommon species were typically sampled less often. Relevé plots with a similar species composition were assigned to a preliminary plant association and we recorded the number of relevés sampled in each of these preliminary types. Our sampling goal was to collect at least 5 relevés in each preliminary association. Some rare associations only occurred in one small location, suitable for one to two relevé plots. An effort was made to achieve good spatial distribution of relevé plots across the landscape and to capture the full range of variation of each preliminary plant association.

Plot size and shape requirements were consistent with Vegetation Mapping Inventory Program guidelines (TNC and ESRI 1994): 1,000 m^2 for forests and woodlands, 400 m^2 for shrublands, and 100 m^2 for herbaceous vegetation. Plot shapes were variable to avoid ecotones. We visually estimated the absolute cover of all vascular plant species within 3 vertical tree strata, 3 vertical shrub strata, and 1 herbaceous stratum. The species representing each stratum were listed and percent canopy cover estimated using a nine-category cover class scale (< 0.1%, 0.1-1%, 1-2%, 2-5%, 5-10%, 10-25%, 25-50%, 50-75%, and > 75%).

Vascular plant species that we could not identify in the field were collected for later identification. We used the first and second editions of the Jepson Manual for California (Hickman 1993, Baldwin et al. 2012) to identify plant taxa. All plants were checked with the published flora of Crater Lake National Park (Zika 2003). The plant nomenclature conforms to the U.S. Department of Agriculture PLANTS database (http://plants.usda.gov, viewed November 21, 2017).

At the time of the completion of this project, the USNVC still recognized the scientific name for Shasta red fir as *Abies* x *shastensis* instead of the accepted name for the taxon in USDA PLANTS, *Abies magnifica* var. *shastensis*. Additionally, Sierra white fir (*Abies lowiana*), the taxon present in the southern Cascades, is still considered white fir (*Abies concolor*) in the USNVC. The USNVC will update the scientific names they use for these two taxa to conform with those in USDA PLANTS in the near future (K. A. Schulz, pers. comm. April 11, 2018). Under the recommendation of Keith Schulz and Patrick McIntyre of NatureServe, we used the accepted scientific names in USDA PLANTS for these two taxa, *Abies lowiana* and *Abies magnifica* var. *shastensis*. The scientific name for these two important tree taxa may appear differently in this report where information is reported directly as it appears in the version of the USNVC that was current at the time of completion of this report.

The following information was also recorded in each relevé:

- Elevation, slope, aspect, landform, topographic position
- Soil texture and drainage, hydrologic (flooding) regime
- Evidence of disturbance (wildlife or land use, fire, etc.)
- Percent cover of unvegetated surface within the following elements: bedrock, litter and duff, wood, bare soil, large rocks (>10 cm), pumice or small rocks (0.2-10 cm), sand (0.1-2 mm), and lichens, mosses, and fungi
- Notes about non-vascular plant species and their cover when they comprised significant cover of the ground layer
- Coordinates (latitude/longitude) from each plot center using a handheld global positioning system (Garmin GPS) and documented the error associated with the location coordinates
- Four photographs in cardinal directions from the center of each relevé plot using Canon Powershot SD 1400 IS 14 megapixel cameras

We sampled a total of 499 relevé plots that were used in the classification. We also incorporated into our dataset 101 plots from the Crater Lake National Park wetland inventory (Adamus and Bartlett 2008). They sampled 76 wetlands that had been mapped in the National Wetlands Inventory. They collected the same classification data as we did: cover of all species in three height strata in a plot. Although their plots in herbaceous vegetation were, like ours, 100 m^2, they did not use larger plot sizes when there was greater than 10% cover of trees and/or shrubs in the plot. There was no appreciable effect of this in the final classification. All plot locations are shown in Figure 13.

2.3 Vegetation Classification

We edited and corrected errors in the Plots v3 databases that we populated. Our next step was to run the vegetation data through the program TURBOVEG (Hennekens 1995) to identify any problems related to species or cover values that could affect the classification. We retained all species/strata for the classification. We used the software program Juice, version 7.0 (Tichý 2002), to perform the initial community classification with Two-Way Indicator Species Analysis (TWINSPAN) (Hill 1979, Roleček et al. 2009). The cover value (midpoint of the nine cover categories above) was used in the analysis. The TWINSPAN analysis classified our relevés into groups based on similarities in species composition. These groups were then used to develop our associations.

A goal of our classification was to identify associations that would be recognizable in the field. There was a great deal of overlap in the dominant species among a number of groups identified by TWINSPAN that had only minor differences in their small number of associated subordinate species. There were also a number of groups, particularly wetland groups, comprised of very few plots that shared dominant species but where separated by TWINSPAN due to their wide diversity of species. This required us to modify the TWINSPAN classification by manually sorting some relevés and

aggregating some groups identified by TWINSPAN. We aggregated some groups, particularly forest types, based on overstory dominance, while some groups were aggregated into broader classes based on particular combinations of species. This considerably reduced the number of groups we recognized as associations. The dichotomous key to vegetation associations (Appendix C) explains the criteria used to define associations.

The resulting associations described through the TWINSPAN classification were matched as much as possible to existing associations described in the USNVC. Associations that were not found to be equivalent to a USNVC association were described as provisional plant associations and as much as possible placed under an appropriate upper level group within USNVC hierarchy. We followed naming conventions for provisional associations using the format of Sawyer et al. (2009), as well as that of the USNVC. Provisional associations were named based on one to three of the most dominant, conspicuous, and/or distinctive species in the forest or shrub canopy layer, or the most abundant species overall in herbaceous associations. In most cases the dominant or diagnostic species of the upper stratum was listed first, followed by the secondary dominant or diagnostic species regardless of stratum. If one species was strongly dominant and diagnostic, and no other species had a strong fidelity to the association, then we named the association based on a single species, otherwise we named it based on two or, occasionally, three species. Strongly dominant and/or diagnostic species in the understory were also sometimes included following the dominant or diagnostic species of the upper stratum. We used a slash ("/") in association names to separate species that occurred in different strata. Species from the same stratum were separated using a hyphen (“-“) in the association name. We present a dichotomous field key to the plant associations in Appendix C, a classification of the associations in Appendix E, and detailed descriptions and photographs for each association in Appendix B. We tested the field key during the validation phase of the project and determined that, following slight modification, it would work effectively at identifying plant associations in the field. We used the key for the accuracy assessment sampling, as described below.

Our classification was peer reviewed by NatureServe and our park provisional associations were evaluated for inclusion in the USNVC. Provisional associations that were being considered for acceptance in the USNVC, but were still under review at the time of this project’s completion, received the Unique Identifier Code CEPP (Community Element Proposed) rather than the standard CEGL (Community Element Global) code for accepted USNVC associations. Upon acceptance into the USNVC the CEPP portion of the code will change to CEGL and the subsequent number portion of the code will remain the same. Provisional associations that were not selected by NatureServe for peer review and inclusion into the USNVC remained park provisional associations and received a park specific code using the parks identifier code CRLA (Crater Lake National Park).

2.4 Digital Imagery and Interpretation

2.4.1 Image Acquisition

The Oregon Geographic Information Council coordinated the acquisition of the project imagery for the state of Oregon in the summer of 2009 through an agreement with the United States Department of Agriculture, Farm Services Agency, and National Agriculture Imagery Program (NAIP). The

Oregon Geospatial Enterprise Office (2012) provided digital video disks of the imagery to the Southern Oregon University research team. The imagery was projected to Oregon State Plane South Federal Information Processing Standards (FIPS) 3602 North American Datum (NAD) 1983. We extracted the Crater Lake imagery from the NAIP aerial orthophotography acquired for the entire state of Oregon. The NAIP imagery was collected in 2011 with a Leica ADS40-SH51 digital camera that recorded 4-band multi-spectral (red, green, blue, and infrared wavelength) images at a spatial resolution of 1 m (3.3 feet). We did not make any additional modifications to the delivered NAIP imagery. The NAIP imagery was viewed in both true color and infrared during the mapping.

Watershed Sciences, Inc. collected Light Detection and Ranging (Lidar) data of Crater Lake National Park in 2010 for the Oregon Department of Geology and Mineral Industries (DOGAMI) which then delivered it to the park. DOGAMI data are in OGIC (HARN): Projection: Oregon Statewide Lambert Conformal Conic; horizontal and vertical datums: NAD83 (HARN)/NAVD88 (Geoid03); Units: International Feet. The Lidar survey utilized four Leica LiDAR systems and three aircraft. Bare earth and highest hit DEMs (digital elevation models) were produced at resolutions of 3 ft grids. We acquired this Lidar data from Crater Lake National Park and used both the bare earth and highest hit DEMs extensively during mapping to identify structural patterns in the vegetation and in the physical landscape.

2.4.2 Image Interpretation and Mapping

We used the USNVC upper level hierarchy of the plant associations identified in our vegetation classification to develop map units. Similar associations were grouped under their lowest common hierarchical scale in the USNVC that could also be identified in the imagery and mapped. Map units crosswalked to component plant associations at the Alliance or Group level in the USNVC and occasionally map units crosswalked directly to a corresponding association. We used the Anderson classification system (Anderson et al. 1976) for non-vegetated surfaces and the Cowardin classification system (FGDC 2013) for ponds that lacked aquatic vegetation.

Delineation of the polygons was performed primarily by Dominic DiPaolo, assisted by Dennis Odion, Jace Ives, and Seth Keena-Levin, using the most current and high-quality imagery data available in terms of spatial and spectral resolution. In addition to the NAIP and Lidar imagery described above, Google Earth and ESRI world imagery were also consulted during mapping. We utilized a minimum mapping unit (MMU) of 0.5 ha (1.24 ac) to develop polygons, but allowed for a MMU of 0.25 ha (0.62 ac) to delineate small, insular and/or otherwise unique vegetation types. The criteria for distinguishing each map unit are defined in Appendix A.

In 2014 we sampled five hundred and sixty-eight 0.5 ha plots throughout the park to use for a map accuracy assessment. These plots were randomly located among the vegetation types identified in the Landfire Existing Vegetation map (https://www.landfire.gov/NationalProductDescriptions21.php, viewed on November 1, 2013). The plots were sampled before we had completed our vegetation mapping and the plots were not randomized with respect to the map we were intending to test for accuracy (ours). Therefore, we decided (with the guidance of the NPS Vegetation Mapping Inventory program), to use the 568 plots for map validation. These plots were used along with 235 validation plots collected in 2013 to help guide the mapping.

Mappers overlaid on the existing imagery the 600 classified relevé plots and the 803 map validation plots that were sampled using the accuracy assessment methods described below. The mapping team used this plot data and additional knowledge of the vegetation acquired during field sampling to identify the spectral signatures on the NAIP and Lidar imagery that corresponded to each map unit. Polygons were hand digitized in ArcMap 10.2.2 over the 2011 NAIP imagery. The specific spectral signatures for each map unit are described in Appendix A.

A summary of the vegetation type labels we applied to each mapped polygon in the ArcGIS geodatabase attributes table is listed in Table 2. To provide the user with additional detail about the species composition and other aspects of the vegetation of a particular map unit polygon, we entered the percentages of up to two associations that, based on the relevés, validation plots and our field experience, were expected to occur in that polygon. These attributed polygons of map units comprised our draft map.

Table 2. The breakdown and description of the vegetation type labels applied to vegetation map polygons in the ArcGIS geodatabase attributes table.

Attribute of Interest	Attribute Code	Description
Primary vegetation	Primary_MapUnit	The dominant map unit (i.e. vegetation type) in each polygon
Primary association	PrimaryAssoc1	The dominant vegetation association in the Primary Map Unit in each polygon
Primary association, percent cover	PrimaryAssoc1_pct	The percent cover of the dominant vegetation association in each polygon (range 60-100%)
Secondary association of primary vegetation (if present)	PrimaryAssoc2	The secondary vegetation association in the Primary Map Unit in each polygon
Secondary association, percent cover	PrimaryAssoc2_pct	The percent cover of the secondary vegetation association in each polygon (range 0-40%)

2.5 Accuracy Assessment

Following the completion of the draft vegetation map, we conducted an accuracy assessment. The goal of the accuracy assessment is to allow users to evaluate the likelihood that a particular vegetation assignment on the map may be incorrect when observed in the field. This information is essential to determining the utility of the vegetation mapping data for particular applications. Map errors occur when polygon attributes differ from field observations. The accuracy assessment reports the errors of omission: the probability that the location of a field observation of a particular map class is not mapped as that map class, and the errors of commission: the probability that a location mapped as a particular map class is in fact not that map class when observed on the ground (Appendix F).

During the 2017 field season we performed the accuracy assessment field sampling of our completed vegetation map according to methods detailed by Lea and Curtis (2010). To accomplish our accuracy assessment, a 6 person field crew sampled 698 plots throughout the Crater Lake National Park project area. Plots were typically 0.5 ha in area, however, a small number of plots were reduced to 0.25 ha if they were located in polygons of rare map units that fell below the MMU of 0.5 ha. The

sample locations were selected using random point data stratified across 26 map units (Figure 14). We created a filter that prevented areas that were 40 m from the boundary of a polygon, or that were unsafe to sample (slopes greater than 30 degrees) from being included in the sampling frame. For rare map units (those frequently mapped in polygons at or below the MMU of 0.5 ha) and for map units typically mapped in linear or introverted polygons, we relaxed the buffer distance to as low as 10 m. Otherwise, these vegetation types would have few or no sampling locations. Areas greater than a distance of 2 km from a road or trail were also excluded from the sample frame as were areas within 100 m of a road or trail. Thirty random points were laid out per map unit using the Create Random Points tool in ArcMap 10.2.2 and fewer for map units less than 50 ha in total area with no less than 5 observation points laid out per map unit.

In the field, the decision tree from Lea and Curtis (2010: Exhibit H) was used to determine whether the vegetation at a location was homogeneous over a 0.5 ha area and whether to reshape the plot to achieve a field observation of a homogeneous stand of vegetation while maintaining the original plot center. Crews were able to move the plot center the minimal distance necessary to achieve a field observation of a homogeneous stand of vegetation while remaining within the stand of homogeneous vegetation into which the original plot center fell. If after following these steps a field observation of a homogeneous stand of vegetation was not still attainable, we instructed the crews to sample where two vegetation types were present, in which case they keyed and recorded both vegetation associations in their order of relative abundance. If all vegetation occurred in a mosaic smaller than the designated MMU size to the point where no clear occurrence of two vegetation types could be ascertained and there was no homogeneous area of vegetation to sample, crews moved the plot center to the nearest location of homogeneous vegetation of at least 0.5 ha. Once the crew located the plot, they recorded the coordinates using a GPS and identified the vegetation association(s) it encompassed using our dichotomous field key (Appendix C). In addition, they recorded the cover of the most dominant species of trees, shrubs, and herbaceous vegetation (up to 5 species in each stratum). They also measured the slope and aspect and took two digital photographs in cardinal directions starting with north and south (see Accuracy Assessment data form in Appendix D).

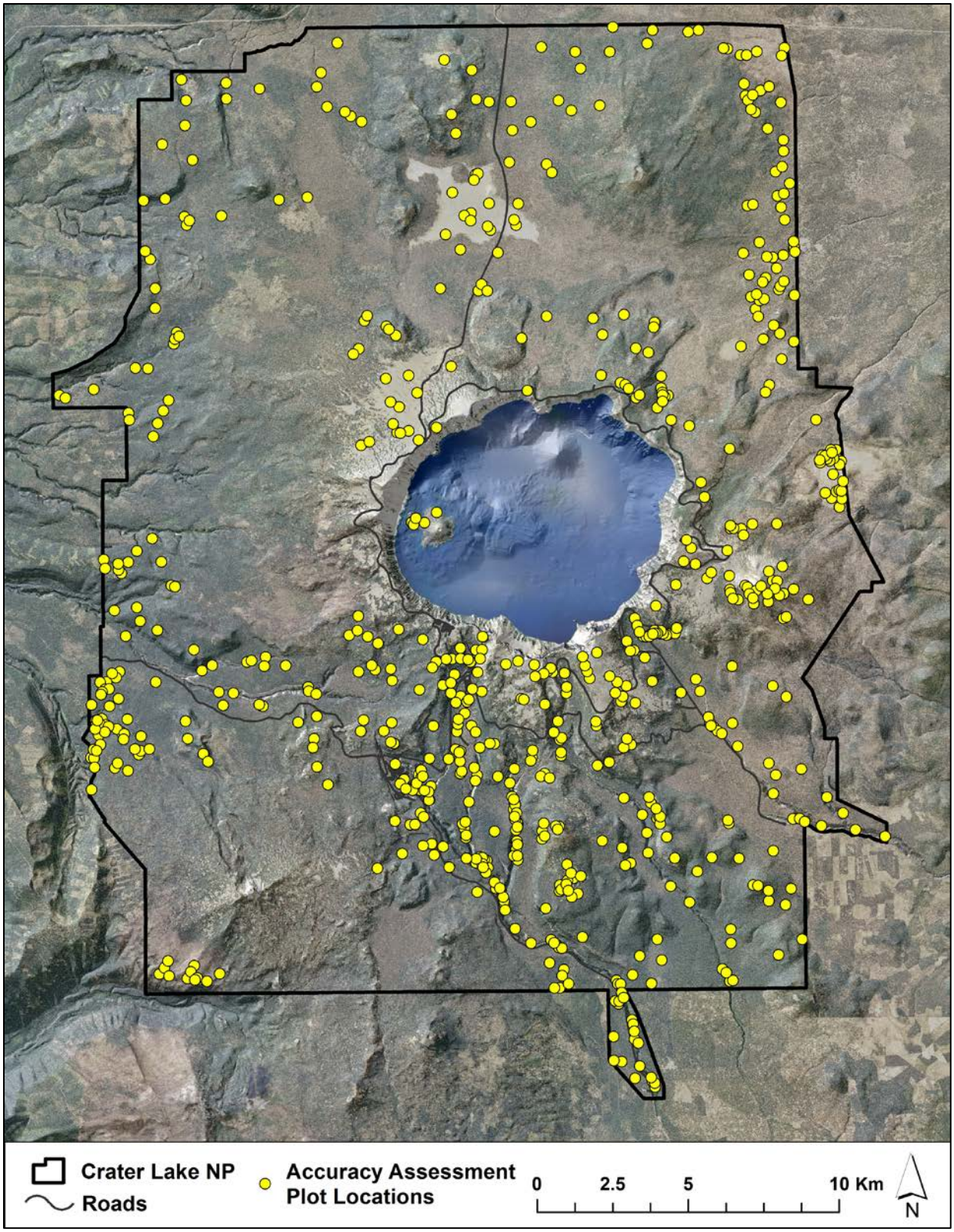


Figure 14. Locations of the 2017 accuracy assessment plots (N=698) at Crater Lake National Park.

To prepare the accuracy assessment field data for analysis, vegetation associations keyed to in the field were crosswalked to their corresponding map units. Our accuracy assessment is based on agreement or disagreement between the mapped vegetation and the corresponding primary or secondary vegetation associations found in the field, without regard to the percent of the field plot occupied by each. For plots in which two associations were identified, primary associations ranged from 60-90% and secondary associations ranged from 10-40%. There were 24 instances where the map unit that crosswalked to the secondary association identified in the field was compared to the map unit in the map, rather than that of the primary association identified in the field.

2.5.1 2017 Wildfires

During the second half of the 2017 accuracy assessment field season, two large wildfires burned in the west side of the park. As of August 1st, large portions of the west side of the park became off limits to sampling. Crews were able to access portions of the west side prior to the closure and completed a subset of the sample points in that area. Portions of the closure area that had not burned were reopened and accessed for sampling later in the field season as well. The portion of the closure area and the sample points that remained inaccessible through the entire 2017 field season are shown in Figure 15.

Due to the unpredictable conditions on the ground, we concluded during the field season that a portion of the sample points within the closure area would remain inaccessible through the remainder of the 2017 field season. At this point it was clear the required number of sample points per map unit could not be achieved with the remaining available points. Between 5 and 10 extra points per map unit were selected during the original random draw of sample points for map units but were not given to field crews. These points were introduced to the sampling as needed to make up for points that became unavailable to us in the closure area. For every point that was inaccessible due to the closure, an equivalent number of points from the overdraw were introduced until the required number of available sample points per map unit was achieved. Overdraw points in the closure areas were not used. In a limited number of map units the required number of sample points could not be achieved through the manner described above. In these cases, a new random draw was performed and only the number of points needed to achieve the required number of available sample points per map unit were drawn and introduced to the sampling. As areas in the closure were reopened to field crews, points from the original random draw were given priority over overdraw points and points from the new random draw. In some cases, more than the required number of points per map unit were sampled. No sampling was done in areas that burned in 2017.

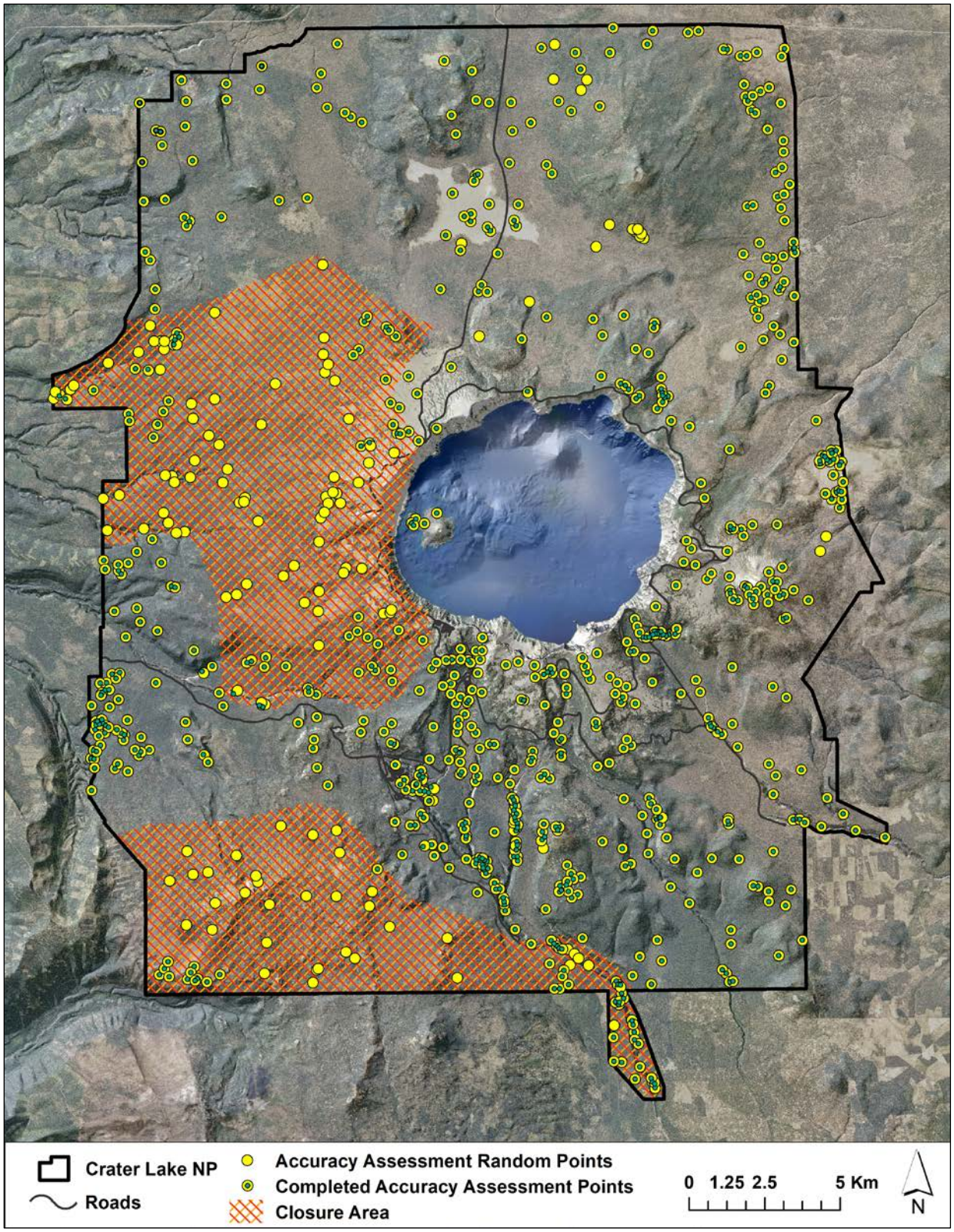


Figure 15. Closure area at Crater Lake National Park that remained inaccessible to field crews during the 2017 accuracy assessment field season due to active wildfires, and the accuracy assessment plots that were made unavailable for sampling.

2.6 Vegetation Change Since 1936

We used the 1936 vegetation map (Anonymous 1936) in concert with ours to assess vegetation change. Our vegetation map was clipped to the boundary of the historic 1936 map so that the area comparisons reflected the same extent of the landscape. A portion of the map from the southeastern corner of the park is shown in Figure 16. The map is colored according to the broad nominal types. Species codes are labeled on the map to show the subtype variation within the broad types. We compared acreages of vegetation subtypes that were tabulated in the 1936 report (Appendix G) that were, in composite, roughly comparable to our vegetation map units. We prepared a crosswalk between the maps to accomplish this. The 1936 subtypes are generally comparable to our vegetation associations in that the scale and floristic composition that each were classified at is roughly similar. 1936 subtypes were crosswalked to our map units based on their similarity to vegetation associations that were used to develop those map units. The broader groupings the 1936 map used to categorize and map the subtypes were also used as a general guide for the crosswalk. The 1936 subtypes were mapped and their acreage calculated by the producers of the 1936 map. These were made available in list form and these subtypes were broken out into broader vegetation types listed in Table 3. We modified the groupings of subtypes slightly to crosswalk them to our map units (see Appendix G). In a number of cases, no reasonable crosswalk was possible. In other cases, we did have a crosswalk, but there were complications that we needed to take into account in the analysis.

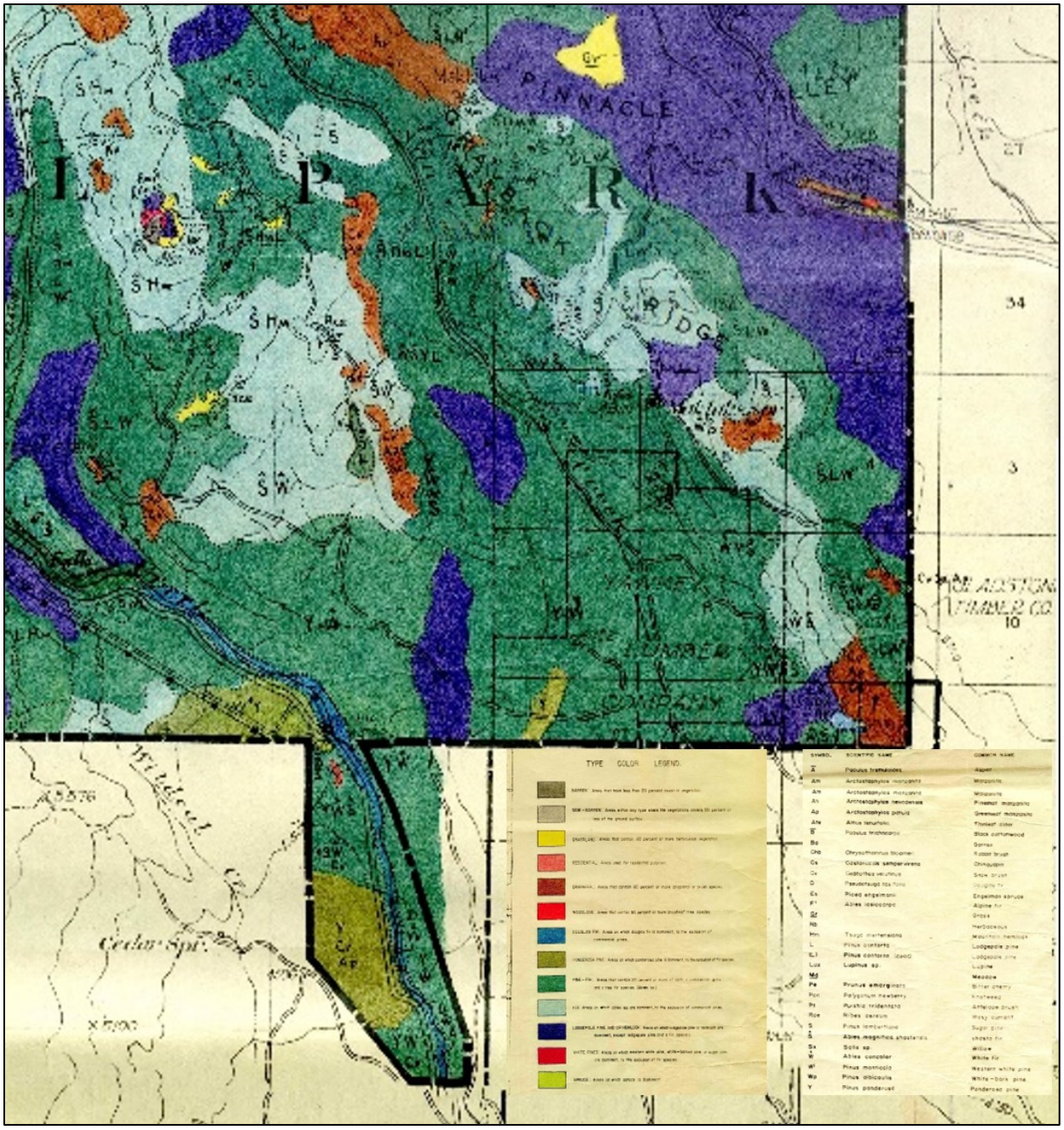


Figure 16. A portion of the 1936 map from the southeastern part of Crater Lake National Park.

The subtypes in the 1936 map listed tree types in pure stands which contained approximately 20% or more of a single species by number of stems, and in mixed stands made up of two or more species, none of which comprised as much as 80% or less than 20% of the total number of stems. In shrub types, a pure type is defined as one in which a single species covers approximately 80% or more of the area, and a mixed type is one in which two or more species occur, with no one occupying as much as 80% or less than 20% of the area. Subtypes were mapped and their areas enumerated (Appendix G). The species within each subtype were shown with the order of density of the species

decreasing from left to right. That is to say, in a mixed type composed of three species, assuming the stand has 50% of one, 30% of another, 20% of a third, then the species on the map were indicated in that order with the one of highest percentage coming first. This was determined using sample plots, which were unavailable to us, and extrapolated out to the mapped polygon of the subtype. Therefore, the density of the various species cannot be read precisely from the type map, but rather can be interpreted using the sample plots. Where the species were of nearly equal density the order of the species was determined by other types occupying similar sites. Table 3 shows the broad categories of vegetation the 1936 map made from the subtypes.

Table 3. Broad vegetation or landcover types mapped and enumerated in the 1936 vegetation survey of Crater Lake National Park.

Vegetation or Land Cover	Area (ha)
Lake	4,511.7
Barren	639.1
Herb: grass and semi-barren herb-grass	2,370.9
Residential	11.6
Chaparral	617
Woodland (aspen)	4.8
Douglas-fir Belt	406.9
Ponderosa pine Belt	2,434.8
Pine-fir belt	16,651
Lodgepole Pine – (mountain) Hemlock	29,736.8
Fir Belt	7,241.7
Whitebark Pine	225.5
Spruce	5.8
Total	**64,911.7**

One complication of comparing the 1936 map with our map was that the 1936 map was drawn on a different base map than ours. For an idea of the magnitude of difference that this makes, the size of Crater Lake in that map is 4,510 ha, while it was 5,333 ha in our map. We also do not know how much the 1936 map and ours differed due to the methods of mapping that were used. The 1936 map defined forest types based on stem density of trees presumably in relative abundance. We defined them based on percent cover in absolute abundance. The acreage of each subtype in the 1936 map was measured using a planimeter, which also introduces some inaccuracy depending on how many repeat measures are taken. The 1936 vegetation classification of subtypes attempted to capture every combination of abundant associated species thereby creating and mapping a larger number of subtypes than what we attempted to capture with our associations, which grouped associations of abundant species whenever they were relatively codominant.

We consider all of these limitations in our assessment of vegetation change.

3. Results

3.1 Vegetation Classification

We classified the relevé plot data into 80 associations (Appendix E), each of which is described in detail in Appendix B. Forty-seven of our Crater Lake National Park plant associations are equivalent with associations in the 2017 version of the USNVC (V2.01). Twenty of our associations are currently under review for inclusion in the USNVC. Thirteen associations are not equivalent with associations in the USNVC and are regarded as provisional.

We crosswalked the vegetation associations to the 25 vegetation/land cover types, referred to as map units, that we mapped (Table 4). Three additional non-vegetated map units that do not crosswalk to associations were also mapped. Each association fits into a single map unit. Therefore, the association key (Appendix C) identifies the plant associations that crosswalk directly to the specific map units that we mapped. As many as 13 associations crosswalked to a single map unit. Thus, there can be considerable complexity within a mapped polygon.

The field crews encountered 526 plant taxa, 519 of which were native (Appendix H), in the relevé plots used in this classification. There are 687 native plant taxa known to Crater Lake National Park. One vascular plant species that had not previously been detected in the park was encountered during field surveys: Whitney's bristleweed (*Hazardia whitneyi* var. *discoidea*).

Table 4. Map unit - vegetation association crosswalk.

Map Unit Code	Map Unit Name Abbreviated	Map Unit USNVC Colloquial Name	Map Unit USNVC Common Name	Sign*	Vegetation Association Common Name	Vegetation Association Scientific Name	Vegetation Code
P	Pond	Palustrine System	Palustrine System	=	Palustrine System Aquatic Bed Class Permanently Flooded Water Regime	N/A	PABH
	Pond	Palustrine System	Palustrine System	=	Palustrine System Unconsolidated Bottom Class Permanently Flooded Water Regime	N/A	PUBH
	Pond	Palustrine System	Palustrine System	>	Rocky Mountain Pond-lily Aquatic Vegetation	*Nuphar polysepala* Aquatic Vegetation	CEGL002001
A4254	Montane Grassland	Cascadian Subalpine - Montane Grassland	Long-stolon sedge – Western Needlegrass – California Brome Grassland Alliance	>	Columbia Needlegrass – Western Coneflower Grassland [Provisional]	*Achnatherum nelsonii – Rudbeckia occidentalis* Grassland [Provisional]	NPSCRLA001
	Montane Grassland	Cascadian Subalpine - Montane Grassland	Long-stolon sedge – Western Needlegrass – California Brome Grassland Alliance	>	California Needlegrass - Anderson's Lupine Grassland	*Achnatherum occidentale* ssp. *californicum – Lupinus andersonii* Grassland	CEPP007204
	Montane Grassland	Cascadian Subalpine - Montane Grassland	Long-stolon sedge – Western Needlegrass – California Brome Grassland Alliance	>	Long-stolon Sedge - Western Needlegrass Grassland	*Carex inops* ssp. *inops – Achnatherum occidentale* Grassland	CEPP007243
	Montane Grassland	Cascadian Subalpine - Montane Grassland	Long-stolon sedge – Western Needlegrass – California Brome Grassland Alliance	>	Long-stolon Sedge - Rydberg's Penstemon Grassland	*Carex inops* ssp. *inops – Penstemon rydbergii* Grassland	CEPP007248
G521	Montane Wet Meadow & Marsh	Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh	Sedge species - Reedgrass species Montane Wet Meadow & Marsh Group	>	Northwest Territory Sedge Wet Meadow	*Carex utriculata* Wet Meadow	CEGL001562

* An = sign is used when the map unit and classified vegetation are equivalent. A > sign is used when associations are subsumed within a map unit. A ~ sign is used when an association is placed within a map unit that does not exactly correspond to that association's USNVC classification.

Table 4 (continued). Map unit - vegetation association crosswalk.

Map Unit Code	Map Unit Name Abbreviated	Map Unit USNVC Colloquial Name	Map Unit USNVC Common Name	Sign*	Vegetation Association Common Name	Vegetation Association Scientific Name	Vegetation Code
G521 (cont.)	Montane Wet Meadow & Marsh	Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh	Sedge species - Reedgrass species Montane Wet Meadow & Marsh Group	>	Tufted Hairgrass Wet Meadow	*Deschampsia cespitosa* Wet Meadow	CEGL001599
	Montane Wet Meadow & Marsh	Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh	Sedge species - Reedgrass species Montane Wet Meadow & Marsh Group	>	Water Sedge Wet Meadow	*Carex aquatilis* Wet Meadow	CEGL001802
	Montane Wet Meadow & Marsh	Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh	Sedge species - Reedgrass species Montane Wet Meadow & Marsh Group	>	Lakeshore Sedge Wet Meadow	*Carex lenticularis* Wet Meadow	CEPP007249
	Montane Wet Meadow & Marsh	Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh	Sedge species - Reedgrass species Montane Wet Meadow & Marsh Group	>	Woodrush Sedge Wet Meadow	*Carex luzulina* Wet Meadow	CEPP007253
	Montane Wet Meadow & Marsh	Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh	Sedge species - Reedgrass species Montane Wet Meadow & Marsh Group	>	Mountain Sedge Wet Meadow	*Carex scopulorum* Wet Meadow	CEGL001822
	Montane Wet Meadow & Marsh	Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh	Sedge species - Reedgrass species Montane Wet Meadow & Marsh Group	>	Few-flower Spikerush Fen	*Eleocharis quinqueflora* Fen	CEGL001836

* An = sign is used when the map unit and classified vegetation are equivalent. A > sign is used when associations are subsumed within a map unit. A ~ sign is used when an association is placed within a map unit that does not exactly correspond to that association's USNVC classification.

Table 4 (continued). Map unit - vegetation association crosswalk.

Map Unit Code	Map Unit Name Abbreviated	Map Unit USNVC Colloquial Name	Map Unit USNVC Common Name	Sign*	Vegetation Association Common Name	Vegetation Association Scientific Name	Vegetation Code
G521 (cont.)	Montane Wet Meadow & Marsh	Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh	Sedge species - Reedgrass species Montane Wet Meadow & Marsh Group	>	Panicled Bulrush Marsh	*Scirpus microcarpus* Marsh	CEGL003322
	Montane Wet Meadow & Marsh	Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh	Sedge species - Reedgrass species Montane Wet Meadow & Marsh Group	>	Arrowleaf Ragwort Wet Meadow	*Senecio triangularis* Wet Meadow	CEGL001987
	Montane Wet Meadow & Marsh	Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh	Sedge species - Reedgrass species Montane Wet Meadow & Marsh Group	>	Western Bluejoint Wet Meadow	*Calamagrostis canadensis* Western Wet Meadow	CEGL001559
	Montane Wet Meadow & Marsh	Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh	Sedge species - Reedgrass species Montane Wet Meadow & Marsh Group	~	Bigleaf Lupine - Common Cowparsnip Meadow [Provisional]	*Lupinus polyphyllus - Heracleum maximum* Meadow [Provisional]	NPSCRLA002
	Montane Wet Meadow & Marsh	Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh	Sedge species - Reedgrass species Montane Wet Meadow & Marsh Group	~	Shasta Sedge Grassland	*Carex straminiformis* Grassland	CEGL001793
	Montane Wet Meadow & Marsh	Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh	Sedge species - Reedgrass species Montane Wet Meadow & Marsh Group	~	Mud Sedge Fen	*Carex limosa* Fen	CEGL001811

* An = sign is used when the map unit and classified vegetation are equivalent. A > sign is used when associations are subsumed within a map unit. A ~ sign is used when an association is placed within a map unit that does not exactly correspond to that association's USNVC classification.

Table 4 (continued). Map unit - vegetation association crosswalk.

Map Unit Code	Map Unit Name Abbreviated	Map Unit USNVC Colloquial Name	Map Unit USNVC Common Name	Sign*	Vegetation Association Common Name	Vegetation Association Scientific Name	Vegetation Code
G521 (cont.)	Montane Wet Meadow & Marsh	Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh	Sedge species - Reedgrass species Montane Wet Meadow & Marsh Group	~	Sitka Sedge Fen	*Carex aquatilis* var. *dives* Fen	CEGL001826
G520	Subalpine Wet Meadow & Dwarf-shrubland	Vancouverian-Rocky Mountain Subalpine-Alpine Snowbed, Wet Meadow & Dwarf-shrubland	White Marsh-marigold - Black Alpine Sedge - Alpine Laurel Subalpine-Alpine Snowbed, Wet Meadow & Dwarf-shrubland Group	>	Black Alpine Sedge Wet Meadow	*Carex nigricans* Wet Meadow	CEGL001816
G320	Subalpine Fell-field	North Pacific Alpine-Subalpine Tundra	Longawn Sedge - Showy Sedge - Spreading Phlox Alpine-Subalpine Tundra Group	>	Brewer's Sedge Alpine Meadow	*Carex breweri* Alpine Meadow	CEGL001805
	Subalpine Fell-field	North Pacific Alpine-Subalpine Tundra	Longawn Sedge - Showy Sedge - Spreading Phlox Alpine-Subalpine Tundra Group	>	Granite Prickly Phlox - Common Woolly Sunflower Alpine Fell-field [Provisional]	*Linanthus pungens* – *Eriophyllum lanatum* Alpine Fell-field [Provisional]	NPSCRLA003
	Subalpine Fell-field	North Pacific Alpine-Subalpine Tundra	Longawn Sedge - Showy Sedge - Spreading Phlox Alpine-Subalpine Tundra Group	>	Greene's Goldenbush / Davis' Knotweed Shrub Grassland	*Ericameria greenei* / *Polygonum davisiae* Shrub Grassland	CEPP007257
	Subalpine Fell-field	North Pacific Alpine-Subalpine Tundra	Longawn Sedge - Showy Sedge - Spreading Phlox Alpine-Subalpine Tundra Group	>	Marumleaf Buckwheat - Crater Lake Sandwort Fell-field	*Eriogonum marifolium* - *Arenaria pumicola* Fell-field	CEPP007262

* An = sign is used when the map unit and classified vegetation are equivalent. A > sign is used when associations are subsumed within a map unit. A ~ sign is used when an association is placed within a map unit that does not exactly correspond to that association's USNVC classification.

Table 4 (continued). Map unit - vegetation association crosswalk.

Map Unit Code	Map Unit Name Abbreviated	Map Unit USNVC Colloquial Name	Map Unit USNVC Common Name	Sign*	Vegetation Association Common Name	Vegetation Association Scientific Name	Vegetation Code
G320 (cont.)	Subalpine Fell-field	North Pacific Alpine-Subalpine Tundra	Longawn Sedge - Showy Sedge - Spreading Phlox Alpine-Subalpine Tundra Group	>	Davis' Knotweed - Squirreltail Fell-field	*Polygonum davisiae – Elymus elymoides* Fell-field	CEPP007270
	Subalpine Fell-field	North Pacific Alpine-Subalpine Tundra	Longawn Sedge - Showy Sedge - Spreading Phlox Alpine-Subalpine Tundra Group	>	Davis' Knotweed - Shasta Buckwheat Fell-field	*Polygonum davisiae – Eriogonum pyrolifolium* Fell-field	CEPP007271
	Subalpine Fell-field	North Pacific Alpine-Subalpine Tundra	Longawn Sedge - Showy Sedge - Spreading Phlox Alpine-Subalpine Tundra Group	>	Shasta Knotweed - Davis' Knotweed Fell-field	*Polygonum shastense – Polygonum davisiae* Fell-field	CEPP007275
A0788	Greenleaf Manzanita - Pinemat Manzanita Shrubland	Greenleaf Manzanita - Pinemat Manzanita Shrubland	Greenleaf Manzanita - Pinemat Manzanita Shrubland Alliance	>	Greenleaf Manzanita – (Snowbrush Ceanothus) / Prostrate Ceanothus Shrubland	*Arctostaphylos patula* - (*Ceanothus velutinus*) / *Ceanothus prostratus* Shrubland	CEGL000957
	Greenleaf Manzanita - Pinemat Manzanita Shrubland	Greenleaf Manzanita - Pinemat Manzanita Shrubland	Greenleaf Manzanita - Pinemat Manzanita Shrubland Alliance	>	Greenleaf Manzanita Sierran Chaparral Shrubland	*Arctostaphylos patula* Sierran Chaparral Shrubland	CEGL005820
	Greenleaf Manzanita - Pinemat Manzanita Shrubland	Greenleaf Manzanita - Pinemat Manzanita Shrubland	Greenleaf Manzanita - Pinemat Manzanita Shrubland Alliance	>	Pinemat Manzanita / Lace Lipfern Shrubland	*Arctostaphylos nevadensis / Cheilanthes gracillima* Shrubland	CEPP007205
	Greenleaf Manzanita - Pinemat Manzanita Shrubland	Greenleaf Manzanita - Pinemat Manzanita Shrubland	Greenleaf Manzanita - Pinemat Manzanita Shrubland Alliance	>	Bearbrush / Lobb's Fiddleleaf Shrubland	*Garrya fremontii* / *Nama lobbii* Shrubland	CEPP007263

* An = sign is used when the map unit and classified vegetation are equivalent. A > sign is used when associations are subsumed within a map unit. A ~ sign is used when an association is placed within a map unit that does not exactly correspond to that association's USNVC classification.

Table 4 (continued). Map unit - vegetation association crosswalk.

Map Unit Code	Map Unit Name Abbreviated	Map Unit USNVC Colloquial Name	Map Unit USNVC Common Name	Sign*	Vegetation Association Common Name	Vegetation Association Scientific Name	Vegetation Code
A3918	Bitter Cherry - Oceanspray Shrubland	Californian Montane Bitter Cherry - Oceanspray Shrubland	Bitter Cherry - Oceanspray Shrubland Alliance	>	Bitter Cherry Sierran Chaparral Shrubland	*Prunus emarginata* Sierran Chaparral Shrubland	CEGL005822
	Bitter Cherry - Oceanspray Shrubland	Californian Montane Bitter Cherry - Oceanspray Shrubland	Bitter Cherry - Oceanspray Shrubland Alliance	>	Oceanspray / Marumleaf Buckwheat - Long-Stolon Sedge Shrubland	*Holodiscus discolor* / *Eriogonum marifolium* - *Carex inops* ssp. *inops* Shrubland	CEPP007264
	Bitter Cherry - Oceanspray Shrubland	Californian Montane Bitter Cherry - Oceanspray Shrubland	Bitter Cherry - Oceanspray Shrubland Alliance	>	Red Elderberry / Spearleaf Arnica Shrubland	*Sambucus racemosa* / *Arnica longifolia* Shrubland	CEPP007280
A3179	Antelope Bitterbrush Shrubland	Antelope Bitterbrush - Big Sagebrush Mesic Steppe & Shrubland	Antelope Bitterbrush - Big Sagebrush Mesic Steppe & Shrubland Alliance	>	Rabbitbush Shrub Grassland [Provisional]	*Ericameria bloomeri* Shrub Grassland [Provisional]	NPSCRLA004
	Antelope Bitterbrush Shrubland	Antelope Bitterbrush - Big Sagebrush Mesic Steppe & Shrubland	Antelope Bitterbrush - Big Sagebrush Mesic Steppe & Shrubland Alliance	>	Antelope Bitterbrush / Long-stolon Sedge - Western Needlegrass Shrub Grassland	*Purshia tridentata* / *Carex inops* ssp. *inops* - *Achnatherum occidentale* Shrub Grassland	CEGL001492
A1003	Willow Wet Shrubland	Cascadian Undergreen Willow Wet Shrubland	Undergreen Willow Wet Shrubland Alliance	>	Undergreen Willow / Mountain Sedge Wet Shrubland	*Salix commutata* / *Carex scopulorum* Wet Shrubland	CEGL001189
	Willow Wet Shrubland	Cascadian Undergreen Willow Wet Shrubland	Undergreen Willow Wet Shrubland Alliance	~	Booth's Willow / Bluejoint Wet Shrubland	*Salix boothii* / *Calamagrostis canadensis* Wet Shrubland	CEGL001175

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Table 4 (continued). Map unit - vegetation association crosswalk.

Map Unit Code	Map Unit Name Abbreviated	Map Unit USNVC Colloquial Name	Map Unit USNVC Common Name	Sign*	Vegetation Association Common Name	Vegetation Association Scientific Name	Vegetation Code
A3771	Western Alder Wet Shrubland	Western Alder Wet Shrubland	Gray Alder - Green Alder Wet Shrubland Alliance	>	Gray Alder / Fowl Mannagrass Wet Shrubland	*Alnus incana* / *Glyceria striata* Wet Shrubland	CEGL000228
	Western Alder Wet Shrubland	Western Alder Wet Shrubland	Gray Alder - Green Alder Wet Shrubland Alliance	>	Sitka Alder / Mesic Forbs Wet Shrubland	*Alnus viridis* ssp. *sinuata* / Mesic Forbs Wet Shrubland	CEGL002633
A1123	Bog Blueberry Wet Shrubland	Pacific Northwest Blueberry Wet Shrubland	Bog Blueberry - Dwarf Bilberry Wet Shrubland Alliance	>	Bog Blueberry / Sitka Sedge Wet Shrubland	*Vaccinium uliginosum* / *Carex aquatilis* var. *dives* Wet Shrubland	CEGL001249
	Bog Blueberry Wet Shrubland	Pacific Northwest Blueberry Wet Shrubland	Bog Blueberry - Dwarf Bilberry Wet Shrubland Alliance	~	Rose Spiraea Wet Shrubland	Spiraea douglasii Wet Shrubland	CEGL001129
A3446	Ponderosa Pine Woodland	Central Rocky Mountain Ponderosa Pine / Shrub Woodland	Ponderosa Pine / Shrub Understory Central Rocky Mountain Woodland Alliance	>	Ponderosa Pine / Greenleaf Manzanita - Antelope Bitterbrush Woodland	*Pinus ponderosa* / *Arctostaphylos patula* - *Purshia tridentata* Woodland	CEGL000063
	Ponderosa Pine Woodland	Central Rocky Mountain Ponderosa Pine / Shrub Woodland	Ponderosa Pine / Shrub Understory Central Rocky Mountain Woodland Alliance	>	Ponderosa Pine / Antelope Bitterbrush / Long-stolon Sedge Forest	*Pinus ponderosa* / *Purshia tridentata* / *Carex inops* ssp. *inops* Forest	CEGL000193
A2036	Quaking Aspen Forest	Rocky Mountain Aspen Forest & Woodland	Quaking Aspen Rocky Mountain Forest & Woodland Alliance	>	Quaking Aspen – Ponderosa Pine Forest [Provisional]	*Populus tremuloides* - *Pinus ponderosa* Forest [Provisional]	NPSCRLA005
	Quaking Aspen Forest	Rocky Mountain Aspen Forest & Woodland	Quaking Aspen Rocky Mountain Forest & Woodland Alliance	>	Quaking Aspen / California Brome Forest	*Populus tremuloides* / *Bromus carinatus* Forest	CEGL000573

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Table 4 (continued). Map unit - vegetation association crosswalk.

Map Unit Code	Map Unit Name Abbreviated	Map Unit USNVC Colloquial Name	Map Unit USNVC Common Name	Sign*	Vegetation Association Common Name	Vegetation Association Scientific Name	Vegetation Code
G344	Montane Conifer Forest	Californian Montane Conifer Forest & Woodland	Incense-cedar - Sugar Pine - White Fir Forest & Woodland Group	>	Sierra White Fir - Sugar Pine - Ponderosa Pine / Greenleaf Manzanita Forest	*Abies lowiana* - *Pinus lambertiana* - *Pinus ponderosa* / *Arctostaphylos patula* Forest	CEGL000016
	Montane Conifer Forest	Californian Montane Conifer Forest & Woodland	Incense-cedar - Sugar Pine - White Fir Forest & Woodland Group	>	Douglas-fir - Sierra White Fir - Incense-cedar Forest	*Pseudotsuga menziesii* - *Abies lowiana* - *Calocedrus decurrens* Forest	CEGL005813
	Montane Conifer Forest	Californian Montane Conifer Forest & Woodland	Incense-cedar - Sugar Pine - White Fir Forest & Woodland Group	>	Sierra White Fir / Pipsissewa Forest	*Abies lowiana* / *Chimaphila umbellata* Forest	CEGL000015
	Montane Conifer Forest	Californian Montane Conifer Forest & Woodland	Incense-cedar - Sugar Pine - White Fir Forest & Woodland Group	>	Sierra White Fir - Douglas-fir / Cascade Barberry Forest	*Abies lowiana* - *Pseudotsuga menziesii* / *Mahonia nervosa* Forest	CEGL000019
	Montane Conifer Forest	Californian Montane Conifer Forest & Woodland	Incense-cedar - Sugar Pine - White Fir Forest & Woodland Group	>	Sierra White Fir - Douglas-fir / Bush Chinquapin Forest	*Abies lowiana* - *Pseudotsuga menziesii* / *Chrysolepis sempervirens* Forest	CEPP007202
	Montane Conifer Forest	Californian Montane Conifer Forest & Woodland	Incense-cedar - Sugar Pine - White Fir Forest & Woodland Group	>	Ponderosa Pine – Incense-cedar / Prostrate Ceanothus Woodland [Provisional]	*Pinus ponderosa* – *Calocedrus decurrens* / *Ceanothus prostratus* Woodland [Provisional]	NPSCRLA006
	Montane Conifer Forest	Californian Montane Conifer Forest & Woodland	Incense-cedar - Sugar Pine - White Fir Forest & Woodland Group	>	Sierra White Fir - Ponderosa Pine / Long-stolon Sedge Forest	*Abies lowiana* - *Pinus ponderosa* / *Carex inops* ssp. *inops* Forest	CEGL000257
	Montane Conifer Forest	Californian Montane Conifer Forest & Woodland	Incense-cedar - Sugar Pine - White Fir Forest & Woodland Group	>	Sierra White Fir - Shasta Red Fir / Pipsissewa Forest	*Abies lowiana* - *Abies magnifica* var. *shastensis* / *Chimaphila umbellata* Forest	CEGL000030

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Table 4 (continued). Map unit - vegetation association crosswalk.

Map Unit Code	Map Unit Name Abbreviated	Map Unit USNVC Colloquial Name	Map Unit USNVC Common Name	Sign*	Vegetation Association Common Name	Vegetation Association Scientific Name	Vegetation Code
A3619	Shasta Red Fir Forest	Sierra-Cascade Red Fir Forest	California Red Fir - Shasta Red Fir Forest Alliance	>	Shasta Red Fir – Western White Pine / Davidson's Penstemon Forest [Provisional]	*Abies magnifica* var. *shastensis* - *Pinus monticola* / *Penstemon davidsonii* Forest [Provisional]	NPSCRLA007
	Shasta Red Fir Forest	Sierra-Cascade Red Fir Forest	California Red Fir - Shasta Red Fir Forest Alliance	>	Shasta Red Fir - Mountain Hemlock / Pinemat Manzanita Forest	*Abies magnifica* var. *shastensis* - *Tsuga mertensiana* / *Arctostaphylos nevadensis* Forest	CEGL000035
	Shasta Red Fir Forest	Sierra-Cascade Red Fir Forest	California Red Fir - Shasta Red Fir Forest Alliance	>	Shasta Red Fir / Thinleaf Huckleberry / Pipsissewa Forest	*Abies magnifica* var. *shastensis* / *Vaccinium membranaceum* / *Chimaphila umbellata* Forest	CEGL000037
	Shasta Red Fir Forest	Sierra-Cascade Red Fir Forest	California Red Fir - Shasta Red Fir Forest Alliance	>	Shasta Red Fir / Long-stolon Sedge Forest	*Abies magnifica* var. *shastensis* / *Carex inops* ssp. *inops* Forest	CEGL000348
	Shasta Red Fir Forest	Sierra-Cascade Red Fir Forest	California Red Fir - Shasta Red Fir Forest Alliance	>	Shasta Red Fir – Douglas-fir / Pinemat Manzanita Forest	*Abies magnifica* var. *shastensis* - *Pseudotsuga menziesii* / *Arctostaphylos nevadensis* Forest	CEPP007203
	Shasta Red Fir Forest	Sierra-Cascade Red Fir Forest	California Red Fir - Shasta Red Fir Forest Alliance	>	California Red Fir – Western White Pine / Pinemat Manzanita Forest	*Abies magnifica* - *Pinus monticola* / *Arctostaphylos nevadensis* Forest	CEGL008615
CEGL008692	Mountain Hemlock - Lodgepole Pine - Whitebark Pine Forest	N/A	Mountain Hemlock - Sierra Lodgepole Pine - Whitebark Pine Forest	=	Mountain Hemlock - Sierra Lodgepole Pine - Whitebark Pine Forest	*Tsuga mertensiana* - *Pinus contorta* var. *murrayana* - *Pinus albicaulis* Forest	CEGL008692
A3621	Lodgepole Pine Forest	Subalpine Sierra Lodgepole Pine Forest & Woodland	Sierra Lodgepole Pine Subalpine Forest & Woodland Alliance	>	(Tall Lodgepole Pine, Sierra Lodgepole Pine) / Pinemat Manzanita Forest	*Pinus contorta* (var. *latifolia,* var. *murrayana*) / *Arctostaphylos nevadensis* Forest	CEGL000133
	Lodgepole Pine Forest	Subalpine Sierra Lodgepole Pine Forest & Woodland	Sierra Lodgepole Pine Subalpine Forest & Woodland Alliance	>	Sierra Lodgepole Pine / Long-stolon Sedge Forest	*Pinus contorta* var. *murrayana* / *Carex inops* ssp. *inops* Forest	CEGL000143

* An = sign is used when the map unit and classified vegetation are equivalent. A > sign is used when associations are subsumed within a map unit. A ~ sign is used when an association is placed within a map unit that does not exactly correspond to that association's USNVC classification.

Table 4 (continued). Map unit - vegetation association crosswalk.

Map Unit Code	Map Unit Name Abbreviated	Map Unit USNVC Colloquial Name	Map Unit USNVC Common Name	Sign*	Vegetation Association Common Name	Vegetation Association Scientific Name	Vegetation Code
A3621 (cont.)	Lodgepole Pine Forest	Subalpine Sierra Lodgepole Pine Forest & Woodland	Sierra Lodgepole Pine Subalpine Forest & Woodland Alliance	>	Lodgepole Pine / Antelope Bitterbrush / Long-stolon Sedge Forest	*Pinus contorta* / *Purshia tridentata* / *Carex inops* ssp. *inops* Forest	CEGL000159
	Lodgepole Pine Forest	Subalpine Sierra Lodgepole Pine Forest & Woodland	Sierra Lodgepole Pine Subalpine Forest & Woodland Alliance	>	Sierra Lodgepole Pine / Sparse Understory Forest	*Pinus contorta* var. *murrayana* / Sparse Understory Forest	CEGL003069
	Lodgepole Pine Forest	Subalpine Sierra Lodgepole Pine Forest & Woodland	Sierra Lodgepole Pine Subalpine Forest & Woodland Alliance	>	Sierra Lodgepole Pine – (Mountain Hemlock) / Pinemat Manzanita / Davidson's Penstemon Woodland	*Pinus contorta* var. *murrayana* - (*Tsuga mertensiana*) / *Arctostaphylos nevadensis* / *Penstemon davidsonii* Woodland	CEPP007266
	Lodgepole Pine Forest	Subalpine Sierra Lodgepole Pine Forest & Woodland	Sierra Lodgepole Pine Subalpine Forest & Woodland Alliance	>	Sierra Lodgepole Pine / Snowbrush Ceanothus Forest	*Pinus contorta* var. *murrayana* / *Ceanothus velutinus* Forest	CEPP007283
CEGL003134	Whitebark Pine Woodland	N/A	Whitebark Pine / Davidson's Penstemon Woodland	>	Whitebark Pine / Davidson's Penstemon Woodland	*Pinus albicaulis* / *Penstemon davidsonii* Woodland	CEGL003134
A3729	Subalpine Fir Forest	Cascadian Subalpine Fir - Engelmann Spruce Forest	Subalpine Fir - Engelmann Spruce / Rough-fruit Berry Cascadian Forest Alliance	>	Subalpine Fir - Mountain Hemlock / Rough-fruit Berry Forest [Provisional]	*Abies lasiocarpa – Tsuga mertensiana* / *Rubus lasiococcus* Forest [Provisional]	NPSCRLA008
	Subalpine Fir Forest	Cascadian Subalpine Fir - Engelmann Spruce Forest	Subalpine Fir - Engelmann Spruce / Rough-fruit Berry Cascadian Forest Alliance	~	Subalpine Fir - Sierra Lodgepole Pine Forest [Provisional]	*Abies lasiocarpa – Pinus contorta* var. *murrayana* Forest [Provisional]	NPSCRLA009

* An = sign is used when the map unit and classified vegetation are equivalent. A > sign is used when associations are subsumed within a map unit. A ~ sign is used when an association is placed within a map unit that does not exactly correspond to that association's USNVC classification.

Table 4 (continued). Map unit - vegetation association crosswalk.

Map Unit Code	Map Unit Name Abbreviated	Map Unit USNVC Colloquial Name	Map Unit USNVC Common Name	Sign*	Vegetation Association Common Name	Vegetation Association Scientific Name	Vegetation Code
A3729 (cont.)	Subalpine Fir Forest	Cascadian Subalpine Fir - Engelmann Spruce Forest	Subalpine Fir - Engelmann Spruce / Rough-fruit Berry Cascadian Forest Alliance	~	Subalpine Fir - Engelmann Spruce / Grouse Whortleberry Forest	*Abies lasiocarpa* - *Picea engelmannii* / *Vaccinium scoparium* Forest	CEGL000344
A3726	Mountain Hemlock Forest	Cascadian Pacific Silver Fir - Mountain Hemlock - Subalpine Fir Forest & Woodland	Pacific Silver Fir - Mountain Hemlock - Subalpine Fir Cascadian Forest & Woodland Alliance	>	Mountain Hemlock – (Pacific Silver Fir, Subalpine Fir) / Hitchcock's Smooth Woodrush Woodland	*Tsuga mertensiana* - (*Abies amabilis*, *Abies lasiocarpa*) / *Luzula glabrata* var. *hitchcockii* Woodland	CEGL007381
	Mountain Hemlock Forest	Cascadian Pacific Silver Fir - Mountain Hemlock - Subalpine Fir Forest & Woodland	Pacific Silver Fir - Mountain Hemlock - Subalpine Fir Cascadian Forest & Woodland Alliance	~	Mountain Hemlock / Sparse Understory Forest	*Tsuga mertensiana* / Sparse Understory Forest	CEGL008685
A0311	Black Cottonwood Riparian Forest	Northern Rocky Mountain Riparian Black Cottonwood Forest	Black Cottonwood Northern Rocky Mountain Riparian Forest Alliance	>	Black Cottonwood - Quaking Aspen / Broadleaf Lupine Forest [Provisional]	*Populus balsamifera* ssp. *trichocarpa* – *Populus tremuloides* / *Lupinus latifolius* ssp. *latifolius* Forest [Provisional]	NPSCRLA010
G507	Subalpine Fir - Lodgepole Pine Riparian Woodland	North Pacific Montane Riparian Woodland	Mountain Hemlock - Fir spp. / Willow spp. Montane Riparian Woodland Group	>	Subalpine Fir - Sierra Lodgepole Pine / Bluejoint - Sedge spp. Forest [Provisional]	*Abies lasiocarpa* - *Pinus contorta* var. *murrayana* / *Calamagrostis canadensis* - *Carex* spp. Forest [Provisional]	NPSCRLA011
	Subalpine Fir - Lodgepole Pine Riparian Woodland	North Pacific Montane Riparian Woodland	Mountain Hemlock - Fir spp. / Willow spp. Montane Riparian Woodland Group	~	(Tall Lodgepole Pine, Sierra Lodgepole Pine) / Bog Blueberry Forest	*Pinus contorta* (var. *latifolia,* var. *murrayana*) / *Vaccinium uliginosum* Forest	CEGL000171
A3767	Engelmann Spruce Swamp Woodland	Cascadian Engelmann Spruce Swamp Woodland	Engelmann Spruce Cascadian Swamp Woodland Alliance	>	Western Hemlock - Engelmann Spruce Forest [Provisional]	*Tsuga heterophylla* – *Picea engelmannii* Forest [Provisional]	NPSCRLA012

* An = sign is used when the map unit and classified vegetation are equivalent. A > sign is used when associations are subsumed within a map unit. A ~ sign is used when an association is placed within a map unit that does not exactly correspond to that association's USNVC classification.

Table 4 (continued). Map unit - vegetation association crosswalk.

Map Unit Code	Map Unit Name Abbreviated	Map Unit USNVC Colloquial Name	Map Unit USNVC Common Name	Sign*	Vegetation Association Common Name	Vegetation Association Scientific Name	Vegetation Code
A3767 (cont.)	Engelmann Spruce Swamp Woodland	Cascadian Engelmann Spruce Swamp Woodland	Engelmann Spruce Cascadian Swamp Woodland Alliance	>	Engelmann Spruce / Blueberry spp. Forest [Provisional]	*Picea engelmannii* / *Vaccinium* spp. Forest [Provisional]	NPSCRLA013
NPSCRLA014	Mountain Hemlock Forest - Lodgepole Pine Forest Complex	N/A	N/A	=	Mountain Hemlock Forest and Lodgepole Pine Forest Map Unit Complex	N/A	NPSCRLA014
G573	Cliff, Scree & Rock Vegetation	Southern Vancouverian Cliff, Scree & Rock Vegetation	Western White Pine / Pinemat Manzanita Cliff, Scree & Rock Vegetation Group	=	Cliff, Scree & Rock Vegetation	N/A	G573
	Cliff, Scree & Rock Vegetation	Southern Vancouverian Cliff, Scree & Rock Vegetation	Western White Pine / Pinemat Manzanita Cliff, Scree & Rock Vegetation Group	~	Davidson's Penstemon Sparse Vegetation	*Penstemon davidsonii* Sparse Vegetation	CEPP007265
	Cliff, Scree & Rock Vegetation	Southern Vancouverian Cliff, Scree & Rock Vegetation	Western White Pine / Pinemat Manzanita Cliff, Scree & Rock Vegetation Group	~	White Pasqueflower - Davidson's Penstemon Sparse Vegetation	*Pulsatilla occidentalis* - *Penstemon davidsonii* Sparse Vegetation	CEPP007276
NPSCRLA015	Pumice/Sand	N/A	N/A	=	Pumice/Sand	N/A	NPSCRLA015
LULC52	Lake	N/A	Lakes	=	Level 1: 5. Water Level 2: 52. Lakes	N/A	LULC52
LULC16	Pavement - Development	N/A	Mixed Urban or Built-up Land	N/A	N/A	N/A	N/A

* An = sign is used when the map unit and classified vegetation are equivalent. A > sign is used when associations are subsumed within a map unit. A ~ sign is used when an association is placed within a map unit that does not exactly correspond to that association's USNVC classification.

3.2 Vegetation Map

Table 5 lists the 25 vegetation types and three unvegetated types, referred to as map units, that we mapped and the total area of each in our map. Detailed descriptions of the map units and our digital imagery interpretation are presented in Appendix A. Our final Crater Lake National Park vegetation map is presented in Figure 17. A high resolution pdf of the vegetation map is available for printing at poster (24" x 36") or other sizes at http://www.nps.gov/im/vmi-crla.

The most common vegetation that we mapped was Shasta Red Fir Forest, which occupied 23,883 ha, or about 1/3rd of the extent of terrestrial vegetation in the park. Mountain Hemlock Forest was the second most common map unit that we mapped (16,379 ha). Most of the remainder of the forest vegetation was Lodgepole Pine Forest (11,605 ha), and Montane Conifer Forest (4,677 ha). In contrast, Whitebark Pine Woodland, a focal vegetation type, was rare (298 ha). However, mixed species forests that may have had only a small amount (5% or greater) of whitebark pine (Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest) had an additional estimated area of 639.1 ha. Herbaceous vegetation accounted for about 6.4% of the mapped vegetation. Shrub vegetation was only 1% of our map.

Table 5. Mapped vegetation and other land cover types (map units) at Crater Lake National Park.

Category	Map Unit	Area in the Park (ha)
I. Pond & Aquatic Vegetation	1. Pond	10.3
II. Herbaceous Vegetation	2. Montane Grassland	592.2
	3. Montane Wet Meadow & Marsh	200.4
	4. Subalpine Wet Meadow & Dwarf-shrubland	11.8
	5. Subalpine Fell-field	2,793.7
	Subtotal	3,598.0
III. Shrub Vegetation	6. Greenleaf Manzanita - Pinemat Manzanita Shrubland	435.9
	7. Bitter Cherry - Oceanspray Shrubland	59.0
	8. Antelope Bitterbrush Shrubland	152.4
	9. Willow Wet Shrubland	18.4
	10. Western Alder Wet Shrubland	181.2
	11. Bog Blueberry Wet Shrubland	13.4
	Subtotal	860.3
IV. Forest and Woodland Vegetation	12. Ponderosa Pine Woodland	1904.1
	13. Quaking Aspen Forest	16.1
	14. Montane Conifer Forest	4,677.4
	15. Shasta Red Fir Forest	23,833.0
	16. Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest	639.1
	17. Lodgepole Pine Forest	11,604.9
	18. Whitebark Pine Woodland	298.8
	19. Subalpine Fir Forest	1,475.5

Table 5 (continued). Mapped vegetation and other land cover types (map units) at Crater Lake National Park.

Category	Map Unit	Area in the Park (ha)
IV. Forest and Woodland Vegetation (cont.)	20. Mountain Hemlock Forest	16,379.3
	21. Black Cottonwood Riparian Forest	12.2
	22. Subalpine Fir - Lodgepole Pine Riparian Woodland	323.7
	23. Engelmann Spruce Swamp Woodland	313.8
	24. Mountain Hemlock Forest – Lodgepole Pine Forest Complex	924.5
	Subtotal	62,402.4
V. Sparsely Vegetated or Unvegetated	25. Cliff, Scree & Rock Vegetation	1,201.4
	26. Pumice/Sand	239.0
	27. Lake	5,332.7
	28. Pavement - Development	110.6
	Subtotal	6883.7
TOTAL		73,775.9

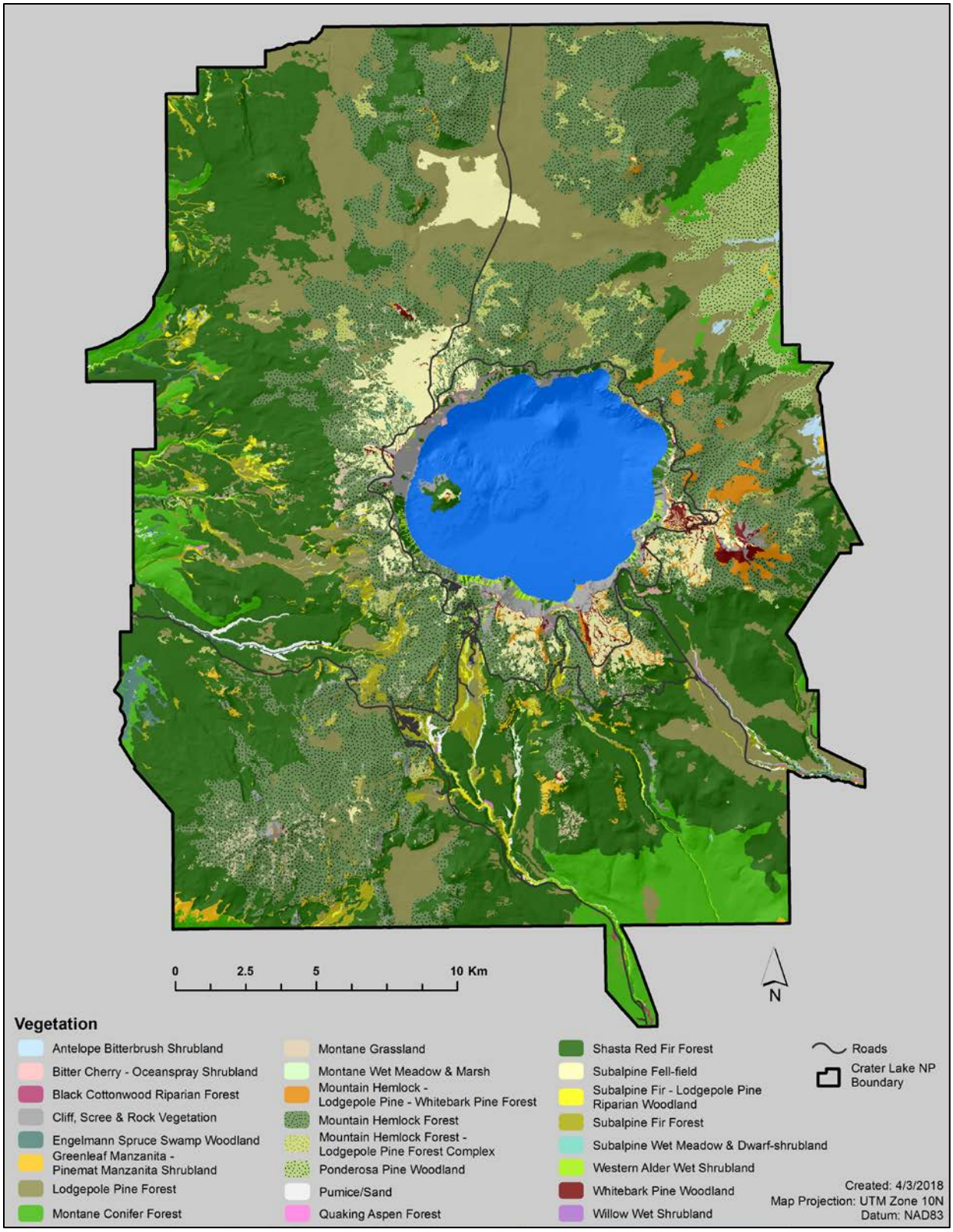


Figure 17. Vegetation map of Crater Lake National Park.

3.3 Accuracy Assessment

Appendix F contains the accuracy assessment contingency table. The overall accuracy of the mapping was relatively high: 86.2%. The lower limit of the 90% confidence interval was 82.2%, while the upper limit was 90.2%. The rows in the contingency table show the number of plots sampled in each map unit that were not identified to this same type in the field (errors of omission). There were several map units with large sample sizes in which there was no error of omission: Ponderosa Pine Woodland (30 plots), Montane Grassland (30 plots), Montane Wet Meadow & Marsh (36 plots), Subalpine Fell-field (31 plots), Lodgepole Pine Forest (28 plots), and Montane Conifer Forest (33 plots).

Conversely, a low percentage accuracy was found for Cliff, Scree & Rock Vegetation (35.6%, 26 plots), while a moderately low percentage accuracy was found for Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest (60%, 30 plots), and Antelope Bitterbrush Shrubland (60%, 30 plots).

There was also low percentage accuracy (11%) for a tentative map unit, Shasta Red Fir Forest – Montane Conifer Forest Complex. Most of the accuracy assessment points in this forest complex map unit were assigned to Shasta Red Fir Forest, indicating the two map units were not distinguishable from each other in the field. Therefore we merged the Shasta Red Fir Forest – Montane Conifer Forest Complex with Shasta Red Fir Forest. Merging these two map units created a large sample of accuracy assessment plots (67) in Shasta Red Fir Forest. The accuracy of the resulting Shasta Red Fir Forest map unit was 80.6%.

There were several vegetation types that occupied a relatively small area in the mapping, and hence, there were few accuracy assessment points that could be located within areas mapped as these map units. For these, a 90% confidence interval surrounding the percent accuracy can be helpful to evaluate the findings (Table 6). The accuracy level that falls within the 90 percent confidence interval is very low (<60%) for Pond, Subalpine Wet Meadow & Dwarf-shrubland, and Willow Wet Shrubland. The confidence interval for Quaking Aspen Forest indicates that there is a high probability that the mapped accuracy for this type is greater than 65%.

Table 6. The number of plots correct out of the total number of plots for map units that are small in area, and the range of accuracy that would be correct with a 90% level of confidence.

Map Unit	# Plots Correct	# Plots Total	Accuracy Range with 90% Confidence
1. Pond	5	7	43-96%
4. Subalpine Wet Meadow & Dwarf-shrubland	5	6	58.2-108%
9. Willow Wet Shrubland	7	11	39.7-87.6%
13. Quaking Aspen Forest	10	12	65.6-100%
21. Black Cottonwood Riparian Forest	4	6	34.9-98.4%

There were 24 cases where the secondary association identified in the field, and not the primary association, matched the map unit of the mapped polygon. This happened most often in Subalpine Fir

– Lodgepole Pine Riparian Woodland (4 plots) and Engelmann Spruce Swamp Woodland (3 plots). If these plots where the secondary association was used were dropped from the analysis, the accuracy of Subalpine Fir – Lodgepole Pine Riparian Woodland would go from 25/32 correct to 21/28 correct (75%), and Engelmann Spruce Swamp Woodland would go from 25/32 correct to 20/28 (72%).

Montane Grassland had high errors of commission in the vegetation map, with 7 Antelope Bitterbrush Shrubland plots keyed to this type. Bitter Cherry – Oceanspray Shrubland also had high errors of commission. There were 7 Cliff, Scree & Rock Vegetation plots, as well as 4 Greenleaf Manzanita-Pinemat Manzanita Shrubland plots keyed to this type. Mountain Hemlock Forest also had high errors of commission, with 12 out of 35 plots in 5 other map units keyed to this type.

One of our mapped vegetation types, Mountain Hemlock Forest - Lodgepole Pine Forest Complex, is a mixture, or complex, of two forest map units. In the imagery, this complex appears as a mosaic of distinct patches of each component forest map unit that are too small and intermixed to map individually given our minimum mapping unit of 0.5 ha. The user's accuracy assessment for this complex was initially low (32%). However, it increased to 84% when we considered field plots to be correct when they keyed to either Mountain Hemlock Forest or Lodgepole Pine Forest, in addition to the complex itself. This treatment of a complex in the accuracy assessment is consistent with the methodology in Lea and Curtis (2010).

The Pond map unit was initially treated as a Pond-lily Aquatic Vegetation map class. As originally defined, only 3 out of 7 locations were a correct field call. The reason for 2 of the 4 incorrect calls was that some ponds that we mapped lacked Rocky Mountain pond-lily (*Nuphar lutea* ssp. *polysepala*). After consulting with park natural resource managers, we changed the definition of ponds to also include those lacking Rocky Mountain pond-lily. This resulted in 5 out of 7 correct calls.

3.4 Non-native Invasive Species

There were only 7 non-native species detected in the relevé plots (Table 7). Common dandelion was the most frequently encountered.

Table 7. Non-native species found in the 600 relevé plots.

Scientific Name	Common Name	Number of plots
Agrostis gigantea	redtop	2
Cerastium fontanum	common mouse-ear chickweed	1
Cirsium vulgare	bull thistle	3
Rumex acetosella	common sheep sorrel	2
Sonchus asper	spiny sowthistle	1
Taraxacum officinale	common dandelion	8
Tragopogon dubius	yellow salsify	1

3.5 Vegetation Change Since 1936

We crosswalked 140 subtypes in the 1936 map to 11 of our map units (Appendix G). Except for Mountain Hemlock – Lodgepole Pine -Whitebark Pine Forest, all of our map units in this comparison had very high accuracy (Appendix F). We found that there was relatively little discrepancy in the comparison between the amounts of Mountain Hemlock Forest, Whitebark Pine Woodland, and Subalpine Fir Forest (Table 8). Thus, we posit that the mappable extents of these vegetation types remained relatively consistent between the time the 1936 map was produced and the present. On the other hand, Greenleaf Manzanita – Pinemat Manzanita Shrubland, Lodgepole Pine Forest, and Ponderosa Pine Woodland showed decreases, and Montane Grassland, Subalpine Fell-field, Montane Conifer Forest, Shasta Red Fir Forest, and Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest showed increases in their mapped extents between this same time period. Some of these differences are likely explained by complications with the crosswalk and differences in the methods used to classify and map vegetation types in the 1936 and in our map. We assess the implication of consistencies and discrepancies between the maps in our discussion.

Table 8. Comparison between select vegetation types mapped in 1936 and our map.

Map Unit	1936 ha	2018 ha
2. Montane Grassland	213.8	584.9
5. Subalpine Fell-field	2,025.5	2,793.7
6. Greenleaf Manzanita - Pinemat Manzanita Shrubland	560.3	418.4
12. Ponderosa Pine Woodland	2,480.3	1,659.1
14. Montane Conifer Forest	3097.3	3720.5
15. Shasta Red Fir Forest	19,809.3	20,629.4
16. Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest	338.5	638.3
17. Lodgepole Pine Forest	14,513.2	9,541.9
18. Whitebark Pine Woodland	225.6	298.8
19. Subalpine Fir Forest	1154.2	1,372.2
20. Mountain Hemlock Forest	14,934.4	14,811.9

4. Discussion

4.1 Vegetation Map

Our vegetation map accomplishes our primary objective: to produce a high-quality, standardized map of the vegetation of Crater Lake National Park. In fact, our vegetation map achieves a level of accuracy of 86.2%. However, there are a few caveats when using this map that are discussed below under Accuracy Assessment discussion. First, there were very few accuracy assessment plots for a few rare map units. Second, we could not fully assess the accuracy of one of our map units, Cliff, Scree & Rock Vegetation. Third, there were a few accuracy assessment plots where two vegetation associations occurred. Lastly, wildfires caused the sampling frames to be slightly biased towards the east side of the park. We analyzed each of these influences, and the net effect was likely to be minor.

Our project provides the most detailed study to date of the distribution and diversity of mappable vegetation types in the park (Figure 17). The vegetation map is most useful for showing the spatial arrangement of these vegetation types throughout the park, and thus, the park's ecological complexity. Understanding the ecology of all biota in the terrestrial environment of the park starts with understanding vegetation patterns. As such, our map can provide a basis for illustrating the controls on vegetation, such as elevation, geology, and natural disturbances. Therefore, our vegetation map should provide a broad context for interpreting the vegetation resources and a baseline for future research at Crater Lake National Park.

From our vegetation map, we developed a generalized profile of the park's vegetation as it typically occurs in relation to elevation. This profile covers a hypothetical transect from the relatively moist southwestern side of the park, over the former Mount Mazama, and down the drier northeast slope of the Crater Lake caldera (Figure 18). The profile can serve as a conceptual model for understanding vegetation patterns. However, the actual vegetation along this transect does not have abrupt boundaries and is not necessarily confined to particular elevation zones, as suggested in this conceptual model.

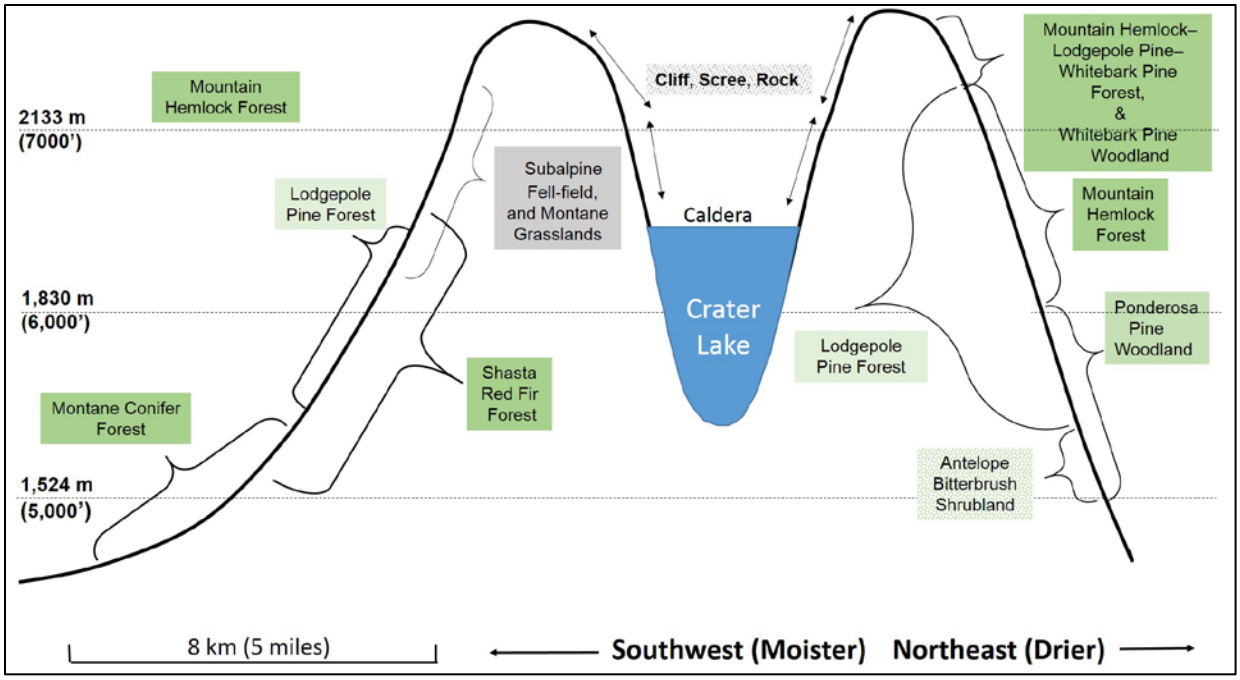


Figure 18. General vegetation profile across Crater Lake National Park from the southwest corner to the northeast corner.

Many vegetation types in the park have distributions that are related not only to elevation, but also localized environmental conditions (Figure 19). These conditions include permanently saturated soils and streamside environments supporting Montane Wet Meadow & Marsh, Western Alder Wet Shrublands, Willow Wet Shrublands, Bog Blueberry Wet Shrublands, Engelmann Spruce Swamp Woodlands, Black Cottonwood Riparian Forests, and Subalpine Fir - Lodgepole Pine Riparian Woodlands, as well as forest openings, droughty or rocky soils or burned areas that may support Quaking Aspen Forests (where soils are moist), Greenleaf Manzanita - Pinemat Manzanita Shrublands, and Lodgepole Pine Forests.

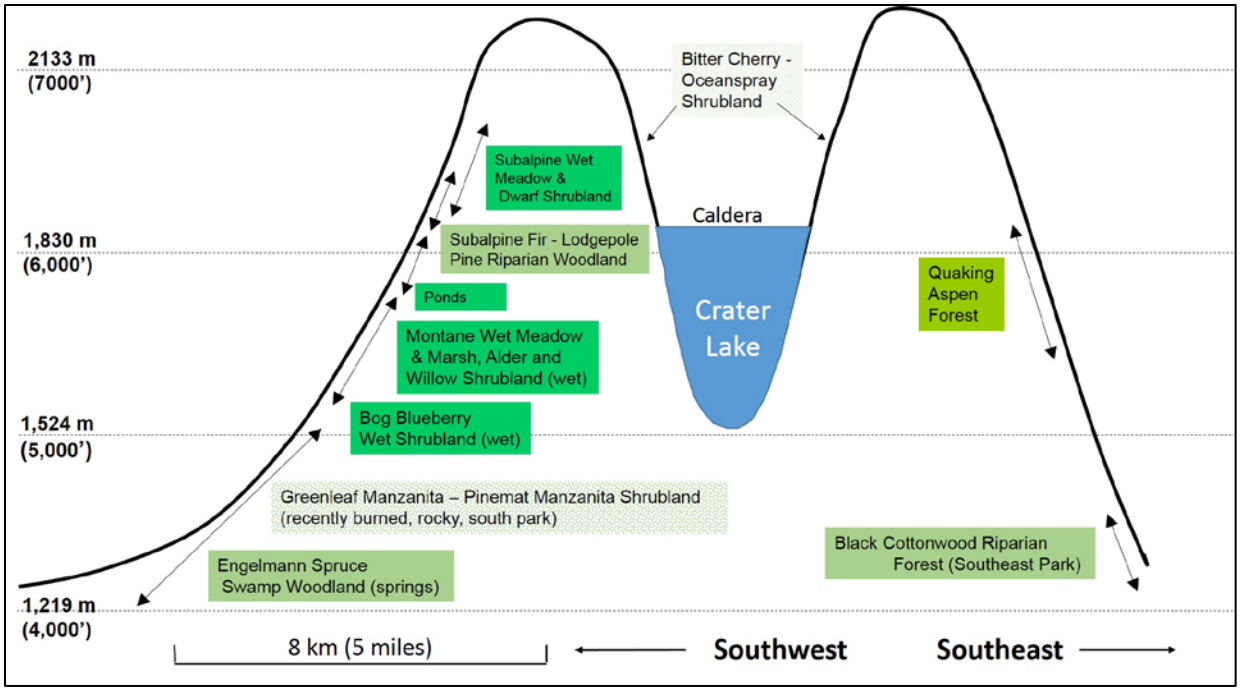


Figure 19. General vegetation profile across Crater Lake National Park from the southwest portion of the park to the southeast portion of the park. Types shown here may be influenced by elevation, but are generally determined by edaphic conditions.

4.2 Vegetation Classification

Our classification is based on the cover of 526 vascular plant taxa in 600 relevé plots. We identified 80 plant associations from these data. We developed a dichotomous key to identify plant associations and additional land cover types in the field. Vegetation associations crosswalk directly to map units. Therefore the dichotomous key identifies our 28 map units, which we mapped with a high level of accuracy. As reflected in the key, the associations overlap considerably in their species composition, but our level of detail was consistent with that of the USNVC.

Our geodatabase contains the locations where particular associations are found at 600 relevé plots, 698 accuracy assessment plots, and 803 validation plots. Along with our map, this provides useful information about patterns in the vegetation and flora of the park. Each point, in conjunction with its corresponding association description (Appendix B), conveys a considerable amount of botanical information present at a location. The classification prepared from the relevé data and the association names and descriptions can function as a lexicon for describing the vegetation and its floristic composition across the park. These point data can be used in modeling studies to extrapolate the occurrence of associations or species in the park.

As with any broad inventory effort, this study would be improved with additional and more targeted sampling. The vegetation data presented in this project may therefore be considered a baseline upon which to build. For example, the map, as well as the point data, could be used to target areas where whitebark pine occurs, which could then be analyzed and mapped in greater detail.

4.3 Accuracy Assessment

Considering the complexity of the vegetation of Crater Lake National Park and the similar appearance of some types of vegetation in the imagery to each other, we achieved excellent accuracy with our mapping (86.2%) (Appendix F). The large number of relevé and validation plots that we sampled helped substantially to identify the vegetation on the ground in the imagery. There were, however, some vegetation types whose accuracy was indeterminable. This occurred where the number of accuracy assessment plots was very small due to the rarity of these vegetation types in our map (Table 6). Due to the small number of accuracy assessment points the distribution of the following map units in the park must be definitively determined through ground-based surveys.

- Pond (7 plots)
- Subalpine Wet Meadow & Dwarf-shrubland (6 plots)
- Black Cottonwood Riparian Forest (6 plots)
- Willow Wet Shrubland (11 plots)

There was one map unit that was common in the map whose map accuracy was very low: the sparsely vegetated or unvegetated Cliff, Scree & Rock Vegetation (9/26 correct or 34.6%); and two types whose accuracy may be considered marginal (60% accuracy): Antelope Bitterbrush (18/30 plots correct, 60%), and Mountain Hemlock – Lodgepole Pine – Whitebark Pine (18/30 plots correct, 60%).

The low accuracy for the Cliff, Scree & Rock Vegetation map unit (only 9/26 plots correct) can be explained by very strong spatial bias in the sampling frame. For safety reasons, the steep areas (> 30% slope) where Cliff, Scree & Rock Vegetation tends to occur, were off limits for accuracy assessment sampling. The Cliff, Scree & Rock Vegetation areas that could be sampled accounted for only 9% of the total area that we mapped as this type. Thus, the accuracy assessment plot locations in this map unit were strongly biased towards areas that were not steep, and therefore not broadly representative.

Another cause for inaccuracy of the Cliff, Scree & Rock Vegetation map unit occurred due to sparseness of vegetation and the need to distinguish Cliff, Scree & Rock Vegetation from other potentially sparse vegetation that occurred where Cliff, Scree & Rock Vegetation also occurred. The cover threshold we used for identifying Cliff, Scree & Rock Vegetation was ≤ 5% cover of vegetation. These areas either had no vegetation, or a sparse cover of Davidson's penstemon *(Penstemon davidsonii*) and/or white pasqueflower (*Pulsatilla occidentalis*). We found it difficult in the imagery to separate these areas from areas with a low vegetation cover of Bitter Cherry – Oceanspray Shrubland, Subalpine Fell-field, and Greenleaf Manzanita – Pinemat Manzanita Shrubland that was dominated by pinemat manzanita (*Arctostaphylos nevadensis*). Out of 17 incorrect Cliff, Scree & Rock Vegetation field calls, these map units accounted for 16 of them. We considered merging all three map units with Cliff, Scree & Rock Vegetation, but these three map units can also have high vegetation cover, far higher than that typically found in Cliff, Scree & Rock

Vegetation. Therefore, combining these map units would make the map unreliable for identifying Bitter Cherry – Oceanspray Shrubland, Subalpine Fell-field, and Greenleaf Manzanita – Pinemat Manzanita Shrubland. Park resource staff recommended against merging any of these map units with Cliff, Scree & Rock Vegetation. The map user must recognize that, for ecological reasons, Cliff, Scree & Rock Vegetation areas that are on slopes > 30% are likely to be, for all practical purposes, non-vegetated. The same is true for all cliff areas that may fall within other map units.

In contrast, for another dangerously unstable substratum, Pumice/Sand, we were able to do an accuracy assessment from nearby vantage points using binoculars. Pumice/Sand is distinctive in the imagery. It occurs where streams have incised into relatively soft pumice. The pumice is distinctly white in the imagery, and these areas are surrounded by dark green forest. For these reasons our map accuracy for Pumice/Sand is very high (34 of 36 plots correct) (Appendix F).

There were 24 cases among accuracy assessment plots where a secondary association identified in the field matched the mapped vegetation type of the polygon. We counted these as correct calls because the secondary association did occupy 30-40 percent of the field plot. It could be argued that these plots should be dropped from the analysis because the primary association did not match the map. Our use of the secondary field call for the accuracy assessment happened most often in Subalpine Fir – Lodgepole Pine Forest (4 plots), and Engelmann Spruce Swamp Woodland (3 plots), but when these plots were dropped, these two types still had reasonably high accuracy (75% and 72% respectively). The effects of secondary field calls in all other cases were negligible.

The 60% accuracy for Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest was the lowest among forest or woodland vegetation map units. Much of the inaccuracy occurred where this woodland was identified in the field as Shasta Red Fir Forest. We believe that the reason for the inaccuracy in this map unit was that whitebark pine can be uncommon and unevenly distributed in the Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest map unit, and the whitebark pines that do occur in these forests are inconspicuous on the imagery. Whitebark pines can be closely mixed with mountain hemlock, and sometimes overtopped by it. Consequently, the distinctive crowns of whitebark pine (see map unit description for Whitebark Pine Woodland, Appendix A) were not as visible in the imagery. Therefore, the mapping had to rely more on sparse tree density and nearby relevé and validation plots than on the visible whitebark pines in the imagery. The Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest map unit would also be more accurate if we increased the threshold of whitebark pine abundance to a cover level higher than 5% and the map unit polygon boundaries had been adjusted to reflect this. However, we defined Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest as having whitebark pine at cover levels as low as 5% because the location of whitebark pines is of great concern to park natural resource staff due to increased mortality caused by an introduced disease (see Natural Resource Concerns).

Another consideration with regard to the accuracy assessment is that our sampling frame was slightly biased towards the east side of the park because of reduced access to the west side of the park during the field season. This occurred because of two large wildfires that burned through large portions of the west side of the park from late July well into October. As a result of these fires, we had to drop some plots on the west side of the park and replace them with plots located predominantly on the east

side of the park. This changed the distribution of our sampling locations so that they were no longer completely random within some map units. The map units most affected by this were Montane Grassland, Montane Wet Meadow & Marsh, Subalpine Fir - Lodgepole Pine Riparian Woodland, Western Alder Wet Shrubland, Shasta Red Fir Forest, Subalpine Fir Forest, and Mountain Hemlock Forest. Without additional accuracy studies, it is impossible to know how the alteration of the accuracy assessment sampling frame due to wildfires may have affected our results. However, we were able to do a large number of plots on the west side of the park before and after being shut out by the fires and the accuracy of our mapped vegetation there was high. Therefore we believe that the effects of the altered sampling frame due to the 2017 fires was likely to be minimal.

An additional fire-related problem that we faced was the occurrence of wildfires after the 2011 date of the NAIP imagery that we used for mapping. In accuracy assessment plots where stand-replacing fires occurred between 2011 and 2016, it was not possible to determine whether the same forest type that had been there before fire was going to regenerate after fire, or whether a different early successional vegetation would develop. Hence, we could not confirm whether the mapping was correct or incorrect. This happened with accuracy assessment points in 4 cases. We dropped these accuracy assessment points.

One option to address issues related to stand-replacing fires that occurred after the 2011 imagery was taken would have been to incorporate the boundaries of the stand-replacing fires into our vegetation map. This would have greatly complicating our map. In addition, the maps of stand-replacing fire that are available through an interagency site have uncertain accuracy. Moreover, incorporating the boundaries of stand-replacing fire into our map would have introduced a great number of sliver polygons. The other option, the one we chose, was to make it absolutely clear to the user of our vegetation map that an overlay of maps of stand-replacing fire since 2011 should be done when using our vegetation map to gain a more accurate picture of the current vegetation conditions in the park.

4.4 Vegetation Change Since 1936

We were able to conduct a crosswalk (Appendix G) and area comparison between our map and a vegetation map of the park produced in 1936 (Anonymous 1936) for 11 of our map units (Table 8). We explain the limitations of this assessment in the methods section. In short, there are projection issues and differences in map production that complicate direct comparisons between the areas of vegetation types. A systematic analysis using more complex and complete overlay procedures and spatial modeling using our plot data would be necessary to provide a better assessment of vegetation change.

4.4.1 Montane Grassland

There was a great deal more area mapped as Montane Grassland in our map than was mapped as grassland subtypes in the 1936 map (584.9 ha vs. 213.8; Table 8). It is very possible that this discrepancy does not reflect a substantial increase in montane grasslands, but rather, differences in mapping. We likely mapped our Montane Grassland map unit at a finer scale than grasslands mapped in the 1936 map. We captured a significant area of grassland vegetation in small and/or narrow polygons with a great deal of inverted edges, whereas the historic map likely included much of this configuration of grassland vegetation with the surrounding forest. In fact, several meadows in the

1936 map were included within forest subtypes, perhaps reflecting a fine scale mosaic of some grasslands within forests. These grasslands included with 1936 forest subtypes were therefore not included in this comparison with our Montane Grassland map unit. It is also likely that our crosswalk missed historic grasslands that were included in the Barren category in the 1936 map. Most of our grassland occurred on edaphically controlled areas on deep, well drained pumice soils. This comparison perhaps indicates that areas of montane grassland that have not been created recently by high severity fire events are relatively stable over time.

4.4.2 Subalpine Fell-field

The discrepancy in area with our Subalpine Fell-field map unit and the subtypes in the 1936 map that crosswalk to it (2,794 vs. 2,026 ha; Table 8) is perhaps explained by similar reasons described above for Montane Grassland, that the discrepancy is the result of the finer scale of our mapping. As with Montane Grassland, it is unlikely there has been a substantial increase in Subalpine Fell-fields as their extent is mostly edaphically controlled. At least some of the acreage mapped as Barren in the 1936 map was mapped as Subalpine Fell-field in our map.

4.4.3 Montane Chaparral

Montane chaparral, the evergreen sclerophyllous shrub vegetation that is comparable to our Greenleaf Manzanita - Pinemat Manzanita Shrubland, occurs at low to moderate, and even some higher, elevations in the park. In the 1936 map, the large majority of this chaparral is greenleaf manzanita and/or snowbrush ceanothus shrubland (Appendix G). Our Greenleaf Manzanita - Pinemat Manzanita Shrubland includes both greenleaf manzanita and snowbrush ceanothus shrublands, mostly growing in historic high severity burn patches, and pinemat manzanita shrubland growing on exposed and rocky outcrops. The inclusion of pinemat manzanita shrublands in our map unit adds a significant amount of area that is not comparable to subtypes included in the 1936 chaparral types. Therefore, the slight reduction in area (418.4 ha vs. 560.3 ha; Table 8) of chaparral from the 1936 map may be greater than that observed in this comparison. However, several subtypes described in the 1936 map as greenleaf manzanita and/or snowbrush ceanothus shrubland included bitter cherry (*Prunus emarginata*) as a component species. Some of these subtypes may crosswalk better to our Bitter Cherry – Oceanspray Shrubland map unit and including them in this comparison may inflate the area of the 1936 map described as chaparral. However, these subtypes that include bitter cherry always list snowbrush ceanothus or greenleaf manzanita as the primary species. As a result, these stands would most likely be mapped as the Greenleaf Manzanita - Pinemat Manzanita Shrubland map unit in our map. Therefore, this error in the crosswalk should be minimal.

Nonetheless, the reduction in area of this vegetation type observed in this comparison, however modest, is consistent with the effects of fire suppression. Both greenleaf manzanita and snowbrush ceanothus resprout following fire, with greenleaf manzanita resprouting from underground burls while ceanothus is a weak resprouter. These shrubs also rely on fire for recruitment of new individuals. Both shrubs abundantly germinate from a dormant seedbank following wildfires. Forrestel et al. (2017) presented evidence for pre-fire suppression mixed severity fires that may have opened space for these shade intolerant species. Several large patches of Greenleaf Manzanita -

Pinemat Manzanita Shrubland dominated by greenleaf manzanita occur in recently burned areas in our map as well.

4.4.4 Ponderosa Pine Woodland

Ponderosa pine subtypes in the 1936 map crosswalked well to our Ponderosa Pine Woodland map unit. There was a decrease (821.2 ha) in area of Ponderosa Pine Woodland in our map when compared to the area of ponderosa pine forest in the 1936 map (Table 8). Most of this reduction in area is accounted for by an increase in Sierra white fir trees in areas mapped in the 1936 map as relatively pure stands of ponderosa pine. The Sierra White Fir - Ponderosa Pine / Long-Stolon Sedge Forest association and other similar mixed conifer forest associations, mapped as the Montane Conifer Forest map unit in our map, now occupies these areas. This shift in species composition occurred in the central portion of the Panhandle west of Annie Creek and in a smaller stand in the lower Sun Creek Valley to the east on the southern boundary. However, the largest area this occurred was in the northeast portion of the park on the lower slopes on the east side of Timber Crater. Ponderosa pine woodlands remain common in both the 1936 map and our map on the flatter terrain east and southeast of Timber Crater and on the slopes above lower Sand Creek.

4.4.5 Montane Conifer Forest

Montane Conifer Forest has increased (623.2 ha) in area between the time of mapping the 1936 map and our map. As stated above, the 1936 map mapped stands of pure ponderosa pine forest in the central portion of the panhandle west of Annie Creek and a smaller stand in the lower Sun Creek Valley to the east on the southern boundary. These stands mapped in 1936 as pure ponderosa pine forest clearly contained more Sierra white fir today than they did historically and currently occur as mixed stands of Sierra white fir and ponderosa pine with sugar pine in some areas. This change from Ponderosa Pine Woodland to Montane Conifer Forest accounts for at least a small amount of the increase in Montane Conifer Forest. A large increase in Montane Conifer Forest also occurred in historic stands on ponderosa pine woodland in the northeast part of the park.

The Panhandle to the south and north of the mapped pure ponderosa pine stand, the entire east side of the panhandle and much of the lower Sun Creek valley between Annie Creek and Sun Creek was mapped in the 1936 map as a ponderosa pine – white fir forest and other mixed pine and fir subtypes. We crosswalked these subtypes to our Montane Conifer Forest map unit and we mapped most of this same area as Montane Conifer Forest. It is likely that there has been an increase in Sierra white fir abundance in the areas historically mapped as mixed ponderosa pine – white fir forest and similar subtypes and Sierra white fir may have overtaken ponderosa pine as the most abundant tree species in some of these stands. Precisely to what degree and where this has taken place would be difficult to ascertain from the data we had available. The 1936 report accompanying the map describes this area of the lower Sun Creek valley as ponderosa pine “[c]losely associated with white fir, a mixed type occupies the lower Sun Creek Valley west[sic] of Annie Creek.” (Anonymous 1936). In addition, a photo plot and accompanying description collected for the 1936 mapping from this same area and just east of Annie Creek describes the location as a dense stand of ponderosa pine and white fir.

This presumed increase in the dominance of Sierra white fir in these locations is likely due to the combination of recruitment of Sierra white fir trees and the removal and mortality of ponderosa pine

trees. Ponderosa pine mortality has occurred there due to past logging (Figure 12), and more recently in association with prescribed burning (Perrakis et al. 2011). However, it is also apparent from the historic map and report that the forests in portions of the panhandle west of Annie Creek, on the east side of the panhandle east of Annie Creek, and in the lower Sun Creek valley near the southern boundary were historically mixed stands of ponderosa pine and white fir.

4.4.6 Shasta Red Fir Forest

There was slightly more (820.1 ha) Shasta Red Fir Forest in our map than in the 1936 map (Table 8). At the same time, there has been a substantial decrease (4971.3 ha) in the area of Lodgepole Pine Forest when compared to the 1936 map (Table 8). When visually comparing in ArcGIS the mapped extents of Shasta Red Fir Forests in our map and Sierra lodgepole pine dominated subtypes in the 1936 map, it appears Shasta Red Fir Forest has increased in some areas formerly occupied by relatively pure stands of Sierra lodgepole pine. Sierra lodgepole pine are shade intolerant and are favored by stand-replacing fires. In the absence of fire, they appear to be prone to changes in species composition through the recruitment of Shasta red fir (Forrestel et al. 2017). Forrestel et al. (2017) describe the occurrence of young Shasta red fir as characteristic of the understory of Sierra lodgepole pine forests in the central west side of the park. However, they also suggest that type conversion from Sierra lodgepole pine forests to Shasta red fir forests might take centuries. Thus, Shasta Red Fir Forest may be increasing in the absence of fire, but the effects are not apparent in this map comparison.

4.4.7 Lodgepole Pine Forest

Overall, there is a much larger amount of Lodgepole Pine Forest in the 1936 map compared to our map. There were 14,513 ha of lodgepole pine forest in the 1936 map and 9,542 ha in ours, a difference of 4,971.3 ha (Table 8). We had high accuracy in our mapping of Lodgepole Pine Forests. There appears to have been a decrease in relatively pure stands of Sierra lodgepole pine forest in areas where we mapped Shasta Red Fir Forest and where we mapped a complex of Mountain Hemlock Forest and Lodgepole Pine Forest.

Consistent with a reduction in Lodgepole Pine Forest, Forrestel et al. (2017) found that young Shasta red fir were common in Sierra lodgepole pine stands on the central west side of the park. This may indicate succession to Shasta Red Fir Forest in the absence of fire. Sierra lodgepole pine is well adapted to proliferate following stand replacement fire events. However, the slight increase in Shasta Red Fir Forest does not account for the substantial decrease in Lodgepole Pine Forest. It is likely that at least some of the area mapped as Sierra lodgepole pine forests in the 1936 map was mapped as vegetation types in our map that did not crosswalk to the historic Sierra lodgepole pine forest. Sierra lodgepole pine forests are also prone to widespread morality due to bark beetle outbreaks. As of 1936, bark beetles were observed to have left many stands at Crater Lake National Park with about 50 % mortality (Anonymous 1936).

4.4.8 Mountain Hemlock - Lodgepole Pine - Whitebark Pine Forest

Given the park's concern about the loss of whitebark pine to blister rust and mountain pine beetles, our mapping of Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest included areas where the cover of whitebark pine was as low as 5%. We mapped much more of this mixed forest type in

our map than was mapped in 1936 map (638.3 ha vs. 338.5 ha). Whitebark pine, as well as other high elevation trees are so slow growing and therefore we suspect that this discrepancy may not reflect increases in whitebark pine, but rather our map accuracy and differences in mapping. Our mapping of Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest was only 60% accurate. When we mapped this vegetation type, we included areas that showed sparse tree density in the imagery with nearby relevé and validation plots classified to the Mountain Hemlock - Sierra Lodgepole Pine - Whitebark Pine Forest association but that possibly had no whitebark pine trees present on the ground. In sum, whitebark pine is probably not becoming more common in mixed high elevation forests, especially considering the findings from the park's and the Klamath Network's monitoring that found that whitebark pines may be dying at a rate of 1% per year due to blister rust (Murray 2010).

4.4.9 Whitebark Pine Woodland

The stability of whitebark pine is of particular interest to the park because this typically high elevation tree is declining over most of its range. It is considered a keystone species, a species that other species in an ecosystem largely depend upon, such that if it were removed the ecosystem would change drastically. Our map had as much Whitebark Pine Woodland as the 1936 map (298.8 ha vs. 225.6 ha, Table 8). Moreover, our mapping of Whitebark Pine Woodland was 91% accurate (Appendix F) and crosswalked well (Appendix G) to the 1936 map. However, our mapping did not assess recent whitebark pine mortality and included areas of high mortality in the areas mapped as Whitebark Pine Woodland. Thus, the overall extent of where whitebark pine woodland grows has remained relatively consistent, though population changes of whitebark pine in these stands are indeterminable through this comparison.

4.4.10 Subalpine Fir Forest

There was only a small discrepancy in area that was mapped as Subalpine Fir Forest in 1936 and what was mapped in our map (1154.2 ha vs. 1,372.2 ha).

4.4.11 Mountain Hemlock Forest

The area of Mountain Hemlock Forest remained consistent between the time of mapping of the 1936 and our map (14,811.9 ha vs. 14934.4 ha).

4.4.12 Summary of Vegetation Change

Overall, there appears to have been an expansion of shade tolerant firs since 1936. The vegetation types most affected by this change appear to be Sierra lodgepole pine forests and ponderosa pine woodlands. Relatively pure stands of Ponderosa Pine Woodland have decreased in the southern and northeastern parts of the park. An increase in Sierra white fir abundance in these areas has shifted the species composition of these forest stands towards mixed pine and fir conifer forests. The extent of Lodgepole Pine Forest has decreased significantly. Montane chaparral is rare in the park, and is probably slightly more so now than in 1936. An increase in shade tolerant firs in areas dominated by shade intolerant conifers and the reduction of montane chaparral is consistent with the expected effects of fire suppression.

4.5 Natural Resource Concerns

4.5.1 Fire

There is widespread concern that the occurrence of fires and fire severity will increase in the future, and large portions of the west side of the park have experienced fires of varying intensity in recent years. Specific changes to fire regimes that may be ongoing or that occur in the future are difficult to predict. A recent analysis projects a near doubling by 2080 of the mean annual area burned in Washington (Littell et al. 2010). A similar prediction might be made for the central Oregon Cascades where Crater Lake National Park occurs. There are several factors that may affect the estimate by Littell et al. (2010). For example, this estimate may be complicated by the effects of the Pacific Decadal Oscillation. This climate driver of fire oscillates over periods of about 30-40 years. It is currently in the warm phase, which may be fostering current high levels of fire in parts of the western U.S. (Heyerdahl et al. 2008, Morgan et al. 2008).

Precipitation patterns (e.g. the amount received as snow vs. rain, the timing of snowmelt, etc.) will influence future fires and the length of the fire season. Precipitation monitoring have found that precipitation has increased by about 5-10% in most of the Pacific Northwest (https://nca2014.globalchange.gov/report/our-changing-climate/precipitation-change#graphic-16688). It is projected to increase slightly in coming decades (https://www.fws.gov/pacific/climatechange/changepnw.html). In addition, in dry fuels, wind speed is the most important factor in determining fire behavior (Cruz et al. 2004, Cruz and Alexander 2010). Recent research indicates that with climate change, the wind speed probability distribution may be shifting towards slower winds, particularly in mid-latitudes (Pryor and Barthelmie 2010, Pryor and Ledolter 2010). Lastly, fire managers inside and outside the park are implementing fuel treatments aimed at mitigating fire effects, and it is also possible that the park will increase its capacity to suppress fires. All of these factors could mitigate future fire.

Were a doubling of fire to occur by 2080, this would not return amounts of fire to estimated historical levels, but it would reverse many of the changes caused by fire suppression. This would include increasing species of the main vegetation types that are promoted by higher-severity fire. These include Lodgepole Pine Forest and Greenleaf Manzanita – Pinemat Manzanita Shrubland. The extent of these vegetation types appears to have declined since 1936 while shade tolerant species appear to have increased. A better understanding of historic conditions and how forest conditions have changed could be achieved by systematic comparisons between our mapping, the 1936 map, as well as historical photos. Our observations of contemporary imagery demonstrated to us the dynamics of Crater Lake National Park vegetation. There are historic burn scars over much of the landscape, creating a diversity of patch age classes and successional diversity. Similar effects have been initiated in portions of the park by recent fires. A key question that remains concerns the effects of climate change on future wildfires.

4.5.2 Climate Change

As with ecosystems throughout the earth, the vegetation changes and ecosystem trajectories in relation to warming climate at Crater Lake National Park cannot be predicted with a high degree of confidence. Some of these predicted effects are summarized by Adamus et al. (2013). The effects

will likely differ as a function of elevation and vegetation type. It is widely anticipated that warmer conditions will result in the movement of species to higher elevations, and that plants occurring at a particular elevation now will experience increasing stress from higher temperatures. There may be exceptions to this. For example, trees at higher elevation may grow better because of more favorable temperatures for plant growth (Bunn et al. 2005). At lower elevations, trees may experience more drought stress due to increased temperatures, but that may be offset to some degree by increased precipitation as both temperatures and precipitation have been increasing (https://www.epa.gov/climate-indicators/climate-change-indicators-us-and-global-precipitation (viewed on October 24, 2017). According to Crimmins et al. (2011), changes in water balance will drive downhill shifts in plant species' optimum elevations. All things being equal, fire would be expected to increase with warmer temperatures, but there is also conflicting information regarding the effects of climate change on fire. Research has found that fire extent and severity have increased in the western U.S.A., except the northern Rockies (Littell et al. 2010, Westerling 2016). Others have found that it has not changed (Baker 2015, Doerr and Santin 2016, Parks et al. 2016), except in the Southwest U.S.A. (Dillon et al. 2011). Therefore, future trajectories are difficult to predict from incipient trends. A further complication is that any ongoing trends that may be due to climate change are confounded by the effects of fire suppression and other management.

4.5.3 Non-native Invasive Species

The Crater Lake National Park Natural Resource Condition Assessment (Adamus et al. 2013) identifies non-native invasive species as a major management concern. Our relevé sampling contains information about the presence and absence of non-native invasive species encountered at 600 locations. It also documents that none of the most common species in 698 accuracy assessment plots, and 803 validation points were non-native invasive species. All of these locations are away from the edge of a road or trail. Roads and trails are often vectors for the introduction of non-native invasive species and the park has an active program of monitoring roads and trail in the park for these introductions. Thus, it is significant that we found only 7 non-native species and relatively few occurrences in our relevés (Table 7).

Of the 7 non-native species in our relevé plots, only redtop (*Agrostis gigantea*) and yellow salsify (*Tragopogon dubius*) were listed in the Klamath Network Invasive Species Protocol as invasive species of greatest concern to the park (Table 9). They were ranked relatively low among these invasive species. On the other hand, the occurrence of bull thistle (*Cirsium vulgare*) in the park is noteworthy. It was not placed on the network protocol list of non-native plant species of greatest concern that was developed in 2010 because it was not thought to grow at high enough elevations to be in the park. However, it has since been found in the park. Bull thistle is similar to Canada thistle (*Cirsium arvense*), which has been identified as an invasive of great concern to the park. Both of these species readily invade burned forests, particularly where fire severity is high. Their seeds are wind-dispersed and existing populations can serve as a source of "propagule pressure." The finding of bull thistle at three relevé locations in the park is therefore cause for concern. Efforts to prevent the further spread of this species in the park should, if possible, include surveying the areas surrounding our relevés where bull thistle was found.

Table 9. Non-native invasive plants of greatest concern at Crater Lake National Park (updated from Odion et al. 2010, and Adamus et al. 2013). The species in this list are not well established, but are of concern because of their capacity to transform ecosystems.

Scientific Name	Common Name	Invasion Phase
Agrostis gigantea	redtop	Establishment
Brassica rapa	field mustard	Colonization
Bromus inermis	smooth brome	Establishment
Bromus tectorum	cheatgrass	Establishment
Centaurea diffusa	diffuse knapweed	Colonization
Centaurea maculata	spotted knapweed	Colonization
Centaurea solstitialis	yellow star-thistle	Colonization
Cirsium arvense	Canada thistle	Establishment
Cirsium vulgare	bull thistle	Colonization
Cytisus scoparius	Scotch broom	Colonization
Dactylis glomerata	orchardgrass	Establishment
Festuca arundinacea	tall fescue	Establishment
Holcus lanatus	velvetgrass	Colonization
Hypochaeris radicata	hairy cat's ear	Establishment
Lactuca serriola	prickly lettuce	Establishment
Leucanthemum vulgare	oxeye daisy	Colonization
Linaria genistifolia	broomleaf toadflax	Colonization
Melilotus albus	white sweetclover	Colonization
Melilotus officinalis	sweetclover	Colonization
Poa bulbosa	bulbous bluegrass	Colonization
Senecio sylvaticus	woodland ragwort	Colonization
Tragopogon dubius	yellow salsify	Establishment

The outstanding non-native species of concern at Crater Lake National Park is the blister rust fungus (*Cronartium ribicola*). It is one of two main factors impacting the condition of the park's whitebark pine (*Pinus albicaulis*) trees. This was also identified as a top management concern by park staff in the Natural Resource Condition Assessment (Adamus et al. 2013). The rust has been in the park for many decades, but has become a greater concern in recent years as the picturesque whitebark pines on the Crater Lake caldera rim have begun to die in greater numbers. Park staff began formal monitoring of the blister rust in 1999 (Murray 2010, Murray and Rasmussen 2003). At monitoring plots, Murray (2010) estimated that pines were dying at a rate of 1% per year. Smith et al. (2011) reported that about 25% of trees in 20 monitoring plots had blister rust cankers. In addition, the Klamath Network has initial monitoring results (Smith 2017) that show of the 159 live whitebark pine trees assessed, 21 had signs of infection. There were six recently dead whitebark pine trees in 2016, and two had inactive blister rust infections in 2013. We did not attempt to assess or document the occurrence of blister rust fungus in any of our plots.

Our vegetation mapping inventory does contain useful information about blister rust for managers, however. We documented 48 plot locations where Whitebark Pine Woodland and another 51 plot locations where Mountain Hemlock – Lodgepole Pine - Whitebark Pine Forest occurred. The percent cover of whitebark pine was estimated at these locations. Moreover, we made a special effort to map vegetation containing whitebark pine with more precision than for any other vegetation (see methods). As a consequence, our mapping of Whitebark Pine Woodland was 100% accurate. Unfortunately, our mapping of the other vegetation containing whitebark pine, the Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest map unit, was only 60% accurate. We believe that the reason for the inaccuracy is that whitebark pine can occur at low cover (as low as 5%) in the Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest map unit and polygons mapped as this map unit included areas where whitebark pine was present with less than 5% cover or was absent. We mapped Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest this way to indicate to park natural resource staff all areas where whitebark pine appeared to be present, even if in spots it occurred in very low numbers.

4.5.4 Wildlife Habitat

Although this study did not emphasize sampling of specific wildlife habitat or structural parameters, the delineation of 25 vegetation types (map units) should aid in analyses of broad patterns in wildlife habitat, and provide data for use in wildlife inventory and monitoring. This should help with the management of numerous species (see Introduction). This project should also help inform modeling and mapping efforts for analyzing wildlife habitat and use. At a minimum, the data presented herein should crosswalk to National Gap Analysis Program analysis efforts for focal species (Davis et al. 1998) and the Atlas of Oregon Wildlife (Csuti et al. 2001).

4.5.5 Natural Resource Interpretation

This study will also serve as a valuable resource for individuals wanting to quickly gain a comprehensive introduction to the vegetation of the park and surrounding vicinity. It provides an in-depth resource for interpretive staff to develop communication programs that describe the complex spatial patterns of vegetation and flora in the park. The descriptions of individual vegetation associations (Appendix B) and map units (Appendix A) should be helpful for interpretive staff to summarize information on particular vegetation types of interest. The key to the associations (Appendix C) also provides a valuable tool to communicate effectively about the diversity of the park's vegetation. The map is a useful visual tool illustrating these vegetation patterns. We also used the map to prepare generalized profiles of the park, which are simplified visual summaries of the vegetation patterns (Figures 18 and 19). Floristic data contained in the association descriptions can be used in conjunction with the vegetation map and the vegetation/elevation profiles, as well as the Flora of Crater Lake National Park (Zika 2003) for descriptions of the park's vegetation and flora. The map can also be customized in a wide variety of ways, depending on the user's needs.

Printed copies of the vegetation map to keep with the Flora of Crater Lake National Park would provide a useful and efficient reference. The map and accompanying data could also be accessed on smart phones and tablet PCs in the field where phone service is available.

4.5.6 Research Opportunities

The vegetation map and database provide opportunities for research on vegetation-environment relations. The spatial data can be overlaid with the recent geology mapping (see Figure 9 and Bacon 2008: https://pubs.usgs.gov/sim/2832/) to provide an additional environmental descriptor for each plot location. Ordination techniques relating our plot data to this and other environmental data could then be applied to pursue vegetation-environment relations. Overlay analyses between geology layers and our vegetation map could also elucidate patterns between substrata and plant growth. Complex relationships between environmental data and the mapped vegetation could be examined to yield important information about vegetation composition, structure, and function and how these elements are affected by elevation, soil, slope, aspect, and disturbance. Our map and plot data could be overlaid with historic geographic data that exists from within the park, such as a range map of five-needle pine species produced for a blister rust control program in the 1930's or the vegetation type survey from 1936 mentioned in this report, to observe vegetation change in the park. In addition, species richness data could be analyzed for patterns related to vegetation association, elevation, disturbance, and other variables. The map data are also useful for wildlife habitat modeling, fire modeling, as a guide for rare plant surveys, wildlife habitat structural analyses, and for inventorying areas that likely contain non-native invasive species.

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(Note: some references are from the appendices that follow this bibliography)

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Appendix A. Map Unit Descriptions, Photo-Interpretation, Mapping Conventions and Visual Key

This appendix describes the vegetation classes mapped for the Crater Lake Vegetation Inventory (Classification and Mapping) Project. We defined these classes mainly by vegetation structure that we detected on the imagery, unlike the vegetation associations, which were defined by vegetation species composition. This report has a key to the vegetation associations in Appendix B. Here, for each mapped vegetation class, we provide:

- A brief description of the vegetation, including the U.S. National Vegetation Classification (USNVC) associations that characterize each vegetation class (if published by NatureServe or others), and the associations we classified that characterize the vegetation class;
- The cumulative aerial extent of each vegetation type we mapped;
- A range map for each mapped vegetation class;
- An image illustrating the photo-signature for the vegetation class, followed by a description of mapping considerations;
- A representative ground photograph/image for each map unit.

The vegetation classes mapped were those we could see on the digital aerial photos (NAIP 2011 imagery) as informed by 600 relevé plots and 803 validation plots.

The vegetation described in this section reflects the classification explicitly designed for this project. For more information on the development of the mapping scheme for Crater Lake National Park, please reference the Digital Imagery and Interpretation subsection of the Methods section of this report and the digital information (i.e., lookup tables, metadata) included with the project deliverables.

The descriptions provided below follow the physiognomic grouping of each map unit starting with herbaceous classes and then moving to shrub and woodland classes.

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I. Pond & Aquatic Herbaceous Vegetation

1. Pond

Map Unit Classification Common Name (NWI): Palustrine System
Map Unit Code: P

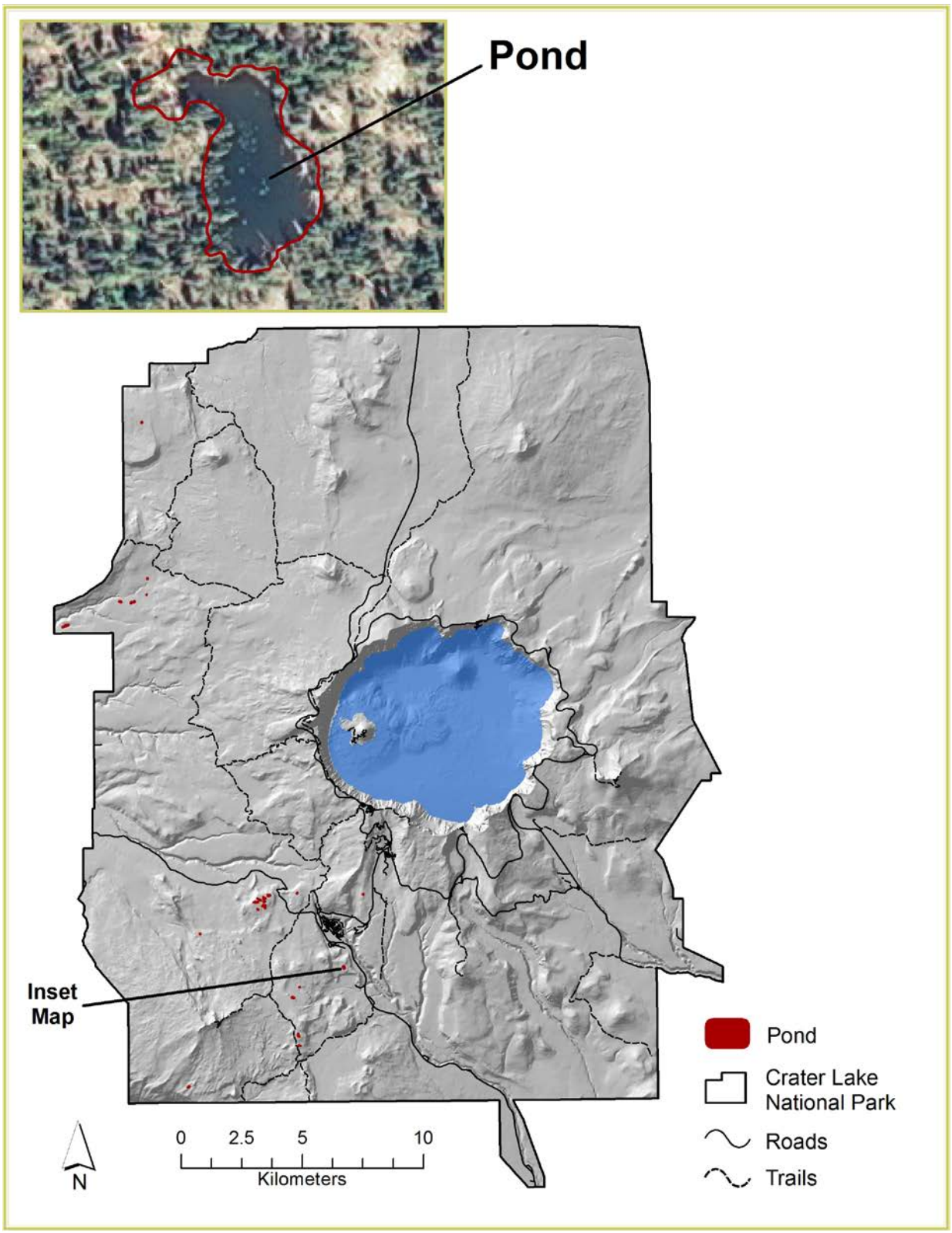
Associations that may dominate the map unit:

Common Name	Scientific Name
Rocky Mountain Pond-lily Aquatic Vegetation	*Nuphar polysepala* Aquatic Vegetation

Total Hectares: 10.2
Percentage of Crater Lake National Park: 0.01
Elevation (m): 1445 - 2030

Description: Ponds occur in shallow depressions that lack an outlet and have little or no drainage. These depressions can occur on flat ridgetops on bedrock with poor drainage where the ponds are filled from annual snowmelt. Ponds also occur as part of larger wetland complexes in depressions that are at or near the water table. Ponds are often ringed by emergent wetland vegetation dominated by sedge (*Carex*) species. Rocky Mountain pond-lily (*Nuphar lutea* ssp. *polysepala*) grows in some shallow ponds in Crater Lake National Park. It is a strongly dominant species and characteristic of the Rocky Mountain Pond-lily Aquatic Vegetation association. Rocky Mountain pond-lily may occupy much of the surface of a pond, or it can be relatively sparse. The cover of pond-lily, including submerged parts, may be as high as 50-75%. Other aquatic vascular plants occurring in Rocky Mountain Pond-lily Aquatic Vegetation have much lower cover. These may include spiny-spore quillwort (*Isoetes tenella*), variableleaf pondweed (*Potamogeton gramineus*), small floating mannagrass (*Glyceria borealis*), water knotweed (*Polygonum amphibium*), common bladderwort (*Utricularia macrorhiza*), and small bur-reed (*Sparganium natans*). Other wetland associated plants that may occur in ponds include common spikerush (*Eleocharis palustris*), Northwest Territory sedge (*Carex utriculata*), lakeshore sedge (*Carex lenticularis*), water sedge (*Carex aquatilis* var. *aquatilis*), as well as the non-vascular plant antifever fontinalis moss (*Fontinalis antipyretica*). Rarely, variableleaf pondweed may supplant Rocky Mountain pond-lily as the most common species in a particular pond. Water treatment ponds were included in this map unit.

Range and Distribution: Ponds are scattered on the west side of the park at all elevations in relatively level areas, particularly near large wetland complexes and at or near the Cascade crest south of Crater Lake.



Above: Photo signature and range map for Ponds at Crater Lake National Park.

Photo Signature and Mapping Considerations: In both true color and color infrared imagery, ponds are quite dark and lack any texture. Ponds in which Rocky Mountain Pond-lily Aquatic Vegetation occur were easily distinguished in the images by the floating vegetation visible in the ponds. The outlines or high water lines of the depressions containing ponds were sometimes discernible in lidar imagery. The 2011 NAIP imagery was taken in early July just following the peak of the annual snowmelt. Not all depressions identified in the imagery as ponds remain inundated throughout the summer months. As standing water evaporates, these depressions instead support other vegetation such as sedge meadows. The water treatment ponds were mapped based on their known location and the visible area of water and adjacent infastructure.

Representative Ground Photo:



Above: Pond at Crater Lake National Park containing Rocky Mountain Pond-lily Aquatic Vegetation. Floating leaves are Rocky Mountain pond-lily (*Nuphar lutea* ssp*. polysepala*). This pond is named Quillwort Pond and has a relatively sparse cover of Rocky Mountain pond-lily. In some ponds aquatic vegetation is quite dense or completely absent.

II. Herbaceous Vegetation

2. Montane Grassland

Map Unit Classification Colloquial Name (USNVC): Cascadian Subalpine - Montane Grassland
Map Unit Classification Common Name (USNVC): Long-stolon sedge – Western Needlegrass – California Brome Grassland Alliance
USNVC Map Unit Code: A4254

Associations that may dominate the map unit:

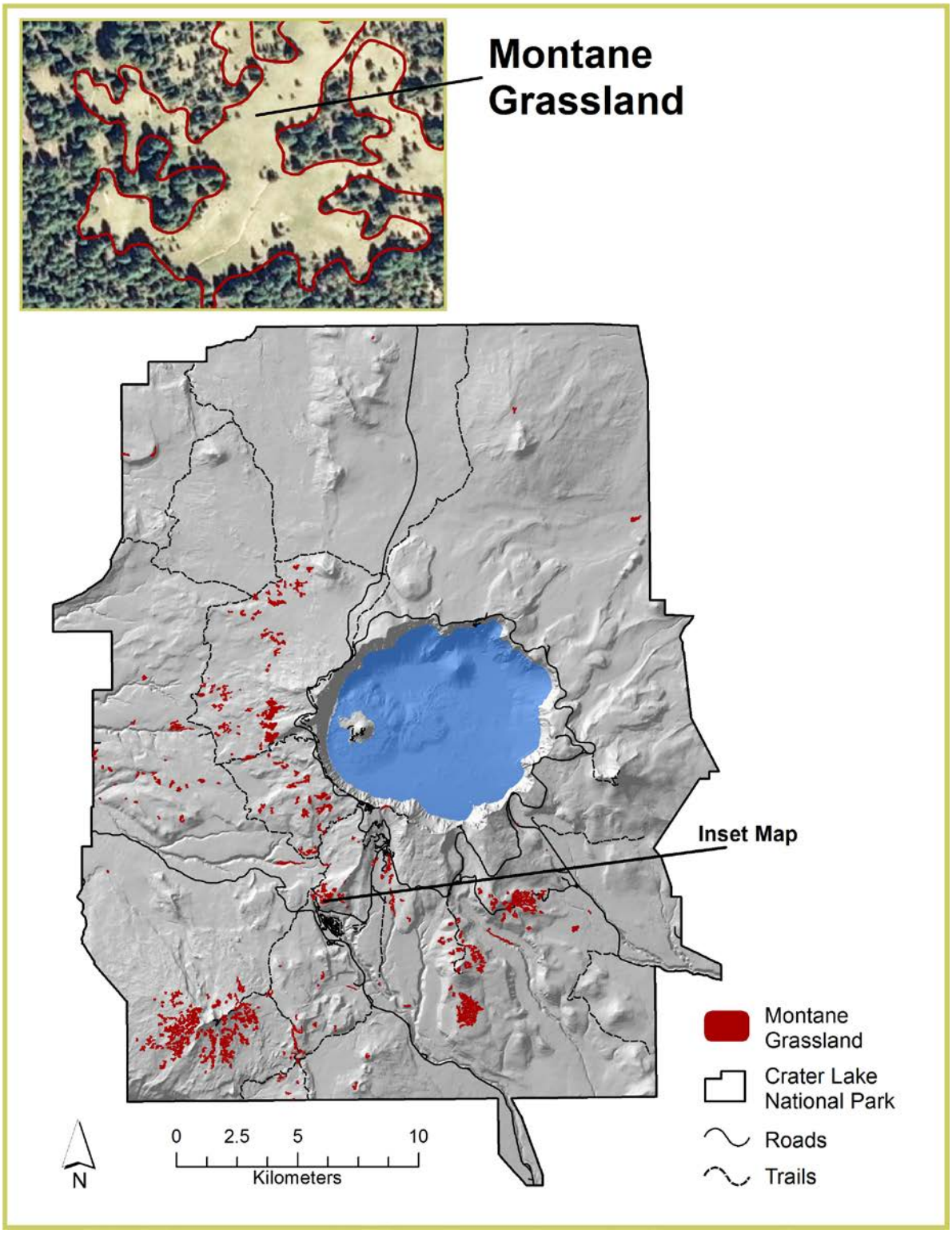
Common Name	Scientific Name
Columbia Needlegrass – Western Coneflower Grassland [Provisional]	*Achnatherum nelsonii – Rudbeckia occidentalis* Grassland [Provisional]
California Needlegrass - Anderson's Lupine Grassland	*Achnatherum occidentale* ssp. *californicum – Lupinus andersonii* Grassland
Long-stolon Sedge - Western Needlegrass Grassland	*Carex inops* ssp. *inops – Achnatherum occidentale* Grassland
Long-stolon Sedge - Rydberg's Penstemon Grassland	*Carex inops* ssp. *inops – Penstemon rydbergii* Grassland

Total Hectares: 592.2
Percentage of Crater Lake National Park: 0.8
Elevation (m): 1473 - 2232

Description: Montane Grassland is a low, relatively open, herbaceous graminoid vegetation often dominated by long-stolon sedge (*Carex inops* ssp. *inops*) and western needlegrass (*Achnatherum occidentale*). These species are characteristic of the Long-stolon Sedge - Rydberg's Penstemon Grassland association, the Long-stolon Sedge - Western Needlegrass Grassland association, and the California Needlegrass - Anderson's Lupine Grassland association. Long-stolon sedge and western needlegrass typically occupy 5-25 percent cover when Montane Grassland is dominated by these associations. In addition, Hall's sedge (*Carex halliana*) is common in Montane Grassland. Montane Grassland also occurs on the periphery of herbaceous wet meadow vegetation. In this case, the vegetation is often dominated by a mix of graminoid needlegrass (*Achnatherum nelsonii*) and the non-graminoid species western coneflower (*Rudbeckia occidentalis*). At sites previously disturbed by cattle grazing, the graminoid Kentucky bluegrass (*Poa pratensis*) may also occur and may be dominant (25% cover) in Montane Grassland.

Range and Distribution: Montane Grassland is scattered at mid-to upper elevations throughout the southern and western parts of the park. It is abundant on all slopes around Union Peak at the far southwestern corner of the park as well as on the south and northeast slopes of Crater Peak. Montane Grassland occurs on areas of deep, well drained soil and on areas of deep, very rapidly drained pumice deposited by the Mt. Mazama eruption. In some cases, Montane Grassland is post-fire openings that may eventually succeed to forest. At upper elevations, Montane Grassland is

sometimes scattered between clumps or lines of trees that are either growing on wind protected or rocky sites.



Above: Photo signature and range map for Montane Grassland at Crater Lake National Park.

Photo Signature and Mapping Considerations: Montane Grassland was clearly distinguishable from the surrounding forest in the lidar highest hit imagery. In the color imagery, Montane Grassland most resembles Subalpine Fell-field. The two were distinguished in part based on elevation: Montane Grassland occurs at slightly lower elevations than Subalpine Fell-field, which mainly occurs on or near the rim of the Crater Lake caldera. Montane Grassland was also be distinguished from Subalpine Fell-field due its subtle light greenish or tawny hue in the true color imagery. Subalpine Fell-field is lighter in color and often appears nearly white. In addition to the subtle differences between Montane Grassland and Subalpine Fell-field in the color imagery, relevé and validation plot data as well as knowledge acquired through fieldwork were helpful in separating Montane Grassland from Subalpine Fell-field.

Representative Ground Photo:



Above: Montane Grassland at Crater Lake National Park. Shown here is the Long-stolon Sedge – Western Needlegrass Grassland.

3. Montane Wet Meadow & Marsh

Map Unit Classification Colloquial Name (USNVC): Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh

Map Unit Classification Common Name (USNVC): Sedge species - Reedgrass species Montane Wet Meadow & Marsh Group

USNVC Map Unit Code: G521

Associations that may dominate the map unit:

Common Name	Scientific Name
Northwest Territory Sedge Wet Meadow	*Carex utriculata* Wet Meadow
Tufted Hairgrass Wet Meadow	*Deschampsia cespitosa* Wet Meadow
Water Sedge Wet Meadow	*Carex aquatilis* Wet Meadow
Lakeshore Sedge Wet Meadow	*Carex lenticularis* Wet Meadow
Woodrush Sedge Wet Meadow	*Carex luzulina Wet Meadow*
Mountain Sedge Wet Meadow	*Carex scopulorum* Wet Meadow
Few-flower Spikerush Fen	*Eleocharis quinqueflora* Fen
Panicled Bulrush Marsh	*Scirpus microcarpus* Marsh
Arrowleaf Ragwort Wet Meadow	*Senecio triangularis* Wet Meadow
Western Bluejoint Wet Meadow	*Calamagrostis canadensis* Western Wet Meadow
Bigleaf Lupine - Common Cowparsnip Meadow [Provisional]	*Lupinus polyphyllus - Heracleum maximum* Meadow [Provisional]
Shasta Sedge Grassland	*Carex straminiformis* Grassland
Mud Sedge Fen	*Carex limosa* Fen
Sitka Sedge Fen	*Carex aquatilis* var. *dives* Fen

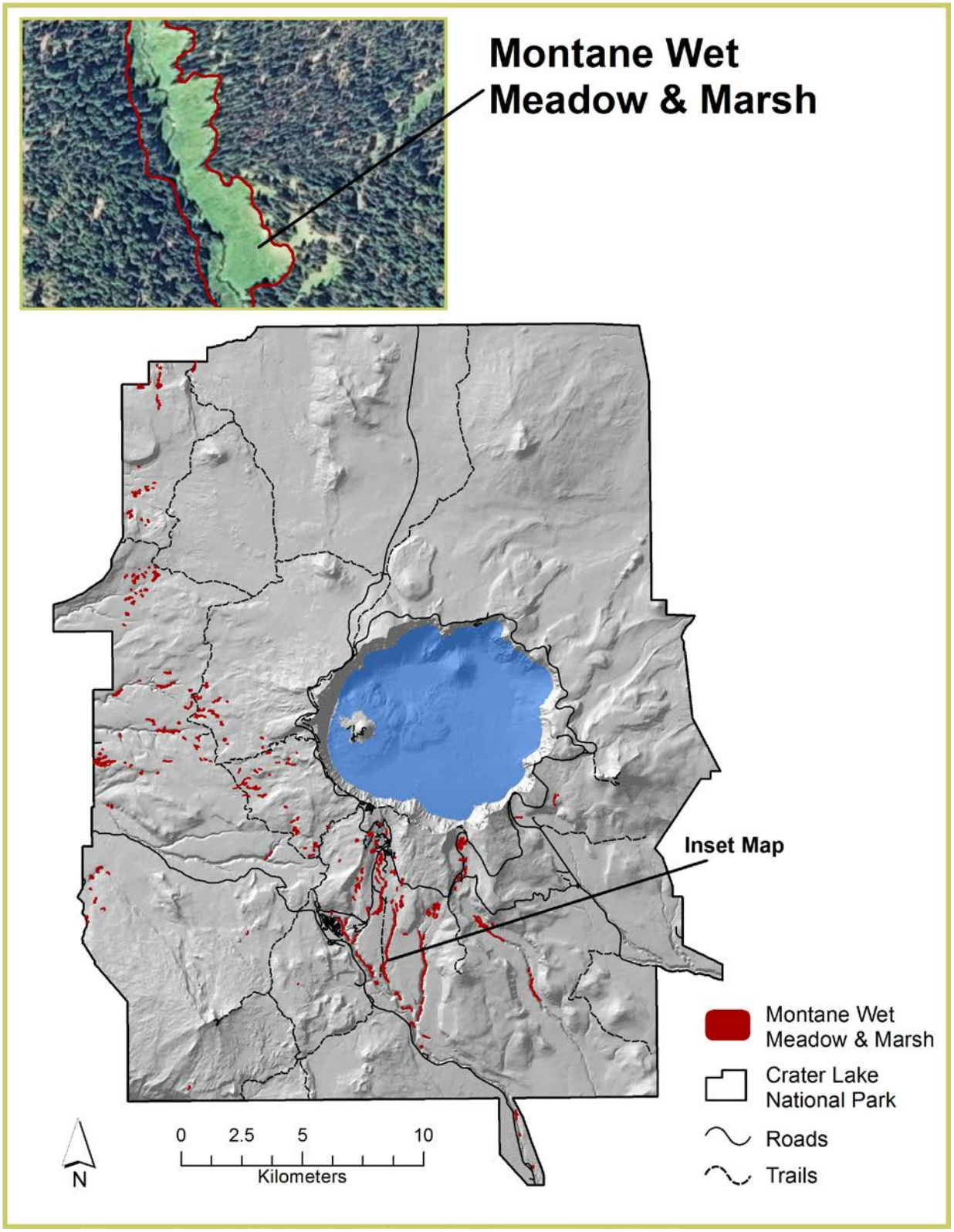
Total Hectares: 200.5

Percentage of National Park: 0.3

Elevation (m): 1336 - 2135

Description: Montane Wet Meadow & Marsh is particularly verdant and consists of dense swards of intertwined graminoids with scattered native herbs. A variety of sedges are the usual dominants, particularly Sitka sedge (*Carex aquatilis* var. *dives*). Grasses such as bluejoint (*Calamagrostis canadensis*) are also common and dominant in some areas. In other areas, instead of graminoids, the broadleaf herb arrowleaf ragwort and/or other herbaceous perennial species dominate.

Range and Distribution: Montane Wet Meadow & Marsh occurs at scattered locations on the western and southern parts of the park on permanently saturated ground along stream courses, on floodplains, springs and seeps, poorly drained depressions, and on the edges of ponds and lakes. It is uncommon or absent over much of the northeast and north central parts of the park and around Union Peak in the far southwest corner of the park.



Above: Photo signature and range map for Montane Wet Meadow & Marsh at Crater Lake National Park.

Photo Signature and Mapping Considerations: The exceptionally verdant Montane Wet Meadow & Marsh was distinguished by its signature bright green coloration and the absence of trees. Montane Wet Meadow & Marsh was clearly distinguishable from forest and shrubland in the lidar highest hit imagery. Montane Wet Meadow & Marsh was also readily discernible from upland vegetation in the color infrared imagery due to the bright red color of the groundcover of highly productive vegetation whereas the groundcover of upland vegetation is tawny or white. Montane Wet Meadow & Marsh often occurs as narrow strips in the landscape because it is associated with creeks. The National Wetlands Inventory map of wetlands produced by the U.S. Fish and Wildlife Service was also used to locate and map Montane Wet Meadow & Marsh in Crater Lake National Park.

Representative Ground Photo:



Above: Montane Wet Meadow & Marsh vegetation at Crater Lake National Park. Shown here is Panicled Bulrush Marsh.

4. Subalpine Wet Meadow & Dwarf-shrubland

Map Unit Classification Colloquial Name (USNVC): Vancouverian-Rocky Mountain Subalpine-Alpine Snowbed, Wet Meadow & Dwarf-shrubland
Map Unit Classification Common Name (USNVC): White Marsh-marigold - Black Alpine Sedge - Alpine Laurel Subalpine-Alpine Snowbed, Wet Meadow & Dwarf-shrubland Group
USNVC Map Unit Code: G520

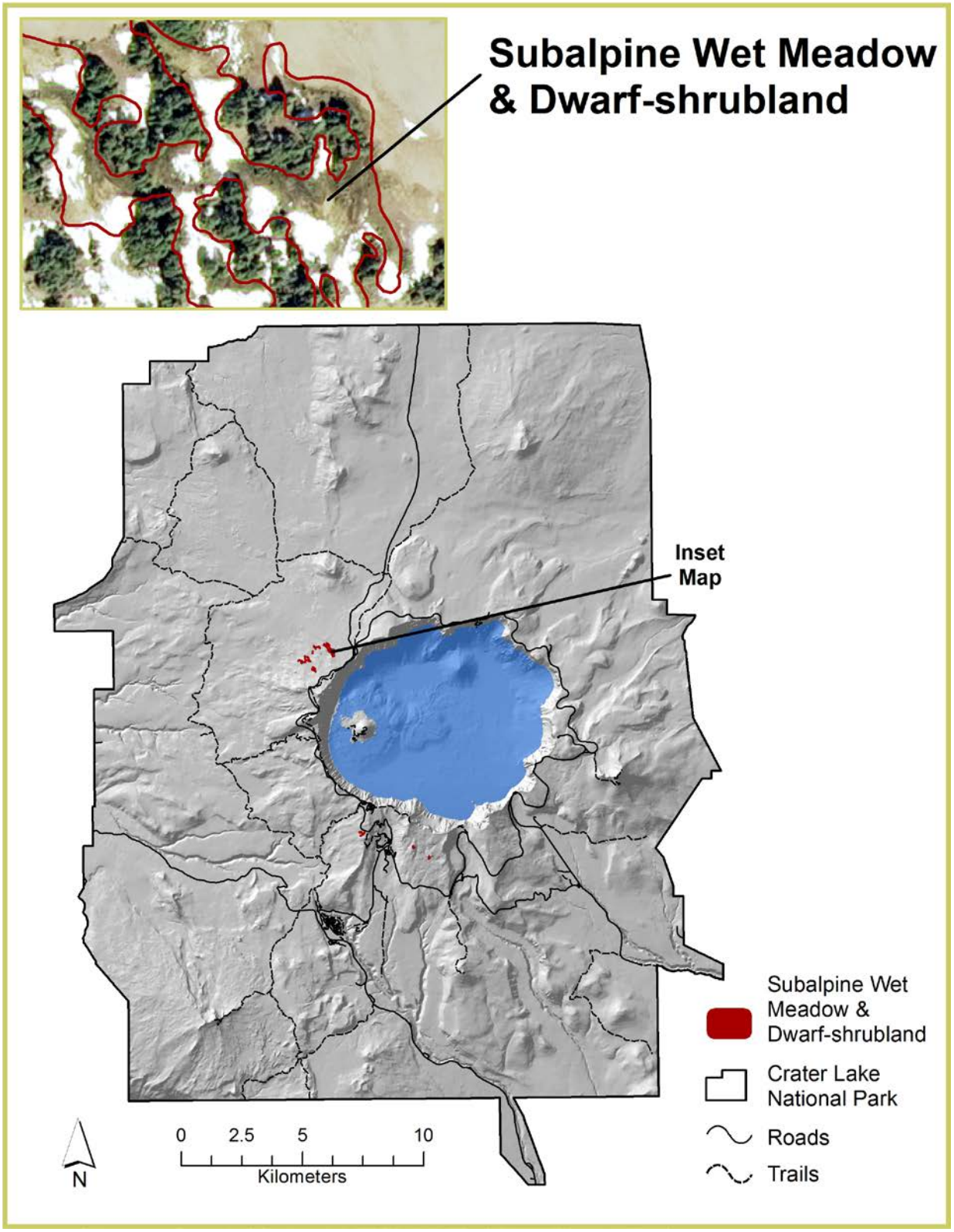
Associations that may dominate the map unit:

Common Name	Scientific Name
Black Alpine Sedge Wet Meadow	*Carex nigricans* Wet Meadow

Total Hectares: 11.8
Percentage of Crater Lake National Park: 0.02
Elevation (m): 2083 – 2269

Description: Subalpine Wet Meadow & Dwarf-shrubland is a low (< 25 cm tall) turf vegetation dominated by black alpine sedge (*Carex nigricans*), high mountain cinquefoil (*Potentilla flabellifolia*) and the dwarf shrub pink mountain heath (*Phyllodoce empetriformis*). Graminoids and shrubs are interspersed at a fine scale within this vegetation. Patches of Subalpine Wet Meadow & Dwarf-shrubland are often small and bounded by conifer vegetation.

Range and Distribution: Subalpine Wet Meadow & Dwarf-shrubland is a rare wetland type occurring on seeps among the pumice Subalpine Fell-field just below the caldera rim (outside) on the northwest side. The elevation at this location is relatively high within the park. We identified several wetlands directly south of the caldera in the imagery as Subalpine Wet Meadow & Dwarf-shrubland but these have not been field verified.



Above: Photo signature and range map for Subalpine Wet Meadow & Dwarf-shrubland at Crater Lake National Park.

Photo Signature and Mapping Considerations: Subalpine Wet Meadow & Dwarf-shrubland has a dark green appearance on the true color imagery and a dark red appearance in the color infrared imagery. It is clearly darker in color than the Subalpine Fell-field that surrounds it. Subalpine Wet Meadow & Dwarf-shrubland occurs in areas that retain snow pack well into the summer season thereby shortening its growing season. As a result, Subalpine Wet Meadow & Dwarf-shrubland can appear in both the true color and color infrared imagery as dark brown, saturated ground where emerging vegetation is not yet visible. This helped distinguish Subalpine Wet Meadow & Dwarf-shrubland from the similar herbaceous wetland map unit, Montane Wet Meadow & Marsh, which nearly always appears as bright green in the true color imagery and bright red in the color infrared imagery. Subalpine Wet Meadow & Dwarf-shrubland also exclusively occurs among Subalpine Fell-field at high elevations whereas Montane Wet Meadow & Marsh occurs at lower elevations. Relevé and validation plots as well as knowledge of vegetation patterns acquired through fieldwork were also helpful in separating Subalpine Wet Meadow & Dwarf-shrubland vegetation from Montane Wet Meadow & Marsh.

Representative Ground Photo:



Above. Subalpine Wet Meadow & Dwarf-shrubland vegetation at Crater Lake National Park. The turf is mostly black sedge (*Carex nigricans*). Dwarf shrubs along the edge of the turf are mostly pink mountain heath (*Phyllodoce empetriformis*).

5. Subalpine Fell-field

Map Unit Classification Colloquial Name (USNVC): North Pacific Alpine-Subalpine Tundra
Map Unit Classification Common Name (USNVC): Longawn Sedge - Showy Sedge - Spreading Phlox Alpine-Subalpine Tundra Group
USNVC Map Unit Code: G320

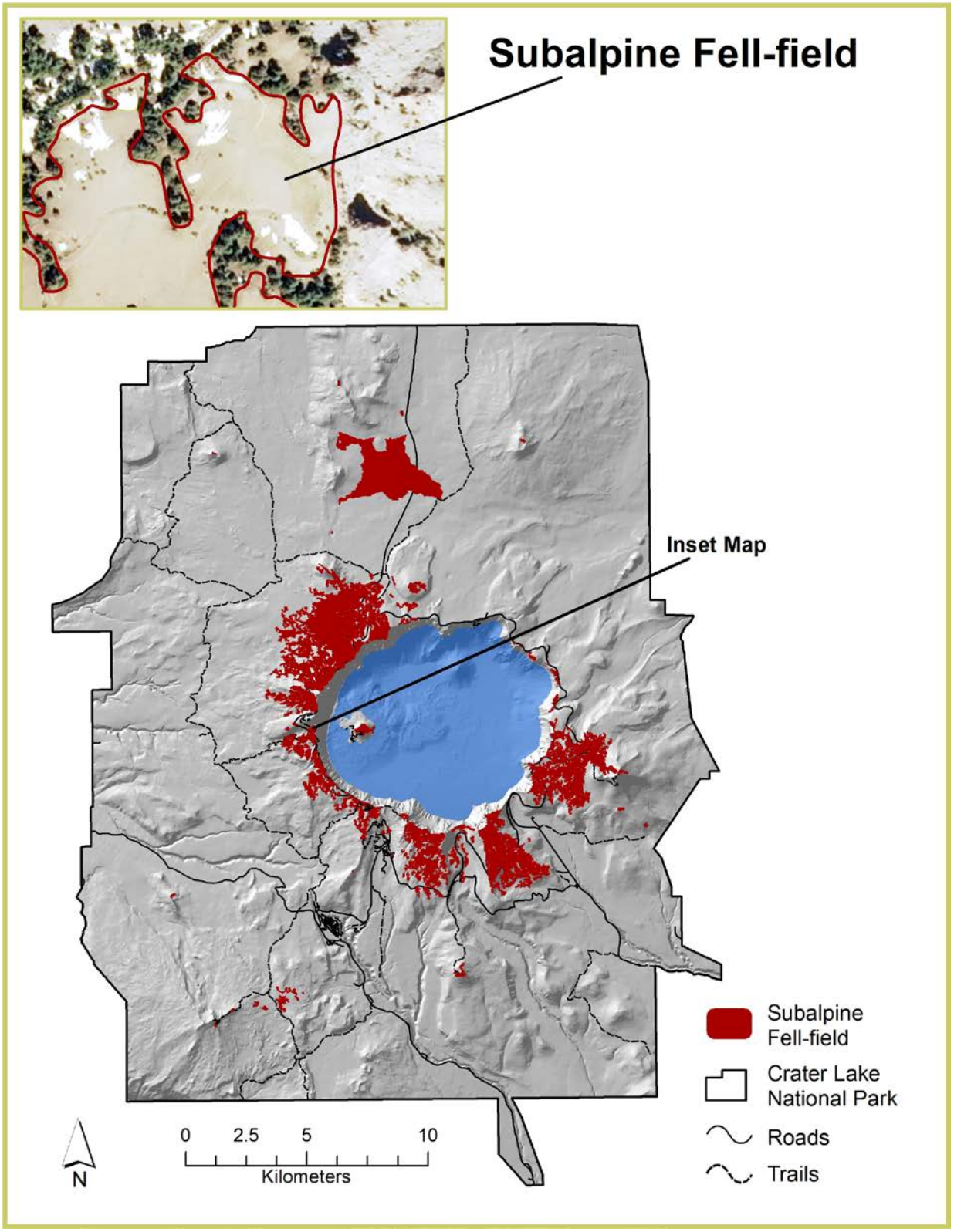
Associations that may dominate the map unit:

Common Name	Scientific Name
Brewer's Sedge Alpine Meadow	*Carex breweri* Alpine Meadow
Granite Prickly Phlox - Common Woolly Sunflower Alpine Fell-field [Provisional]	*Linanthus pungens - Eriophyllum lanatum* Alpine Fell-field [Provisional]
Greene's Goldenbush / Davis' Knotweed Shrub Grassland	*Ericameria greenei* / *Polygonum davisiae* Shrub Grassland
Marumleaf Buckwheat - Crater Lake Sandwort Fell-field	*Eriogonum marifolium - Arenaria pumicola* Fell-field
Davis' Knotweed - Squirreltail Fell-field	*Polygonum davisiae - Elymus elymoides* Fell-field
Davis' Knotweed - Shasta Buckwheat Fell-field	*Polygonum davisiae – Eriogonum pyrolifolium* Fell-field
Shasta Knotweed - Davis' Knotweed Fell-field	*Polygonum shastense - Polygonum davisiae* Fell-field

Total Hectares: 2,793.7
Percentage of Crater Lake National Park: 3.8
Elevation (m): 1817 - 2712

Description: Subalpine Fell-field is a dense to very sparse herbaceous vegetation occurring in subalpine areas where the substratum consists mainly of pumice and/or small rocks. Seven different plant associations may occur in areas mapped as Subalpine Fell-field. All of these associations are dominated by a mix of forbs, such as Davis' knotweed (*Polygonum davisiae*), marumleaf buckwheat (*Eriogonum marifolium*), Shasta Knotweed (*Polygonum shastense*), Mt. Hood pussypaws (*Cistanthe umbellata*), Shasta tansyaster (*Machaeranthera canescens*), Shasta Buckwheat (*Eriogonum pyrolifolium*), and western needlegrass (*Achnatherum occidentale*). The low subshrub Greene's goldenbush (*Ericameria greenei*) may also occur. Other common forbs may include Anderson's lupine (*Lupinus andersonii*) and the graminoids squirreltail (*Elymus elymoides*) and Brewer's Sedge (*Carex breweri*).

Range and Distribution: There are broad expanses of Subalpine Fell-field around the caldera rim area (outside) and the Pumice Desert. At upper elevations, Subalpine Fell-field is sometimes scattered between clumps or lines of trees that are growing on wind protected or rocky sites and in some places may be exhibiting wave regeneration patterns (Sprugel 1976).



Above: Photo signature and range map for Subalpine Fell-field at Crater Lake National Park.

Photo Signature and Mapping Considerations: Subalpine Fell-field most resembles Montane Grassland and Pumice/Sand in the color imagery. Subalpine Fell-field occurs at slightly higher elevations than Montane Grassland, constituting upland herbaceous vegetation at the highest elevations in the park that is not Cliff, Scree & Rock Vegetation. In addition, Subalpine Fell-field is lighter in color than Montane Grassland and often appears light brown or nearly white in the true color imagery. Montane Grassland has a subtle light greenish or tawny hue in the true color imagery. Relevé plots and knowledge of vegetation patterns that we acquired through fieldwork was also helpful in separating Subalpine Fell-field from Montane Grassland.

Pumice/Sand occurs at lower elevations than Subalpine Fell-field vegetation. Pumice/Sand also occurs as linear strips along creeks that have incised deeply into the pumice substratum. These incised, bare areas are easily distinguished on the imagery.

Representative Ground Photo:



Above: Subalpine Fell-field at Crater Lake National Park.

III. Shrub Vegetation

6. Greenleaf Manzanita - Pinemat Manzanita Shrubland

Map Unit Classification Colloquial Name (USNVC): Greenleaf Manzanita - Pinemat Manzanita Shrubland
Map Unit Classification Common Name (USNVC): Greenleaf Manzanita - Pinemat Manzanita Shrubland Alliance
USNVC Map Unit Code: A0788

Associations that may dominate the map unit:

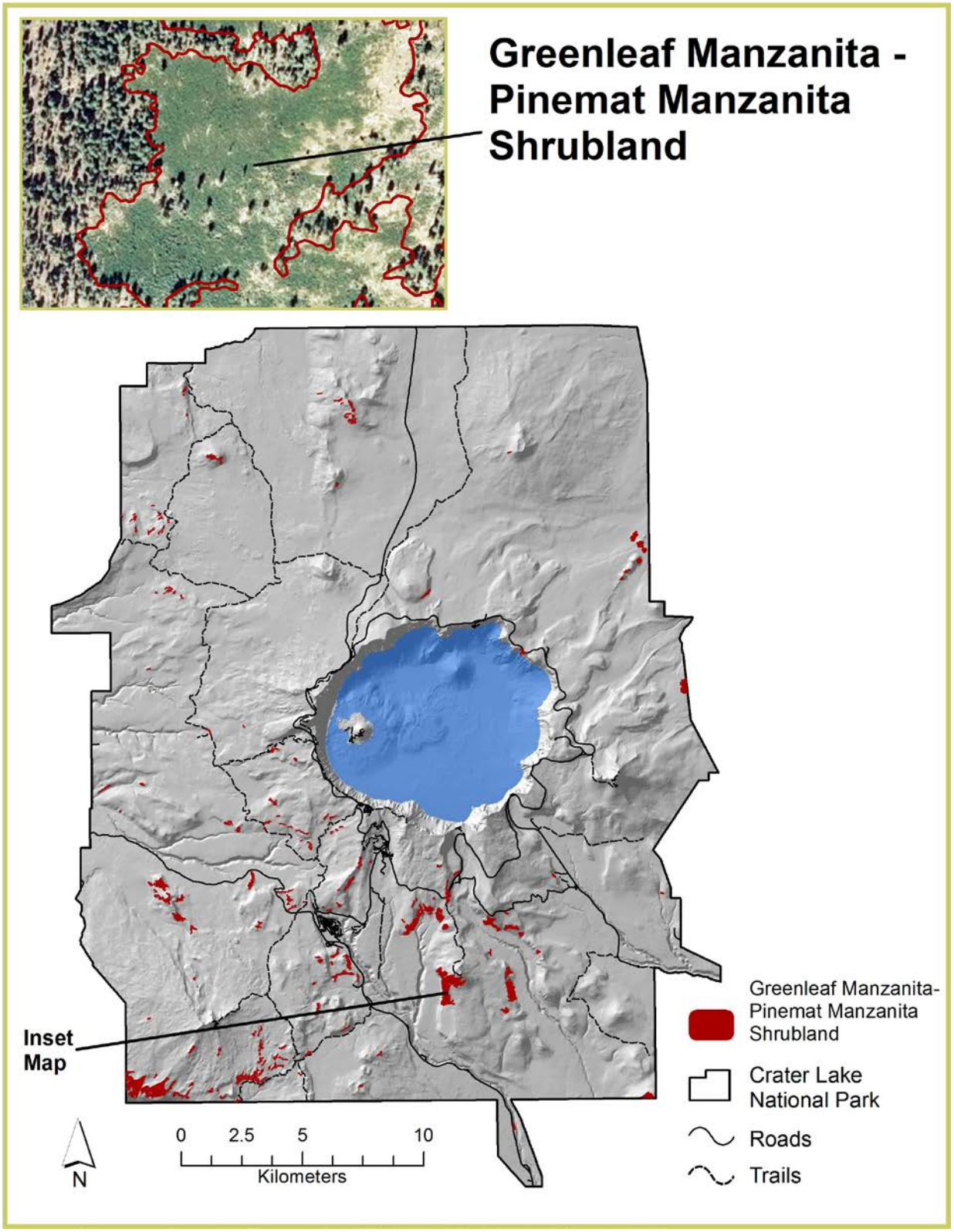
Common Name	Scientific Name
Greenleaf Manzanita – (Snowbrush Ceanothus) / Prostrate Ceanothus Shrubland	*Arctostaphylos patula* - (*Ceanothus velutinus*) / *Ceanothus prostratus* Shrubland
Greenleaf Manzanita Sierran Chaparral Shrubland	*Arctostaphylos patula* Sierran Chaparral Shrubland
Pinemat Manzanita / Lace Lipfern Shrubland	*Arctostaphylos nevadensis / Cheilanthes gracillima* Shrubland
Bearbrush / Lobb's Fiddleleaf Shrubland	*Garrya fremontii* / *Nama lobbii* Shrubland

Total Hectares: 436
Percentage of Crater Lake National Park: 0.6
Elevation (m): 1364 - 2242

Description: Greenleaf Manzanita - Pinemat Manzanita Shrubland is a moderately dense to dense shrub vegetation dominated by 1-2 m tall greenleaf manzanita (*Arctostaphylos patula*) and snowbrush ceanothus (*Ceanothus velutinus*), or by dense, ground covering pinemat manzanita (*Arctostaphylos nevadensis*). Dense shrublands dominated by greenleaf manzanita and snowbrush ceanothus often occur on steep slopes impacted by high severity fires whereas pinemat manzanita dominated shrublands occur on rocky areas with extremely shallow soil. Open shrublands dominated by greenleaf manzanita also occur on rocky shallow soil areas and often co-occurring with prostrate ceanothus (*Ceanothus prostratus*). Also included with this vegetation type are relatively recently burned shrub-dominated areas in the Red Blanket canyon where there are many standing dead, fire-killed conifers. Bearbrush (*Garrya fremontii*) and bush chinquapin (*Chrysolepis sempervirens*) are dominant or codominant with greenleaf manzanita and snowbrush ceanothus in the shrubland in this area. The perennial herb/subshrub, Lobb's fiddleleaf (*Nama lobbii*), a short-lived fire-following species, is abundant in the herb layer in these recent burns. Deciduous shrubs may also occur with the evergreen greenleaf manzanita in the Red Blanket canyon area and include Oregon white oak (*Quercus garryana*) and Saskatoon serviceberry (*Amelanchier alnifolia*).

Range and Distribution: Greenleaf Manzanita - Pinemat Manzanita Shrubland in which greenleaf manzanita and/or snowbrush ceanothus are dominant occur predominantly at middle to low elevations on south and west sides of the park. Greenleaf manzanita dominated shrublands also occur at low to mid-elevations on the far east side of the park, where it is sometimes mixed with Ponderosa Pine Woodland, and inside the northeast portion of the Crater Lake caldera. Greenleaf Manzanita -

Pinemat Manzanita Shrubland where bearbrush (*Garrya fremontii*) is often dominant occurs on the south-facing slopes of Red Blanket Canyon in the southwest corner of the park. Low, pinemat manzanita dominated shrubland is common in areas of exposed bedrock throughout the park, particularly at higher elevations along the Cascade crest and around Union Peak in the Shasta red fir (*Abies magnifica* var. *shastensis*) zone and upward into the mountain hemlock (*Tsuga mertensiana*) zone. Pinemat manzanita dominated shrublands often occupy forest openings in these areas, many of which are smaller in size than the minimum mapping unit (0.5 ha).



Above: Photo signature and range map for Greenleaf Manzanita – Pinemat Manzanita Shrubland at Crater Lake National Park.

Photo Signature and Mapping Considerations: Greenleaf Manzanita - Pinemat Manzanita Shrubland is typically a green or tawny color on the true color imagery. Greenleaf Manzanita - Pinemat Manzanita Shrubland was clearly distinguishable from forest in the lidar highest hit imagery. Greenleaf manzanita and snowbrush ceanothus dominated shrublands have distinctive smooth texture visible in the color imagery indicative of the near solid, interlocking canopy of shrubs. Pinemat manzanita shrubland is a speckled brownish green or tawny against a background of rock that appears whitish. Greenleaf manzanita, snowbrush ceanothus, and bearbrush are generally fire-following species, and there are usually standing or fallen dead trees from past fire that occur in some of these shrublands and are quite visible in the imagery. The burn scars where Greenleaf Manzanita - Pinemat Manzanita Shrubland occur were also discernible. Relevé and validation plots as well as knowledge acquired through fieldwork were also helpful in identifying Greenleaf Manzanita - Pinemat Manzanita Shrubland.

Representative Ground Photo:



Above: A variant of Greenleaf – Pinemat Manzanita Shrubland at Crater Lake National Park. Shown here are greenleaf manzanita (*Arctostaphylos patula*), right foreground and most of the shrub vegetation in the background, and Snowbrush ceanothus (*Ceanothus velutinus*), left foreground.

7. Bitter Cherry - Oceanspray Shrubland

Map Unit Classification Colloquial Name (USNVC): Californian Montane Bitter Cherry - Oceanspray Shrubland
Map Unit Classification Common Name (USNVC): Bitter Cherry - Oceanspray Shrubland Alliance
USNVC Map Unit Code: A3918

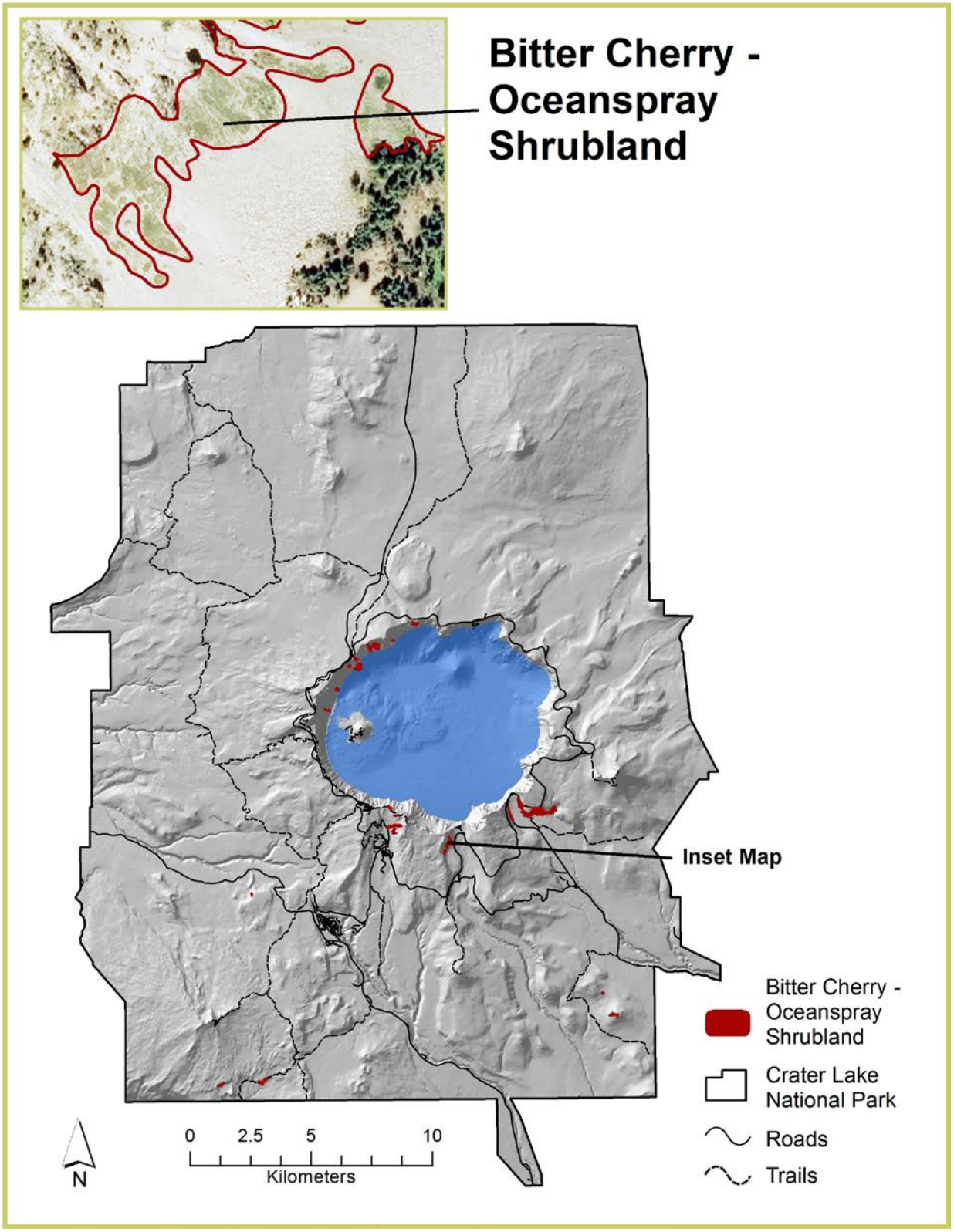
Associations that may dominate the map unit:

Common Name	Scientific Name
Bitter Cherry Sierran Chaparral Shrubland	*Prunus emarginata* Sierran Chaparral Shrubland
Oceanspray / Marumleaf Buckwheat - Long-Stolon Sedge Shrubland	*Holodiscus discolor* / *Eriogonum marifolium* - *Carex inops* ssp. *inops* Shrubland
Red Elderberry / Spearleaf Arnica Shrubland	*Sambucus racemosa* / *Arnica longifolia* Shrubland

Total Hectares: 59
Percentage of Crater Lake National Park: 0.08
Elevation (m): 1768 – 2327

Description: Bitter Cherry - Oceanspray Shrubland is an open to dense, largely deciduous shrub vegetation that occurs among areas of cliffs, scree and rock. It is dominated either by bitter cherry (*Prunus emarginata*) or by oceanspray (*Holodiscus discolor*) but also occurs as a mixture of these two species. On more mesic sites, red elderberry (*Sambucus racemosa*) can be the dominant shrub species. Other shrubs often occur, particularly in associations with bitter cherry and oceanspray. These include greenleaf manzanita (*Arctostaphylos patula*), pinemat manzanita (*Arctostaphylos nevadensis*) and snowbrush ceanothus (*Ceanothus velutinus*). The trailing subshrub, creeping snowberry (*Symphoricarpos mollis*) may be abundant in the understory of Bitter Cherry - Oceanspray Shrubland. Herbaceous understory species include long-stolon sedge (*Carex inops* ssp. *inops*). Small trees, e.g., Shasta red fir (*Abies magnifica* var. *shastensis*), may also occur.

Range and Distribution: Mostly near the Crater Lake caldera rim at the southern edge and inside the caldera on the northwest side among areas of cliffs, scree and rock.



Above: Photo signature and range map for Bitter Cherry – Oceanspray Shrubland at Crater Lake National Park.

Photo Signature and Mapping Considerations: Bitter Cherry – Oceanspray Shrubland occurs on rocky talus slopes at relatively high elevations where little vegetation is apparent on the imagery. Bitter Cherry – Oceanspray Shrubland was discernible from the rock and scree due to its light green color against a background of rock and scree that appears whitish on the true color imagery. Bitter Cherry – Oceanspray Shrubland was also identifiable in the color infrared imagery due to its pink coloration, which was also discernible from the whitish colored rock and scree. The vegetation cover of the Bitter Cherry – Oceanspray Shrubland can appear as solid stands of light green or pink color against the white colored rock and scree, as sparse and patchy stands, and as faintly colored in the color imagery. Bitter Cherry – Oceanspray Shrubland was mapped based on the presence of talus and other aspects of the ecological setting in which it was found. Relevé plots and knowledge acquired through fieldwork were very helpful in identifying where Bitter Cherry – Oceanspray Shrubland occurs.

Representative Ground Photo:



Above: Bitter Cherry - Oceanspray Shrubland at Crater Lake National Park. Shown here is Oceanspray / Marumleaf Buckwheat - Long-Stolon Sedge Shrubland. The dominant shrub in the fore and mid ground is oceanspray (*Holodiscus discolor*).

8. Antelope Bitterbrush Shrubland

Map Unit Classification Colloquial Name (USNVC): Antelope Bitterbrush - Big Sagebrush Mesic Steppe & Shrubland
Map Unit Classification Common Name (USNVC): Antelope Bitterbrush - Big Sagebrush Mesic Steppe & Shrubland Alliance
USNVC Map Unit Code: A3179

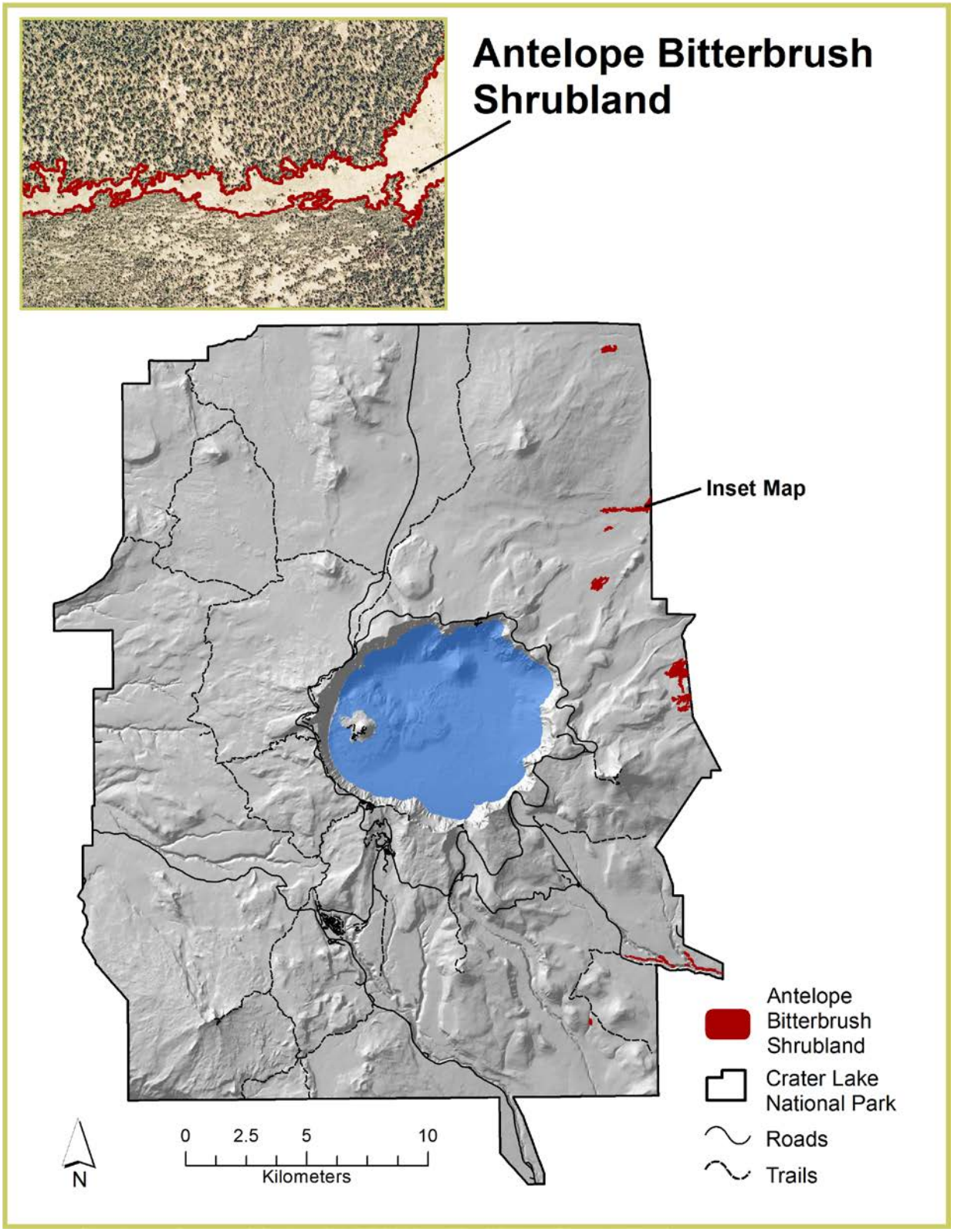
Associations that may dominate the map unit:

Common Name	Scientific Name
Rabbitbush Shrub Grassland [Provisional]	*Ericameria bloomeri* Shrub Grassland [Provisional]
Antelope Bitterbrush / Long-stolon Sedge - Western Needlegrass Shrub Grassland	*Purshia tridentata* / *Carex inops* ssp. *inops* - *Achnatherum occidentale* Shrub Grassland

Total Hectares: 152.4
Percentage of Crater Lake National Park: 0.2
Elevation (m): 1551 - 1921

Description: Antelope Bitterbrush Shrubland is an open to dense shrub vegetation dominated by antelope bitterbrush (*Purshia tridentata*) or, in recently burned Sierra lodgepole pine stands, rabbitbush (*Ericameria bloomeri*). Scattered greenleaf manzanita (*Arctostaphylos patula*) may also occur. The herb layer is sparse and dominated by western needlegrass (*Achnatherum occidentale*) and long-stolon sedge (*Carex inops* ssp. *inops*). Antelope Bitterbrush Shrubland that has rabbitbush as the most common shrub occurs in high severity burned areas, may have very little shrub cover (as low as 3%), and is instead composed of mainly herbaceous species.

Range and Distribution: Antelope Bitterbrush Shrubland occurs in a few discrete areas at the lowest elevations in the far east side of the park. Distinctive stands dominated by antelope bitterbrush occur in the Desert Creek Research Natural Area and on the pumice slopes above Sand Creek. Antelope Bitterbrush Shrubland that has rabbitbush as the most common shrub occurs in high severity burned areas on the far east side of the park.



Above: Photo signature and range map for Antelope Bitterbrush Shrubland at Crater Lake National Park.

Photo Signature and Mapping Considerations: Antelope Bitterbrush Shrubland can be mixed with Montane Grassland and the two look similar on imagery. The lidar highest hit imagery was used to distinguish Antelope Bitterbrush Shrubland from Montane Grassland when shrubs were tall enough. The brown speckles of the antelope bitterbrush shrubs were also distinguishable from the smooth tawny of the Montane Grassland. The lidar highest hit imagery was also used to distinguish Antelope Bitterbrush Shrubland from surrounding forest vegetation. Relevé and validation plots as well as knowledge of vegetation patterns acquired through fieldwork were helpful in identifying where Antelope Bitterbrush Shrubland occurs.

Representative Ground Photo:



Above: Antelope Bitterbrush Shrubland at Crater Lake National Park. The shrubs in this photo are antelope bitterbrush (*Purshia tridentata*).

9. Willow Wet Shrubland

Map Unit Classification Colloquial Name (USNVC): Cascadian Undergreen Willow Wet Shrubland
Map Unit Classification Common Name (USNVC): Undergreen Willow Wet Shrubland Alliance
USNVC Map Unit Code: A1003

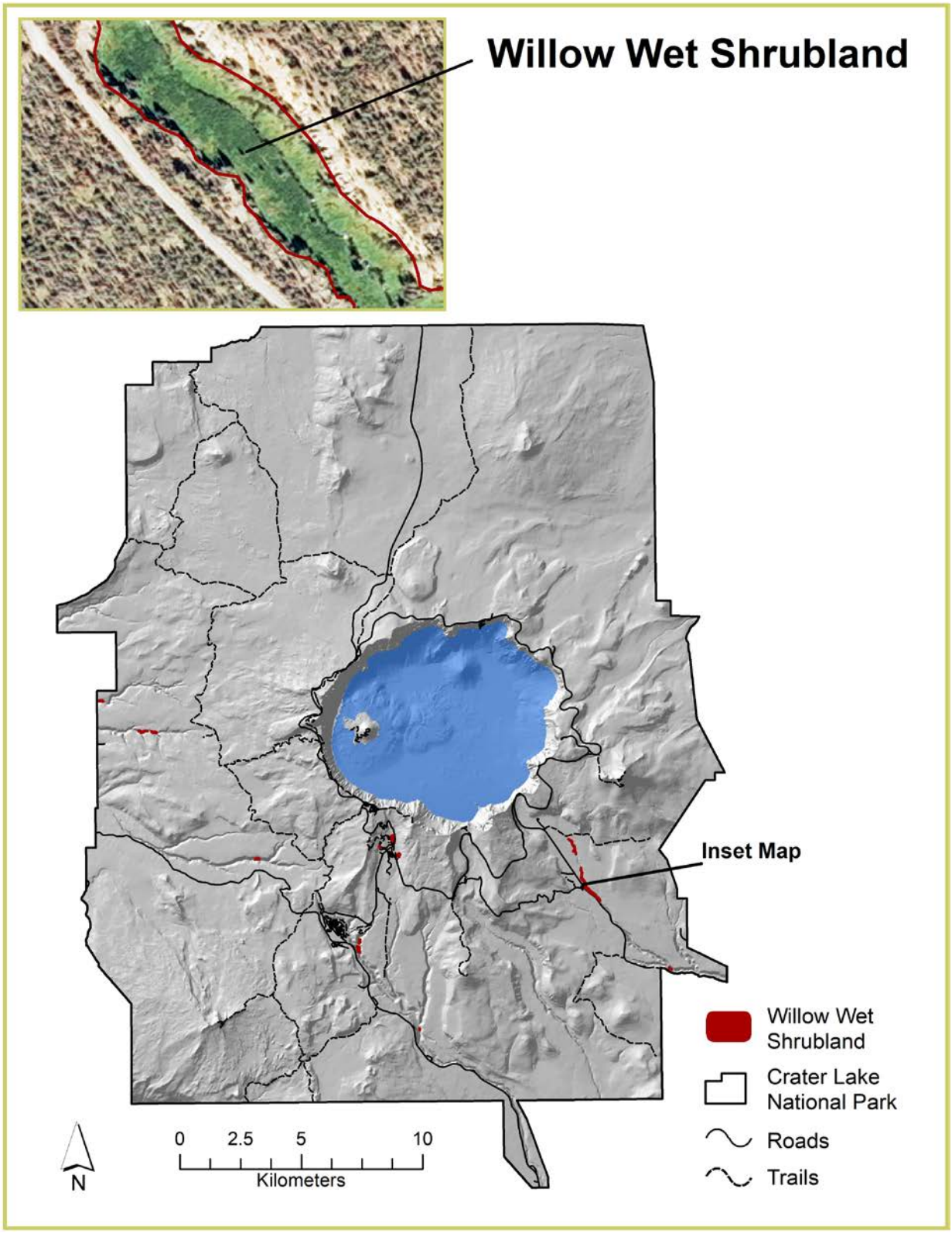
Associations that may dominate the map unit:

Common Name	Scientific Name
Undergreen Willow / Mountain Sedge Wet Shrubland	*Salix commutata* / *Carex scopulorum* Wet Shrubland
Booth's Willow / Bluejoint Wet Shrubland	*Salix boothii* / *Calamagrostis canadensis* Wet Shrubland

Total Hectares: 18.4
Percentage of Crater Lake National Park: 0.02
Elevation (m): 1436 - 1995

Description: Willow Wet Shrubland consists of dense, deciduous 1-2 m tall willow shrubs that may be so dense that their branches are interlocking. Two different willow associations may dominate this shrubby vegetation. Stands dominated by Booth's willow (*Salix boothii*) may sometimes be shorter than 1 m and thoroughly intermixed with herbaceous graminoid species such as panicled bulrush (*Scirpus microcarpus*). Conifers such as subalpine fir (*Abies lasiocarpa*) and Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) occasionally occur, generally as isolated and relatively small individuals poking through the shrub canopy. Herbs from wet meadow environments occur in the shrub understory or in openings. These include Columbian monkshood (*Aconitum columbianum*), arrowleaf ragwort (*Senecio triangularis*), broadleaf lupine (*Lupinus latifolius*) and bluejoint (*Calamagrostis canadensis*). The herbaceous understory may also be dominated by alpine nerve sedge (*Carex neurophora*), and lakeshore sedge (*Carex lenticularis*). Some willow stands mapped as Willow Wet Shrubland may not contain the two component willow associations that make up this map unit and instead are dominated by other willow species present in the park.

Range and Distribution: Willow Wet Shrubland occurs in a few discreet patches along creeks and in wetlands at low to higher elevations in the park. There is a long strip of Willow Wet Shrubland along Sun Creek in the southeast portion of the park as well as some larger stands in wetlands in Munson valley.



Above: Photo signature and range map for Willow Wet Shrubland at Crater Lake National Park.

Photo Signature and Mapping Considerations: Willow Wet Shrubland is a wetland vegetation that appears bright green on true color imagery and bright red in the color infrared imagery due to its co-occurrence with Montane Wet Meadow & Marsh. Willow Wet Shrubland was distinguishable from Montane Wet Meadow & Marsh because the shrubby willow species forms nearly pure stands and is a darker grayish green. Montane Wet Meadow & Marsh is a brighter green. Willow Wet Shrubland was also clearly distinguishable from the surrounding herbaceous vegetation in the lidar highest hit imagery. Willow Wet Shrubland often occurs in similar environmental settings as Western Alder Wet Shrubland, which is much more common. We distinguished Willow Wet Shrubland from the darker green of Western Alder Wet Shrubland on the imagery by its lighter, grayish green color and shorter stature. Relevé and validation plots as well as knowledge acquired through fieldwork were very helpful in identifying where Willow Wet Shrubland occurs. The National Wetlands Inventory map of wetlands produced by the U.S. Fish and Wildlife Service was also used to locate and map Willow Wet Shrubland in Crater Lake National Park.

Representative Ground Photo:



Above: Willow Wet Shrubland at Crater Lake National Park. The dominant shrub is Booth's willow (*Salix boothii*).

10. Western Alder Wet Shrubland

Map Unit Classification Colloquial Name: Western Alder Wet Shrubland
Map Unit Classification Common Name: Gray Alder - Green Alder Wet Shrubland Alliance
USNVC Map Unit Code: A3771

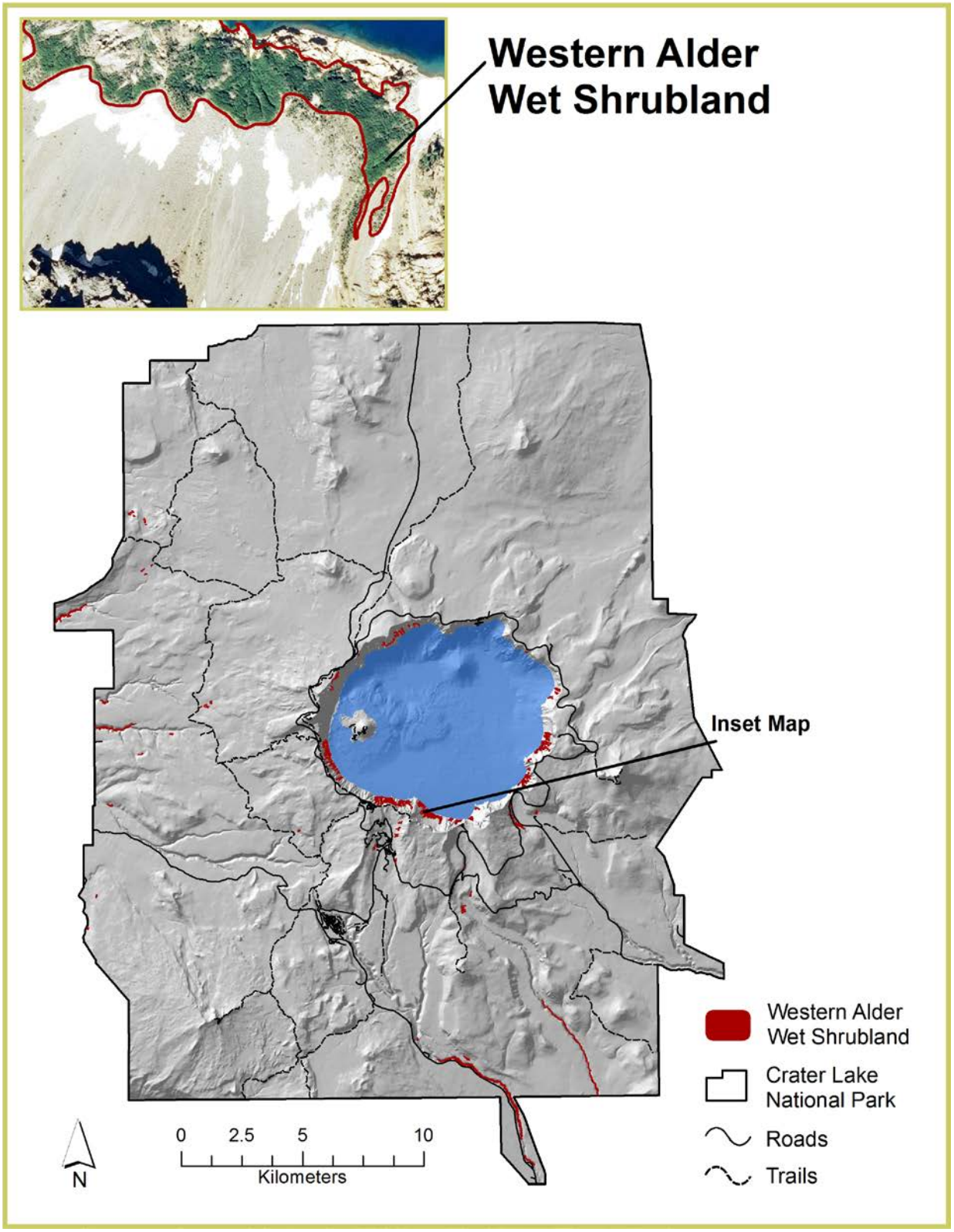
Associations that may dominate the map unit:

Common Name	Scientific Name
Gray Alder / Fowl Mannagrass Wet Shrubland	*Alnus incana* / *Glyceria striata* Wet Shrubland
Sitka Alder / Mesic Forbs Wet Shrubland	*Alnus viridis* ssp. *sinuata* / Mesic Forbs Wet Shrubland

Total Hectares: 181.2
Percentage of Crater Lake National Park: 0.3
Elevation (m): 1336 - 2315

Description: Western Alder Wet Shrubland is a very dense, deciduous shrubland. The shrubs range from 2-4 m in height and may be so dense that their branches are interlocking. Canopy cover is usually greater than 75% and often close to 100%. Western Alder Wet Shrubland vegetation is strongly dominated by Sitka alder (*Alnus viridis* ssp. *sinuata*) primarily occurring on talus slopes, or gray alder (*Alnus incana* ssp. *tenuifolia*) typically found along major steam courses. Red elderberry (*Sambucus racemosa*) can sometimes be interspersed among Sitka alder on talus slopes. The most abundant herbs with Sitka alder are Pacific bleeding heart (*Dicentra formosa*), red baneberry (*Actaea rubra*), and small enchanter's nightshade (*Circaea alpina*). Each of these can reach 10% cover, but are often rare or absent. Herbs associated with gray alder are fowl mannagrass (*Glyceria striata*), and a wide variety of graminoids and forbs. These include sedges (*Carex* spp.), arrowleaf ragwort (*Senecio triangularis*), and pioneer violet (*Viola glabella*).

Range and Distribution: Western Alder Wet Shrubland dominated by Sitka alder occurs primarily within the Crater Lake caldera as well as on talus slopes outside the caldera near the rim. Western Alder Wet Shrubland dominated by gray alder is found along nearly all major steam course in the southern and western parts of Crater Lake National Park as well as in some larger wetland complexes.



Above: Photo signature and range map for Western Alder Wet Shrubland at Crater Lake National Park.

Photo Signature and Mapping Considerations: Western Alder Wet Shrubland was distinguished as one of two tall shrublands that are bright green on the true color imagery and bright red on the color infrared imagery, the other being Willow Wet Shrubland. Western Alder Wet Shrubland was separated from Willow Wet Shrubland by its darker green color on the true color imagery (Willow Wet Shrubland is slightly gray). Western Alder Wet Shrubland is also taller than Willow Wet Shrubland. Western Alder Wet Shrubland was also clearly distinguishable from the surrounding herbaceous and forest vegetation in the lidar highest hit imagery. Western Alder Wet Shrubland was readily visible inside of the Crater Lake caldera and nearby talus slope outside the caldera, where the shrub vegetation was easily distinguished from the surrounding cliff and talus. Relevé and validation plots, as well as knowledge of vegetation patterns acquired through fieldwork were also helpful in identifying where Western Alder Wet Shrubland occurs. The National Wetlands Inventory map of wetlands produced by the U.S. Fish and Wildlife Service was also used to locate and map some areas of Western Alder Wet Shrubland in Crater Lake National Park.

Representative Ground Photo:



Above: Western Alder Wet Shrubland at Crater Lake National Park. The shrub vegetation shown is composed entirely of gray alder (*Alnus incana* ssp. *tenuifolia*).

11. Bog Blueberry Wet Shrubland

Map Unit Classification Colloquial Name (USNVC): Pacific Northwest Blueberry Wet Shrubland
Map Unit Classification Common Name (USNVC): Bog Blueberry - Dwarf Bilberry Wet Shrubland Alliance
USNVC Map Unit Code: A1123

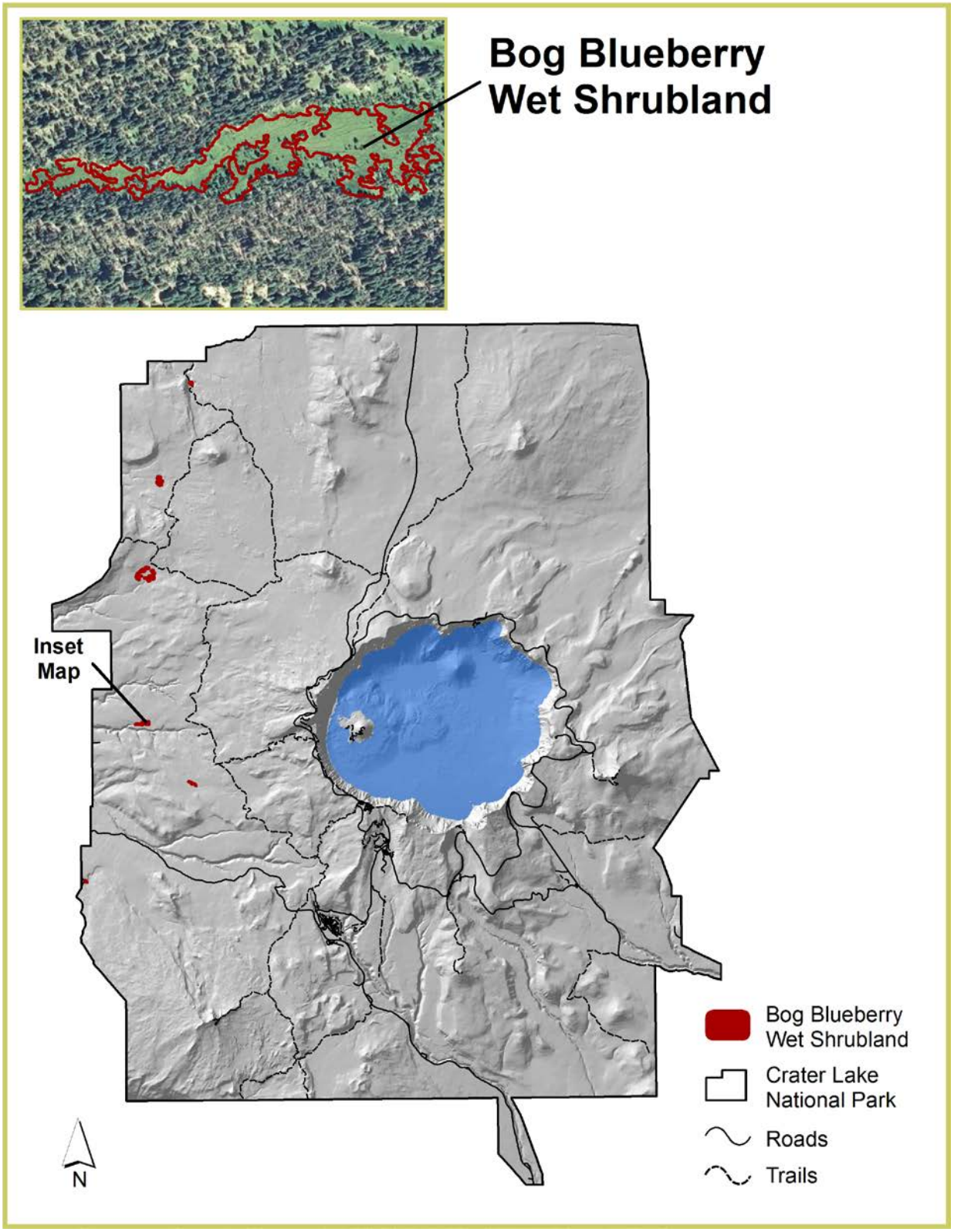
Associations that may dominate the map unit:

Common Name	Scientific Name
Bog Blueberry / Sitka Sedge Wet Shrubland	*Vaccinium uliginosum* / *Carex aquatilis* var. *dives* Wet Shrubland
Rose Spirea Wet Shrubland	*Spiraea douglasii* Wet Shrubland

Total Hectares: 13.4
Percentage of Crater Lake National Park: 0.02
Elevation (m): 1477 - 1722

Description: Bog Blueberry Wet Shrubland is dominated by the low, deciduous shrub, bog blueberry (*Vaccinium uliginosum*), which is generally 1 m or less in height. Dense swards of Sitka sedge (*Carex aquatilis* var. *dives*) commonly occur in openings between shrubs as well as intermixed with bog blueberry. Bog Blueberry Wet Shrubland may also consist of a dense cover of 1 m tall rose spirea (*Spiraea douglasii*) with a dense understory of Sitka sedge. Scattered Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) may be present.

Range and Distribution: Bog Blueberry Wet Shrubland occurs in large wetland complexes on the west side of Crater Lake National Park. These areas are associated with springs. One of the areas is a relatively large wetland complex known as Sphagnum Bog.



Above: Photo signature and range map for Bog Blueberry Wet Shrubland at Crater Lake National Park.

Photo Signature and Mapping Considerations: Bog Blueberry Wet Shrubland was discernible from upland vegetation in the color infrared imagery due to the bright red color of the groundcover of highly productive vegetation, whereas the groundcover of upland vegetation is tawny or white. Bog Blueberry Wet Shrubland often occurs with and closely resembles Montane Wet Meadow & Marsh. Both are bright green in the true color imagery and bright red in the color infrared imagery. The two were best separated using lidar highest hit imagery. The shrubs can also be seen in the bright green wet meadow areas as having a slightly blueish hue. Relevé and validation plots as well as knowledge of vegetation patterns acquired through fieldwork were also helpful in identifying where Bog Blueberry Wet Shrubland occurs. The National Wetlands Inventory map of wetlands produced by the U.S. Fish and Wildlife Service was also used to locate and map Bog Blueberry Wet Shrubland in Crater Lake National Park.

Representative Ground Photo:



Above: Bog Blueberry Wet Shrubland at Crater Lake National Park. Bog blueberry (*Vaccinium uliginosum*) is dominant in the fore and background. Sitka sedge (*Carex aquatilis* var. *dives*) co-occurs with bog blueberry and is dominant in a dense sward in the mid ground.

IV. Forest and Woodland Vegetation

12. Ponderosa Pine Woodland

Map Unit Classification Colloquial Name (USNVC): Central Rocky Mountain Ponderosa Pine / Shrub Woodland
Map Unit Classification Common Name (USNVC): Ponderosa Pine / Shrub Understory Central Rocky Mountain Woodland Alliance
USNVC Map Unit Code: A3446

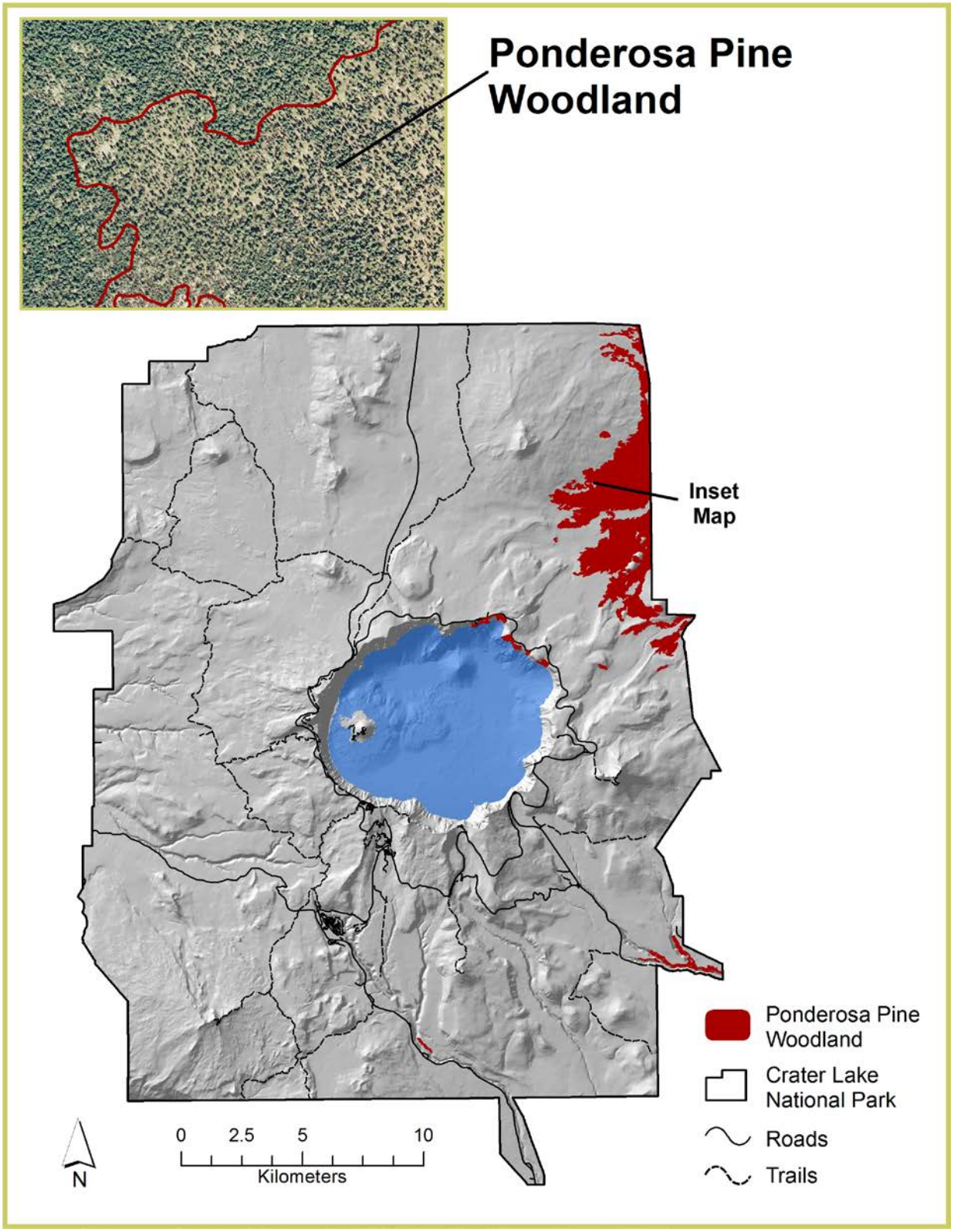
Associations that may dominate the map unit:

Common Name	Scientific Name
Ponderosa Pine / Greenleaf Manzanita - Antelope Bitterbrush Woodland	*Pinus ponderosa* / *Arctostaphylos patula* - *Purshia tridentata* Woodland
Ponderosa Pine / Antelope Bitterbrush / Long-stolon Sedge Forest	*Pinus ponderosa* / *Purshia tridentata* / *Carex inops* ssp. *inops* Forest

Total Hectares: 1904.1
Percentage of Crater Lake National Park: 2.6
Elevation (m): 1551 - 2121

Description: Ponderosa Pine Woodland is an open to moderately dense, conifer forest dominated by large ponderosa pine (*Pinus ponderosa*) overstory trees, occasionally with smaller ponderosa in the midstory. Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) sometimes forms an abundant midstory. Greenleaf manzanita (*Arctostaphylos patula*) is often abundant in the understory where Sierra lodgepole pine is less common. Antelope bitterbrush (*Purshia tridentata*) is common in the understory where Sierra lodgepole pine is more abundant. Long-stolon sedge (*Carex inops* ssp. *inops*) and western needlegrass (*Achnatherum occidentale*) are common herbaceous species throughout this map unit. Snowbrush ceanothus (*Ceanothus velutinus*) can be present and is sometimes abundant in the understory.

Range and Distribution: Ponderosa Pine Woodland vegetation is common on the northeast side of the park where the driest forest or woodland conditions occur and where tree cover is relatively low. Ponderosa Pine Woodland also occurs on the dry pumice slopes along lower Sand Creek and Annie Creek in the more mesic southeastern part of the park. Lastly, Ponderosa Pine Woodland occurs inside the northwest portion of the Crater Lake caldera.



Above: Photo signature and range map for Ponderosa Pine Woodland at Crater Lake National Park.

Photo Signature and Mapping Considerations: Ponderosa Pine Woodland can be distinguished on the imagery because the trees are less dense and the ground cover is clearly visible. The scattered large ponderosa pine trees protrude noticeably above the main forest and ground cover and have a distinctive crown shape and color noticeable in the imagery. This pattern was discernible in the imagery we used, as well as with use of the oblique perspective from Google Earth imagery. Ponderosa Pine Woodland could be confused with sparse Lodgepole Forest or Shasta Red Fir Forest. The distinctive crown shape and color of the large ponderosa pine trees noticeable in both the true color imagery and the color infrared imagery aided in distinguishing Ponderosa Pine Woodland from these other map units. Relevé and validation plots as well as knowledge of vegetation patterns acquired through fieldwork were also helpful in identifying where Ponderosa Pine Woodland occurs.

Representative Ground Photo:



Above: Ponderosa Pine Woodland at Crater Lake National Park. Shown here is the Ponderosa Pine / Greenleaf Manzanita **-** Antelope Bitterbrush Woodland dominated by large and medium sized ponderosa pines (*Pinus ponderosa*), a few smaller ponderosa pines and Sierra white fir (*Abies lowiana*) (in the distance), and with the understory shrubs greenleaf manzanita (*Arctostaphylos patula*) and pinemat manzanita (*Arctostaphylos nevadensis*).

13. Quaking Aspen Forest

Map Unit Classification Colloquial Name (USNVC): Rocky Mountain Aspen Forest & Woodland
Map Unit Classification Common Name (USNVC): Quaking Aspen Rocky Mountain Forest & Woodland Alliance
USNVC Map Unit Code: A2036

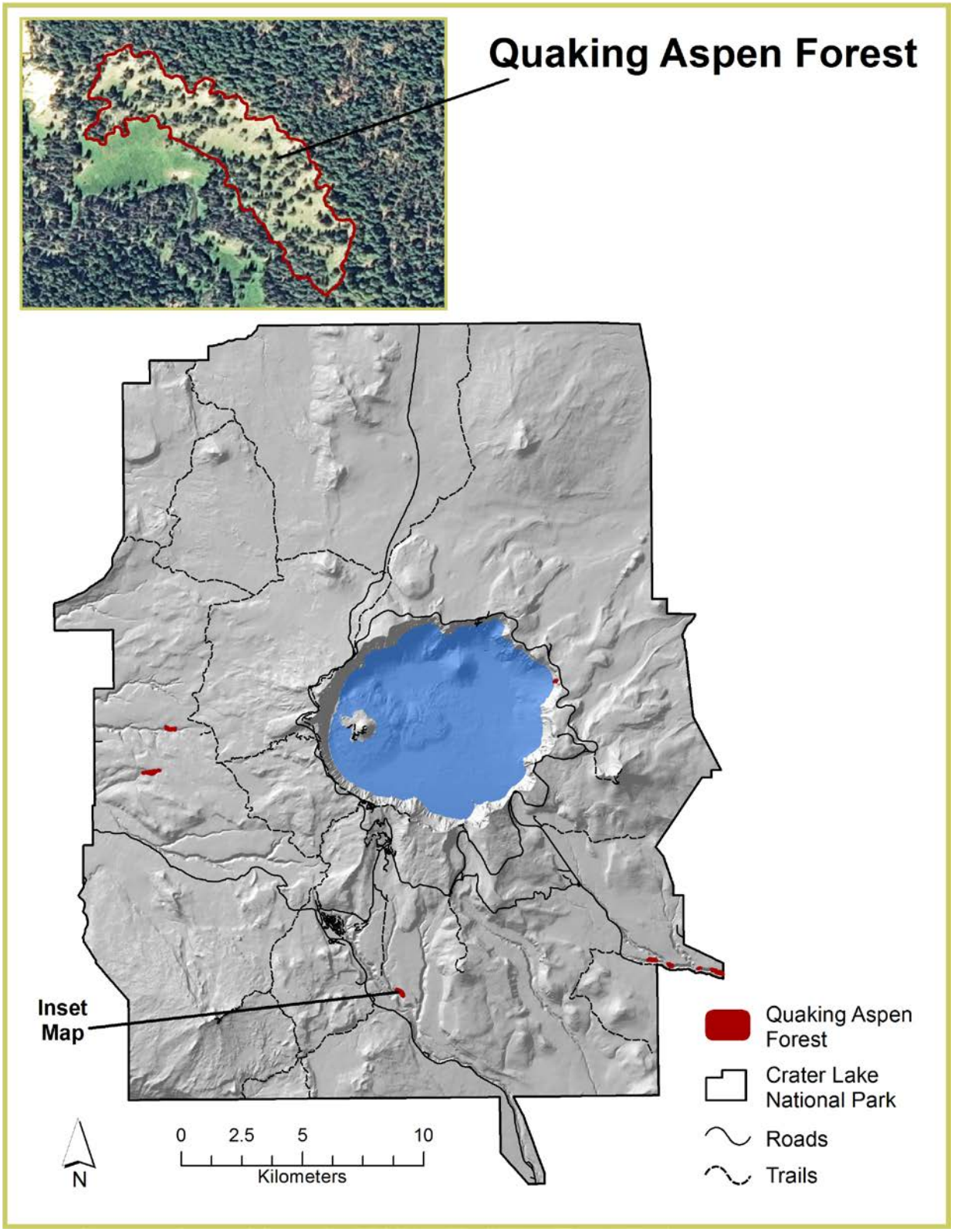
Associations that may dominate the map unit:

Common Name	Scientific Name
Quaking Aspen - Ponderosa Pine Forest [Provisional]	*Populus tremuloides - Pinus ponderosa* Forest [Provisional]
Quaking Aspen / California Brome Forest	*Populus tremuloides* / *Bromus carinatus* Forest

Total Hectares: 16.1
Percentage of Crater Lake National Park: 0.02
Elevation (m): 1546 - 1987

Description: Quaking Aspen Forest occurs as open to moderately dense forests or woodlands of quaking aspen (*Populus tremuloides*). It often occurs in pure stands of quaking aspen but may also occur with small Sierra lodgepole pines (*Pinus contorta* var. *murrayana*) and subalpine fir (*Abies lasiocarpa*) on the west and south side of the park and with ponderosa pine (*Pinus ponderosa*), and Sierra white fir (*Abies lowiana*) on the east side of the park. Stands on the slopes above lower Sand Creek tend to be drier and support shrub species such as antelope bitterbrush (*Purshia tridentata*) and snowbrush ceanothus (*Ceanothus velutinus*). Stands on the south and west side of the park are more mesic and often support a rich herbaceous understory, including the forb Rydberg's penstemon (*Penstemon rydbergii*). Graminoids are common in the understory of Quaking Aspen Forest throughout its range and include long-stolon sedge (*Carex inops* ssp. *inops*), blue wildrye (*Elymus glaucus*), and (*Bromus carinatus*).

Range and Distribution: Quaking Aspen Forest is found in several discrete patches on the slopes above the riparian corridors along Bybee Creek, a tributary of Castle Creek, Annie Creek, and lower Sand Creek. Though not confirmed, a patch was identified in the imagery inside of the Crater Lake caldera on the northeast side. A few small patches of quaking aspen occur at scattered locations in the southeast corner of the park and in the Panhandle but are smaller than the minimum mapping unit of 0.5 hectares.



Above: Photo signature and range map for Quaking Aspen Forest at Crater Lake National Park.

Photo Signature and Mapping Considerations: Quaking Aspen Forest was discernible from neighboring vegetation in the true color imagery by the visible white aspen trunks and the noticeably rounded crowns that are lighter green compared to the darker green conifer trees. Relevé and validation plots and knowledge of vegetation patterns acquired through fieldwork were also helpful in identifying where Quaking Aspen Forest occurs.

Representative Ground Photo:



Above: Quaking Aspen Forest at Crater Lake National Park. The trees in the foreground are quaking aspen (*Populus tremuloides*), while the dominant understory grass is blue wildrye (*Elymus glaucus*).

14. Montane Conifer Forest

Map Unit Classification Colloquial Name (USNVC): Californian Montane Conifer Forest & Woodland

Map Unit Classification Common Name (USNVC): Incense-cedar - Sugar Pine - White Fir Forest & Woodland Group

USNVC Map Unit Code: G344

Associations that may dominate the map unit:

Common Name	Scientific Name
Sierra White Fir - Sugar Pine - Ponderosa Pine / Greenleaf Manzanita Forest	*Abies lowiana - Pinus lambertiana - Pinus ponderosa* / *Arctostaphylos patula* Forest
Douglas-fir - Sierra White Fir - Incense-cedar Forest	*Pseudotsuga menziesii - Abies lowiana - Calocedrus decurrens* Forest
Sierra White Fir / Pipsissewa Forest	*Abies lowiana* / *Chimaphila umbellata* Forest
Sierra White Fir - Douglas-fir / Cascade Barberry Forest	*Abies lowiana - Pseudotsuga menziesii* / *Mahonia nervosa* Forest
Sierra White Fir - Douglas-fir / Bush Chinquapin Forest	*Abies lowiana - Pseudotsuga menziesii* / *Chrysolepis sempervirens* Forest
Ponderosa Pine - Incense cedar / Prostrate Ceanothus Woodland [Provisional]	*Pinus ponderosa - Calocedrus decurrens* / *Ceanothus prostratus* Woodland [Provisional]
Sierra White Fir - Ponderosa Pine / Long-stolon Sedge Forest	*Abies lowiana - Pinus ponderosa* / *Carex inops* ssp. *inops* Forest
Sierra White Fir - Shasta Red Fir / Pipsissewa Forest	*Abies lowiana - Abies magnifica* var. *shastensis* / *Chimaphila umbellata* Forest

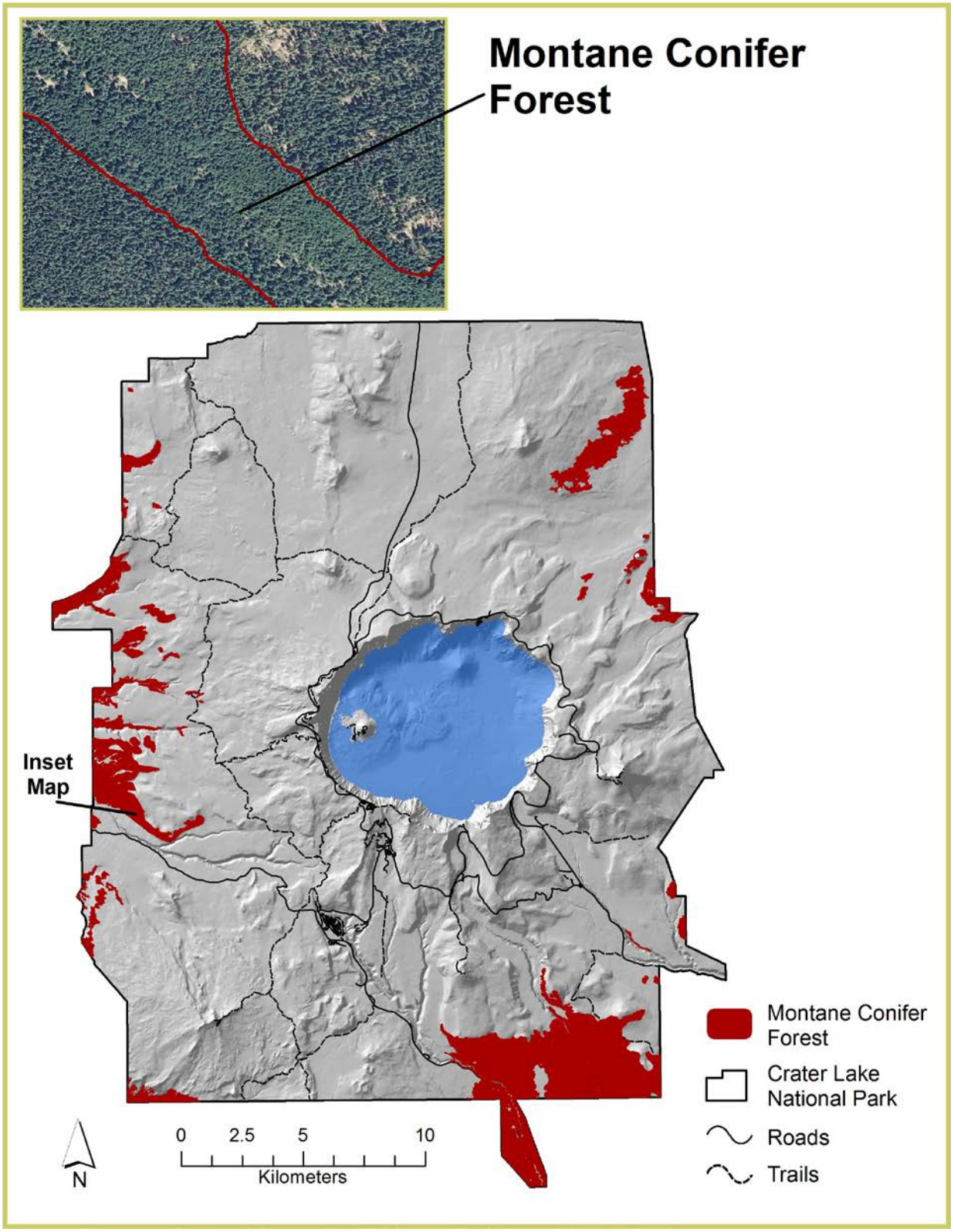
Total Hectares: 4,680

Percentage of Crater Lake National Park: 6.3

Elevation (m): 1211 - 1946

Description: Montane Conifer Forest at Crater Lake National Park is dense, with large overstory trees and smaller trees of all sizes creating a multi layered canopy. Montane Conifer Forest can occur as pure stands of Sierra white fir (*Abies lowiana*), but often occurs with a wide variety of other conifers, hence, this vegetation was subdivided into eight associations. Associated tree species at lower elevations include ponderosa and sugar pine (*Pinus ponderosa*, *P. lambertiana*), Douglas-fir (*Pseudotsuga menziesii*), and incense cedar (*Calocedrus decurrens*). At higher elevations, Shasta red fir (*Abies magnifica* var. *shastensis*) is often common and may be codominant in Montane Conifer Forest. In areas of more open forest, pinemat manzanita (*Arctostaphylos nevadensis*) and long-stolon sedge (*Carex inops* ssp. *inops*) are common in the understory. In denser forests, Cascade barberry (*Mahonia nervosa*) and/or pipsissewa (*Chimaphila umbellata*) are common in the understory.

Range and Distribution: Montane Conifer Forest occurs over large areas on the western side of the park at relatively low park elevations. It also occurs in the northeast portion of the park and in a large area in the southeastern part of the park.



Above: Photo signature and range map for Montane Conifer Forest at Crater Lake National Park.

Photo Signature and Mapping Considerations: Montane Conifer Forest was difficult to discern from Shasta Red Fir Forest and was identified using the color infrared imagery. In this imagery, Sierra white fir and Douglas-fir (*Pseudotsuga menziesii*) are a brighter red color than other conifers, including the widespread Shasta red fir (*Abies magnifica* var. *shastensis*). Shasta red fir is a darker red. In the true color imagery Sierra white fir and and Douglas-fir are green while Shasta red fir is a dark bluish green. Relevé and validation plots as well as knowledge of vegetation patterns acquired through fieldwork were also helpful in identifying where Montane Conifer Forest occurs.

Representative Ground Photo:



Above: Montane Conifer Forest at Crater Lake National Park. Down wood is abundant. Most of the trees in this photo are Sierra white fir (*Abies lowiana*).

15. Shasta Red Fir Forest

Map Unit Classification Colloquial Name (USNVC): Sierra-Cascade Red Fir Forest
Map Unit Classification Common Name (USNVC): California Red Fir - Shasta Red Fir Forest Alliance
USNVC Map Unit Code: A3619

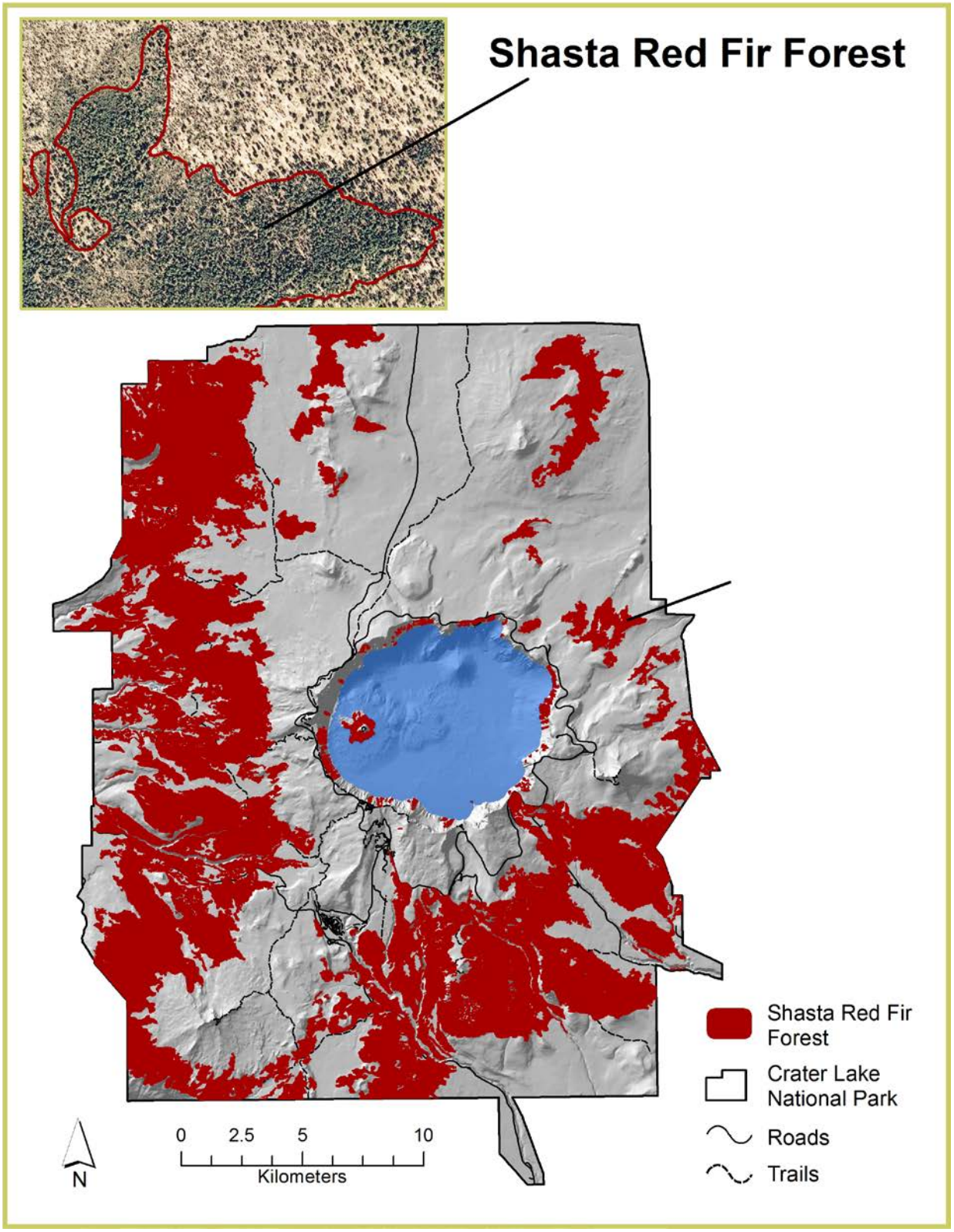
Associations that may dominate the map unit:

Common Name	Scientific Name
Shasta Red Fir **-** Western White Pine / Davidson's Penstemon Forest [Provisional]	*Abies magnifica* var. *shastensis* **-** *Pinus monticola / Penstemon davidsonii* Forest [Provisional]
Shasta Red Fir **-** Mountain Hemlock / Pinemat Manzanita Forest	*Abies magnifica* var. *shastensis - Tsuga mertensiana* / *Arctostaphylos nevadensis* Forest
Shasta Red Fir / Thinleaf Huckleberry / Pipsissewa Forest	*Abies magnifica* var. *shastensis* / *Vaccinium membranaceum* / *Chimaphila umbellata* Forest
Shasta Red Fir / Long**-**stolon Sedge Forest	*Abies magnifica* var. *shastensis* / *Carex inops* ssp. *inops* Forest
Shasta Red Fir **-** Douglas-fir / Pinemat Manzanita Forest	*Abies magnifica* var. *shastensis - Pseudotsuga menziesii / Arctostaphylos nevadensis* Forest
California Red Fir – Western White Pine / Pinemat Manzanita Forest	*Abies magnifica - Pinus monticola* / *Arctostaphylos nevadensis* Forest

Total Hectares: 23,833.5
Percentage of Crater Lake National Park: 32.3
Elevation (m): 1369 - 2290

Description: Shasta Red Fir Forest is dense and often characterized by large trees. Shasta red fir (*Abies magnifica* var. *shastensis*) can form relatively pure stands but it is also common for other tree species to co-occur with Shasta red fir. Mountain hemlock (*Tsuga mertensiana*) and western white pine (*Pinus monticola*) are often present in the overstory and can be codominant. At the lower elevations of its range where it meets Montane Conifer Forest, Sierra white fir (*Abies lowiana*) and Douglas-fir (*Pseudotsuga menziesii*) may be present and codominant in the overstory with Shasta red fir. Shasta Red Fir Forest occurs in generally even aged stands with a single cohort of larger trees as well as in multilayered stands with large overstory trees and an abundance of medium and/or small trees. In areas of more open forest, pinemat manzanita (*Arctostaphylos nevadensis*) is common in the understory along with long-stolon sedge (*Carex inops* ssp. *inops*). In denser forests, pipsissewa (*Chimaphila umbellata*) is common in the understory.

Range and Distribution: Shasta Red Fir Forest occurs throughout much of the park, but less so in the northeast portion and at the highest elevations. It is most abundant at lower to middle elevations, but can be found at or near the Crater Lake rim. Stands of Shasta Red Fir Forest are also scattered inside the caldera and on Wizard Island.



Above: Photo signature and range map for Shasta Red Fir Forest at Crater Lake National Park.

Photo Signature and Mapping Considerations: Shasta Red Fir Forest was discernible in the true color imagery by its dark bluish green color. It was also discernible from other forest types using the color infrared imagery. At the lower elevations of its range, Shasta Red Fir Forest is a darker red than the brighter red color of Montane Conifer Forest. At the higher elevations of its range, Shasta Red Fir Forest is also a darker red than the brighter red color of the Mountain Hemlock Forest. Shasta Red Fir Forest was also distinguishable from Mountain Hemlock Forest because the shapes of mountain hemlock crowns were easily recognizable in the imagery as having a more branched and messy appearance while Shasta red fir is more uniformly conical in shape. Relevé and validation plots as well as knowledge of vegetation patterns acquired through fieldwork were also helpful in identifying where Shasta Red Fir Forest occurs.

Representative Ground Photo:



Above: Shasta Red Fir Forest at Crater Lake National Park. Down wood and Shasta red fir seedlings are abundant in these forests. Saplings are both Shasta red fir (*Abies magnifica* var. *shastensis*) and mountain hemlock (*Tsuga mertensiana*).

16. Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest

Map Unit Classification Colloquial Name (USNVC): N/A
Map Unit Classification Common Name (USNVC): Mountain Hemlock – Sierra Lodgepole Pine – Whitebark Pine Forest
USNVC Map Unit Code: CEGL008692

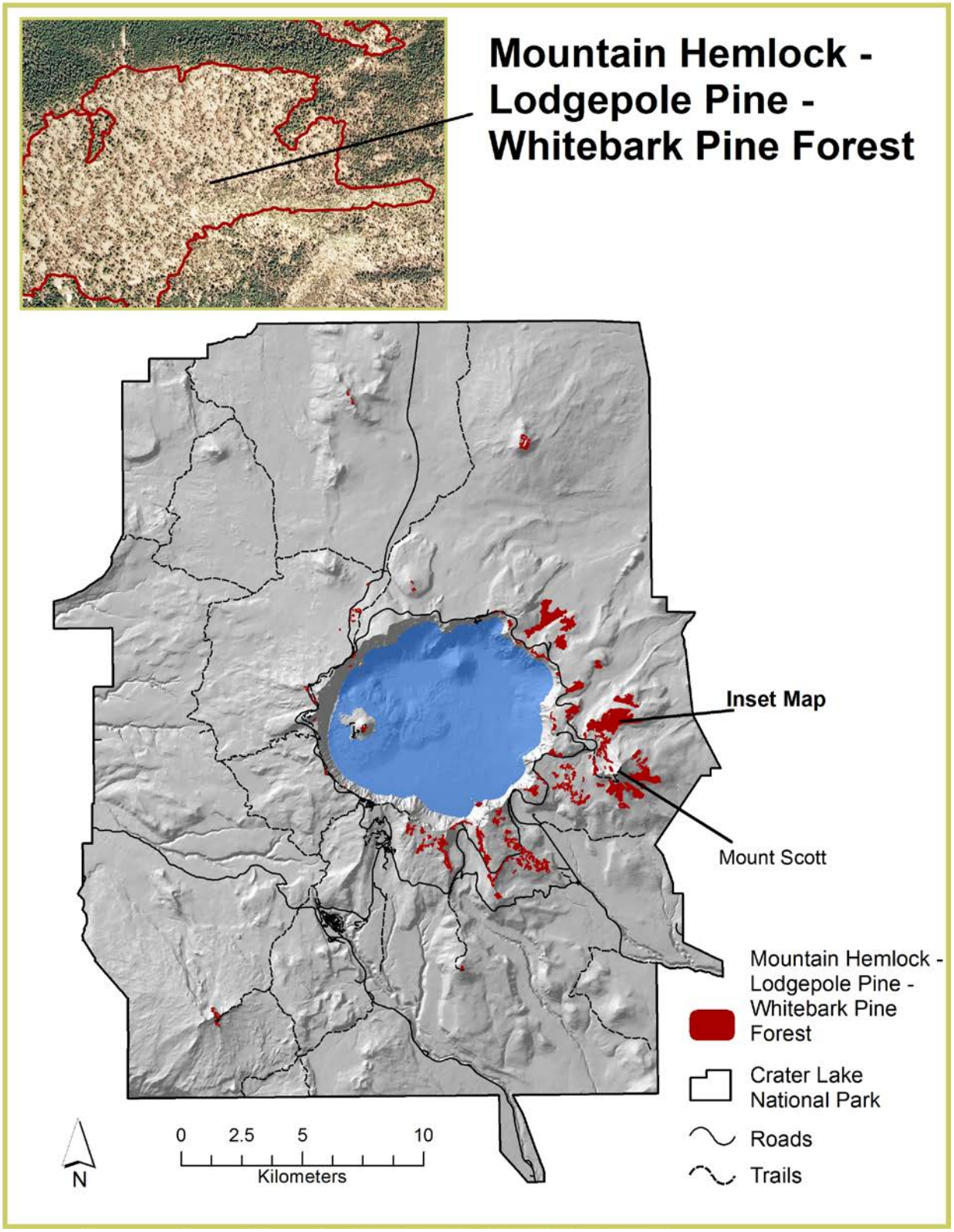
Associations that may dominate the map unit:

Common Name	Scientific Name
Mountain Hemlock - Lodgepole Pine - Whitebark Pine Forest	*Tsuga mertensiana - Pinus contorta* var. *murrayana - Pinus albicaulis* Forest

Total Hectares: 639.1
Percentage of Crater Lake National Park: 0.9
Elevation (m): 1862 - 2575

Description: Mountain Hemlock - Lodgepole Pine - Whitebark Pine Forest is a relatively open conifer forest that occurs at high elevations of the subalpine area, extending up to the caldera rim. It often occurs on deep pumice deposits and soils are often fairly loose. Trees tend to be sparse and are often clustered, with openings of nearly bare soil and little vegetation between the clumps. Mountain hemlock (*Tsuga mertensiana*), Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) and whitebark pine (*Pinus albicaulis*) are often codominant in the overstory. However, due to the uneven presence of whitebark pine in this map unit, mountain hemlock and/or Sierra lodgepole pine may dominate or codominate the overstory with whitebark pine being subordinate in the overstory. Whitebark pine often occurs on the perimeter of tree clumps. Mountain Hemlock - Lodgepole Pine - Whitebark Pine Forest also occurs on steep rocky areas where the trees are more evenly distributed. Mountain Hemlock - Lodgepole Pine - Whitebark Pine Forest is defined by the presence of whitebark pine with at least five percent absolute cover. Seedlings and saplings of all three component species may be abundant in the understory. Herbaceous vegetation is generally sparse in the understory. Considerable mortality is presently affecting whitebark pine trees due to the non-native white pine blister rust (*Cronartium ribicola*) and native bark beetles that have moved up in elevation with climate change (Smith et al. 2011).

Range and Distribution: Mountain Hemlock - Lodgepole Pine - Whitebark Pine Forest vegetation is scattered at higher elevations, mainly to the east, northeast, and south of Crater Lake outside the caldera. Considerable patches occur on the south and east slopes of Mount Scott. Small patches also occur at scattered locations elsewhere along the caldera rim both inside and outside as well as on Grouse Hill, Crater Peak, Desert Ridge, Timber Crater and Union Peak.



Above: Photo signature and range map for Mountain Hemlock - Lodgepole Pine - Whitebark Pine Forest at Crater Lake National Park.

Photo Signature and Mapping Considerations: Mountain Hemlock - Lodgepole Pine - Whitebark Pine Forest is mapped largely based on the occurrence of whitebark pines. We were able to identify whitebark pine by a combination of its asymmetrical and contorted branching arrangement. Whitebark pine also has a grayish blue green color in the true color imagery that helps differentiate it from the forest green of mountian hemlock and the brownish green of the Sierra lodgepole pine. The distict narrow conical shape of the crowns of Sierra lodgepole pines also help differentiate them from white bark pines. We mapped Mountain Hemlock - Lodgepole Pine - Whitebark Pine woodlands where whitebark pine was codominant with mountain hemlock and Sierra lodgepole pine, or when whitebark pine cover was greater than 5 percent and was mixed with mountain hemlock and Sierra lodgepole pine, which may have individually equaled or exceeded the cover of whitebark pine. These areas often had sparse forest cover with a good deal of bare ground visible in the imagery.

Whitebark pines are a special interest species in Crater Lake National Park. They are often described as a keystone species because of their mutualistic relationship with the Clark's nutcracker, a species that caches the pine's seeds, which are a nutritious food source for other species. Whitebark pines are threatened by a non-native pathogen (see Smith et al. 2011 for specifics at Crater Lake National Park), and the diminishing amounts of whitebark pine may have cascading effects. For these reasons, we arranged to have a Southern Oregon University student, Eric Keena-Levin, map whitebark pine using plot data collected by park staff as well as plot data collected during the mapping project described herein, and Eric's on the ground knowledge of whitebark pine occurrences obtained from two consecutive years of field work. Eric used these data to develop a predictive model of whitebark pine occurrence in ArcGIS. Eric then used his raster data to draw vector polygons over existing aerial imagery using the photo signatures of whitebark pine occurrence described above. We further refined and added to these polygons using a combination of Eric's field data modeling and mapping as well as our relevé plot data and map validation data. Sierra lodgepole pine and mountain hemlock can sometimes have contorted branching structure as well, especially smaller trees at timberline. Ultimately, to distinguish whitebark pine, we relied on all our data sources: a combination of Eric's data and modeling, our relevé plots, our validation plots, knowledge of vegetation patterns acquired through fieldwork, and the subtly grayer color of the whitebark pine in the true color imagery to identify where whitebark pine occurs at Crater Lake National Park.

Representative Ground Photo:



Above: Mountain Hemlock - Lodgepole Pine - Whitebark Pine Forest at Crater Lake National Park. Whitebark pines (*Pinus albicaulis*) are the large trees on the left in the photo.

17. Lodgepole Pine Forest

Map Unit Classification Colloquial Name (USNVC): Subalpine Sierra Lodgepole Pine Forest & Woodland
Map Unit Classification Common Name (USNVC): Sierra Lodgepole Pine Subalpine Forest & Woodland Alliance
USNVC Map Unit Code: A3621

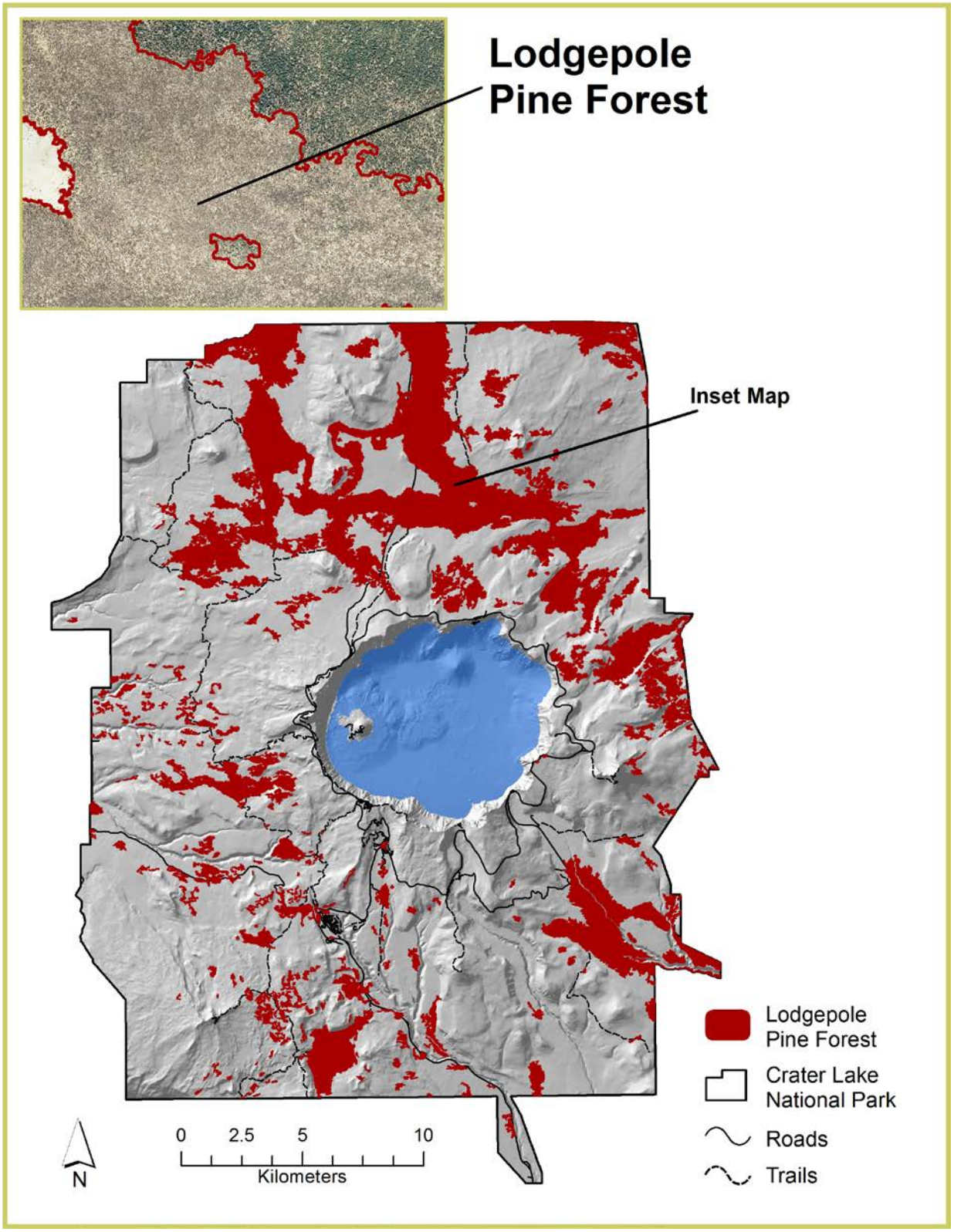
Associations that may dominate the map unit:

Common Name	Scientific Name
(Tall Lodgepole Pine, Sierra Lodgepole Pine) / Pinemat Manzanita Forest	*Pinus contorta* (var. *latifolia*, var. *murrayana*) / *Arctostaphylos nevadensis* Forest
Sierra Lodgepole Pine / Long-stolon Sedge Forest	*Pinus contorta* var. *murrayana* / *Carex inops* ssp. *inops* Forest
Lodgepole Pine / Antelope Bitterbrush / Long-stolon Sedge Forest	*Pinus contorta* / *Purshia tridentata* / *Carex inops* ssp. *inops* Forest
Sierra Lodgepole Pine / Sparse Understory Forest	*Pinus contorta* var. *murrayana* / Sparse Understory Forest
Sierra Lodgepole Pine – (Mountain Hemlock) / Pinemat Manzanita / Davidson's Penstemon Woodland	*Pinus contorta* var. *murrayana* - (*Tsuga mertensiana*) / *Arctostaphylos nevadensis* / *Penstemon davidsonii* Woodland
Sierra Lodgepole Pine / Snowbrush Ceanothus Forest	*Pinus contorta* var. *murrayana* / *Ceanothus velutinus* Forest

Total Hectares: 11,604.9
Percentage of Crater Lake National Park: 15.7
Elevation (m): 1409 - 2562

Description: Lodgepole Pine Forest comprises forest stands dominated by Sierra lodgepole pine (*Pinus contorta* var. *murrayana*). Stands range from relatively sparse, low stature forests to taller and denser forests to dense forests of relatively small diameter trees. Lodgepole Pine Forest occurs in nearly pure stands of Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) on sterile, pumice soils that are common in Crater Lake National Park. Pure stands of mature Sierra lodgepole pine also occur in areas where Shasta Red Fir Forest, Mountain Hemlock Forest, or Lodgepole Pine Forest burned decades in the past. These stands often have abundant seedlings and saplings of Shasta red fir (*Abies magnifica* var. *shastensis*) and mountain hemlock (*Tsuga mertensiana*) in the understory. Lodgepole Pine Forest also occurs as dense seedlings, saplings or small trees in areas of Sierra lodgepole pine vegetation that has burned in recent years. Lodgepole Pine Forest also occurs as open stands Sierra lodgepole pine on areas of exposed rocky areas with shallow soils and an understory dominated by pinemat manzanita (*Arctostaphylos nevadensis*) along with Davidson's Penstemon (*Penstemon davidsonii*) and lace lipfern (*Cheilanthes gracillima*). The understory of Lodgepole Pine Forest is often very sparse, but there are areas with a modest amount of understory vegetation comprised of western needlegrass (*Achnatherum occidentale*), Anderson’s lupine (*Lupinus andersonii*), long-stolon sedge (*Carex inops* ssp. *inops*) and/or pinemat manzanita.

Range and Distribution: Lodgepole Pine Forest is common throughout the park at all elevations. It is most common on the deep pumice deposits in the northern third of the park. Lodgepole Pine Forest also covers large areas in Pumice Flat and in the valley that contains Sand Creek.



Above: Photo signature and range map for Lodgepole Pine Forest at Crater Lake National Park.

Photo Signature and Mapping Considerations: Lodgepole Pine Forest typically occurs in pure or nearly pure stands of Sierra lodgepole pine. The sparse nature of the tree crowns is visible in the color imagery as well as in the trees' shadows. Sierra lodgepole pine has distinctive brownish color in the true color imagery, whereas most other common forest trees are darker shades of green. The pure stands of Sierra lodgepole pine that comprise Lodgepole Pine Forest appear as broad swaths of brown trees and therefore easy to distinguish from other forest types.

Representative Ground Photo:



Above: Lodgepole Pine Forest at Crater Lake National Park. All of the trees in this photo are Sierra lodgepole pine (*Pinus contorta* var. *murrayana*).

18. Whitebark Pine Woodland

Map Unit Classification Colloquial Name (USNVC): N/A
Map Unit Classification Common Name (USNVC): Whitebark Pine / Davidson's Penstemon Woodland
USNVC Map Unit Code: CEGL003134

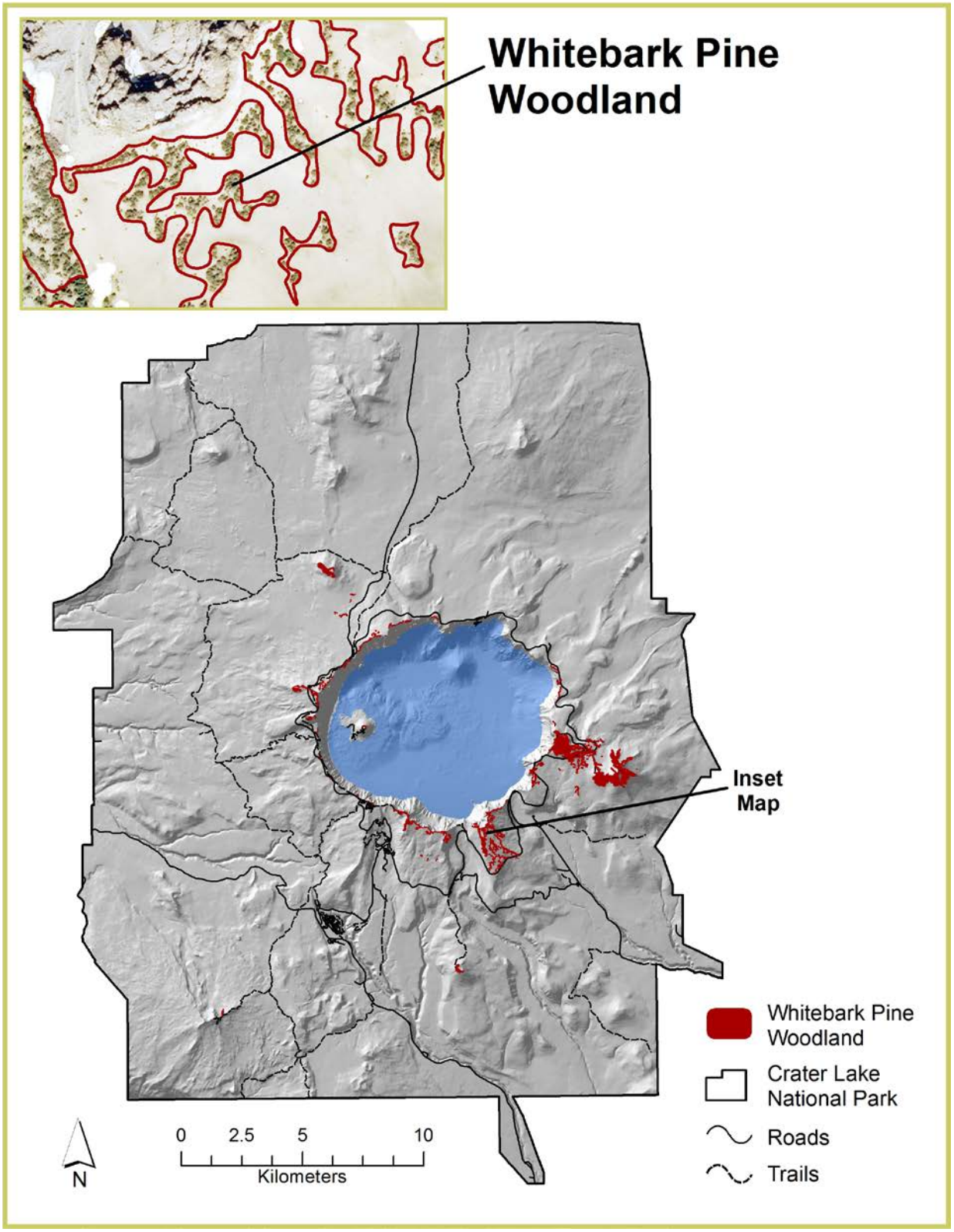
Associations that may dominate the map unit:

Common Name	Scientific Name
Whitebark Pine / Davidson's Penstemon Woodland	*Pinus albicaulis* / *Penstemon davidsonii* Woodland

Total Hectares: 298.8
Percentage of Crater Lake National Park: 0.4
Elevation (m): 2030 - 2723

Description: Whitebark Pine Woodland is a high elevation conifer woodland that is often sculpted by icy winds. The overstory is dominated by whitebark pine (*Pinus albicaulis*), sometimes with scattered mountain hemlock (*Tsuga mertensiana*). It is commonly found in patches or linear strips of trees among the open landscapes of the Subalpine Fell-field map unit. It also occurs on areas of exposed rock near the caldera rim and on ridge tops and summits. Some large contiguous stands occur in places such as on Cloudcap and Mount Scott. The understory is dominated by the shrub Crater Lake currant (*Ribes erythrocarpum*) and/or the subshrub/herb Davidson's penstemon (*Penstemon davidsonii*), along with a variety of flowering herbs common in the Subalpine Fell-field. In many areas, particularly directly on the caldera rim and other ridgetops, the whitebark pines have a stunted, windswept krummholz growth formation. Considerable mortality is presently occurring in whitebark pine due to the non-native white pine blister rust (*Cronartium ribicola*) and native bark beetles that have moved up in elevation with climate change (Smith et al. 2011).

Range and Distribution: Whitebark Pine Woodland occurs at scattered locations on the Crater Lake caldera rim. Considerable areas of Whitebark Pine Woodland also occur on Dutton Ridge, Mount Scott and Cloudcap with smaller patches occurring on Red Cone, Crater Peak and Williams Crater. Whitebark Pine Woodland is most common to the southeast and east of the Crater Lake caldera. It often grows on slightly wind protected or rocky sites and in some places may be exhibiting wave regeneration patterns (Sprugel 1976).



Above: Photo signature and range map for Whitebark Pine Woodland at Crater Lake National Park.

Photo Signature and Mapping Considerations: Whitebark Pine Woodland is mapped based on the dominance of whitebark pine trees. We were able to identify whitebark pine by a combination of its asymmetrical and contorted branching arrangement. Whitebark pine also has a grayish blue green color in the true color imagery that helps differentiate it from the forest green of mountian hemlock and the brownish green of the Sierra lodgepole pine (*Pinus contorta* var. *murrayana*). The silver colored dead branches on many whitebark pine trees, as well as the silver colored whitebark pine snags present in some stands helped in identifying the presence of whitebark pine trees. The distict narrow conical shape of the crowns of Sierra lodgepole pines also help differentiate them from white bark pines. Patches of whitebark pine that were mapped were sometimes smaller than the minium mapping unit of 0.5 hectares.

We distinguished Whitebark Pine Woodland from Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest by the overall dominance of whitebark pine cover or where Sierra lodgepole pine cover was generally low and mountain hemlock was less than or equal to the cover of whitebark pine. Pure stands of whitebark pine were often difficult to delineate as this pine is often at a fine scale associated with mountain hemlock, either adult trees or seedlings and saplings.

Whitebark pines are a special interest species in Crater Lake National Park. They are often described as a keystone species because of their mutualistic relationship with the Clark's nutcracker, a species that caches the pine's seeds, which are a nutritious food source for other species. Whitebark pines are threatened by a non-native pathogen (see Smith et al. 2011 for specifics at Crater Lake National Park), and the diminishing amounts of whitebark pine may have cascading effects. For these reasons, we arranged to have a Southern Oregon University student, Eric Keena-Levin, map whitebark pine using plot data collected by park staff as well as plot data collected during the mapping project described herein, and Eric's on the ground knowledge of whitebark pine occurrences obtained from two consecutive years of field work. Eric used these data to develop a predictive model of whitebark pine occurrence in ArcGIS. Eric then used his raster data to draw vector polygons over existing aerial imagery using the photo signatures of whitebark pine occurrence described above. We further refined and added to these polygons using a combination of Eric's field data modeling and mapping as well as our relevé plot data and map validation data. Sierra lodgepole pine and mountain hemlock can sometimes have contorted branching structure as well, especially smaller trees at timberline. Ultimately, to distinguish whitebark pine, we relied on all our data sources: a combination of Eric's data and modeling, our relevé plots, our validation plots, knowledge of vegetation patterns acquired through fieldwork, and the subtly grayer color of the whitebark pine in the true color imagery to identify where whitebark pine occurs at Crater Lake National Park.

Representative Ground Photo:



Above: Whitebark Pine Woodland at Crater Lake National Park. A moderately krummholzed whitebark pine (*Pinus albicaulis*) is shown in the center of the photo.

19. Subalpine Fir Forest

Map Unit Classification Colloquial Name (USNVC): Cascadian Subalpine Fir - Engelmann Spruce Forest
Map Unit Classification Common Name (USNVC): Subalpine Fir - Engelmann Spruce / Rough-fruit Berry Cascadian Forest Alliance
USNVC Map Unit Code: A3729

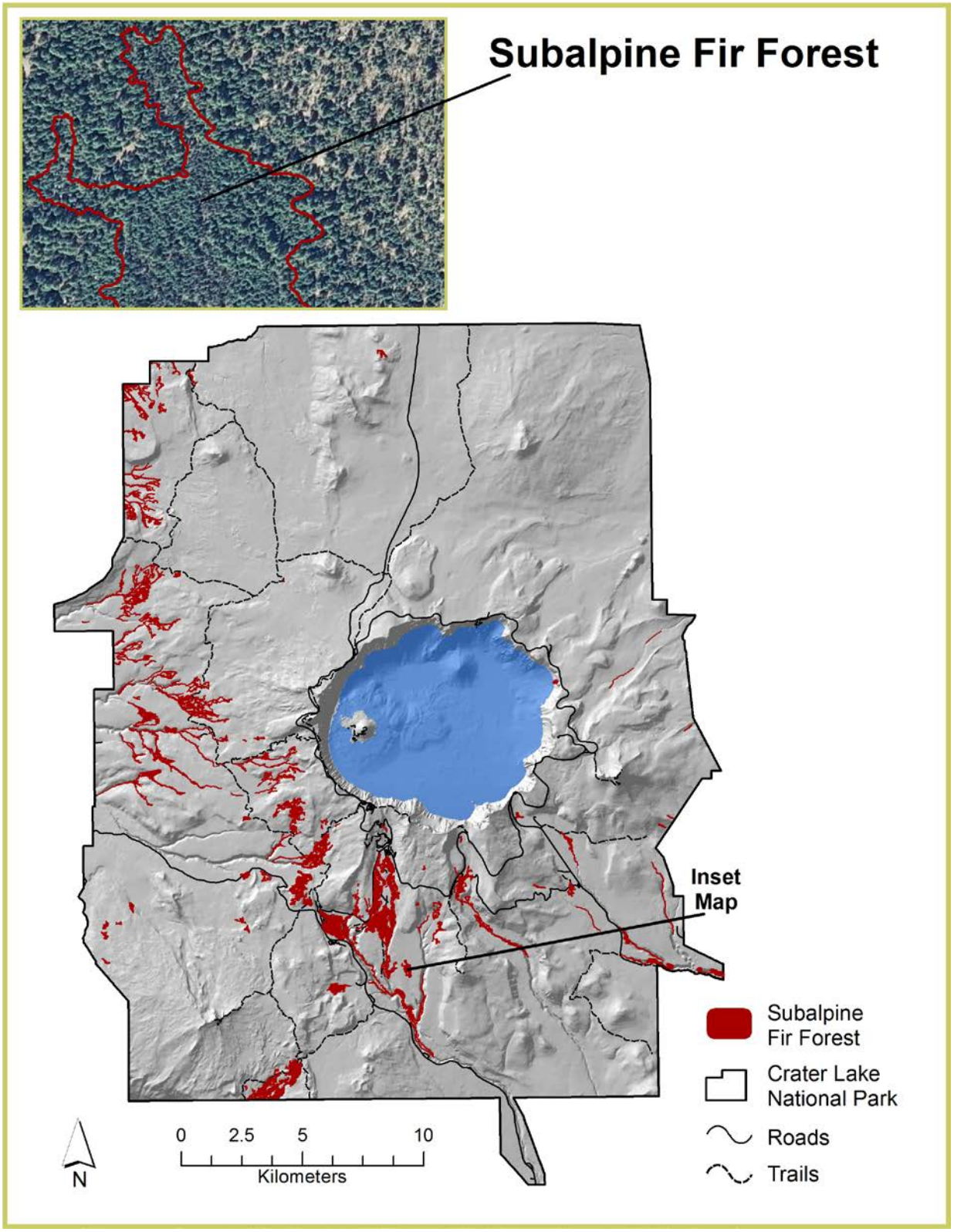
Associations that may dominate the map unit:

Common Name	Scientific Name
Subalpine Fir **-** Mountain Hemlock / Rough-fruit Berry Forest [Provisional]	*Abies lasiocarpa - Tsuga mertensiana* / *Rubus lasiococcus* Forest [Provisional]
Subalpine Fir **-** Sierra Lodgepole Pine Forest [Provisional]	*Abies lasiocarpa - Pinus contorta* var. *murrayana* Forest [Provisional]
Subalpine Fir **-** Engelmann Spruce / Grouse Whortleberry Forest	*Abies lasiocarpa* **-** *Picea engelmannii* / *Vaccinium scoparium* Forest

Total Hectares: 1,475.5
Percentage of Crater Lake National Park: 2.0
Elevation (m): 1431 - 2156

Description: Subalpine Fir Forest is a relatively dense conifer forest dominated or codominated by subalpine fir (*Abies lasiocarpa*) trees of various heights, with trees of short to medium-height being the most common. On mesic sites, subalpine fir is often codominant with mountain hemlock (*Tsuga mertensiana*) and/or Engelmann spruce (*Picea engelmannii*). The understory of these sites may have an abundance of subalpine fir saplings as well as an abundant cover of grouse whortleberry (*Vaccinium scoparium*) and several mesic site herb species. On colder and drier sites, Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) and/or mountain hemlock may be common. Dry site herbs such as western needlegrass (*Achnatherum occidentale*), Anderson's lupine (*Lupinus andersonii*) and long-stolon sedge (*Carex inops* ssp. *inops*) may dominate the understory.

Range and Distribution: Subalpine Fir Forest is common along riparian corridors and around wetland complexes. Subalpine Fir Forest is also common south of Crater Lake at higher elevations as well as to the southeast of Union Peak.



Above: Photo signature and range map for Subalpine Fir Forest at Crater Lake National Park.

Photo Signature and Mapping Considerations: Subalpine Fir Forest was identified by the presence of subalpine fir trees that were dominant or codominant with at least five percent cover in the forest overstory. Subalpine fir trees were recognizable on the true color imagery by their very narrow conical, almost columnar crown shape and dark blue-green color. Other co-occuring conifer trees have broader crowns and are lighter shades of green. Google Earth imagery was also used in this way to identify the location of subalpine fir trees. Subalpine Fir Forest is often, but not always, associated with nearby riparian areas and wetlands. Therefore, the ground under Subalpine Fir Forest at more mesic sites sometimes exhibited a green color in the true color imagery and light pink color in the color infrared imagery indicating a more abundant ground cover of herbaceous species and/or grouse whortleberry. This contrasted with the white colored ground of the adjacent drier uplands that lacked subalpine fir. Relevé and validation plots and knowledge of vegetation patterns acquired through fieldwork were also helpful in identifying where Subalpine Fir Forest occurs.

Representative Ground Photo:



Above: Subalpine Fir Forest at Crater Lake National Park. Subalpine fir (*Abies lasiocarpa*) have distinctive, narrow crowns. The trees in the center of this photo are subalpine fir.

20. Mountain Hemlock Forest

Map Unit Classification Colloquial Name (USNVC): Cascadian Pacific Silver Fir - Mountain Hemlock - Subalpine Fir Forest & Woodland
Map Unit Classification Common Name (USNVC): Pacific Silver Fir - Mountain Hemlock - Subalpine Fir Cascadian Forest & Woodland Alliance
USNVC Map Unit Code: A3726

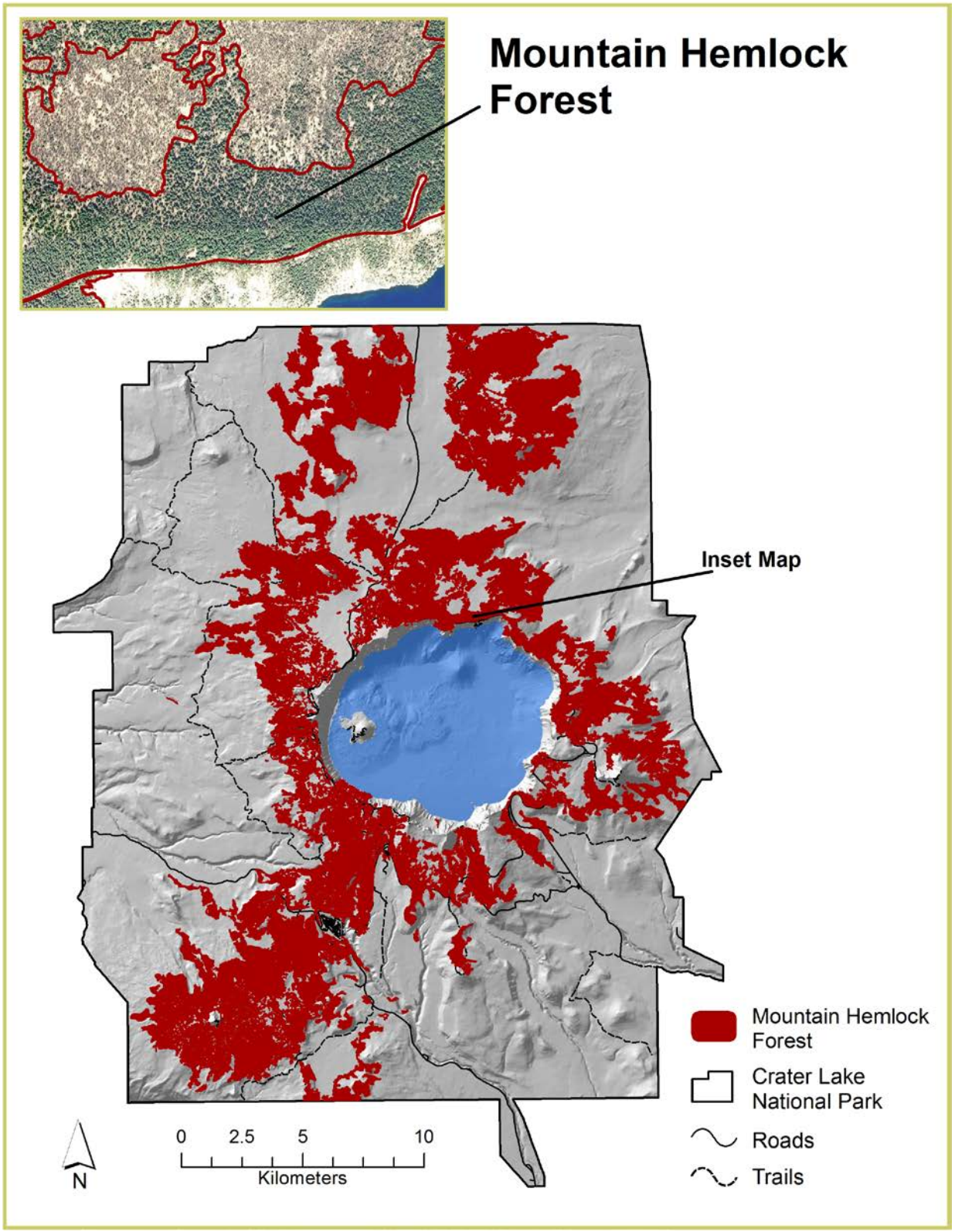
Associations that may dominate the map unit:

Common Name	Scientific Name
Mountain Hemlock – (Pacific Silver Fir, Subalpine Fir) / Hitchcock's Smooth Woodrush Woodland	*Tsuga mertensiana* - (*Abies amabilis*, *Abies lasiocarpa*) / *Luzula glabrata* var. *hitchcockii* Woodland
Mountain Hemlock / Sparse Understory Forest	*Tsuga mertensiana* / Sparse Understory Forest

Total Hectares: 16,396.7
Percentage of Crater Lake National Park: 22.2
Elevation (m): 1602 - 2520

Description: Mountain Hemlock Forest is a dense evergreen conifer forest strongly dominated by medium-sized to large mountain hemlock (*Tsuga mertensiana*). Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) and/or Shasta red fir (*Abies magnifica* var. *shastensis*) are occasional and sometimes common in the overstory. The understory is often open and sparse but is occasionally dominated by seedlings and saplings of mountain hemlock. The graminoid, Hitchcock's smooth woodrush (*Luzula glabrata* var. *hitchcockii*) may be common in the understory at higher elevations. Pinemat manzanita (*Arctostaphylos nevadensis*) can also occur in the understory at middle elevations in the park.

Range and Distribution: Mountain Hemlock Forest occurs over almost the entire elevation range of Crater Lake National Park, however, it is most common at higher elevations. It is widespread and common on middle to upper slopes on the outside of the Crater Lake caldera, along the Cascade crest south of Crater Lake to the slopes around Union Peak, along the Cascade crest north of Crater Lake to beyond Gaywas Peak, and on the slopes around Mount Scott and Timber Crater.



Above: Photo signature and range map for Mountain Hemlock Forest at Crater Lake National Park.

Photo Signature and Mapping Considerations: Mountain Hemlock Forest was identified by the dominance of mountain hemlock trees. Mountain hemlock trees were recognizable in the color imagery by their green color and the asymmetrical, somewhat messy branching pattern visible in the tree crown perimeter. This contrasted with the neat, conical crown shape and blue green color of Shasta red fir and the brownish-green color of Sierra lodgepole pine trees. Relevé and validation plots and knowledge of vegetation patterns acquired through fieldwork were also helpful in identifying where Mountain Hemlock Forest occurs.

Representative Ground Photo:



Above: Pure stand of Mountain Hemlock Forest at Crater Lake National Forest. All trees in the photo are mountain hemlock (*Tsuga mertensiana*).

21. Black Cottonwood Riparian Forest

Map Unit Classification Colloquial Name (USNVC): Northern Rocky Mountain Riparian Black Cottonwood Forest

Map Unit Classification Common Name (USNVC): Black Cottonwood Northern Rocky Mountain Riparian Forest Alliance

USNVC Map Unit Code: A0311

Associations that may dominate the map unit:

Common Name	Scientific Name
Black Cottonwood - Quaking Aspen / Broadleaf Lupine Forest [Provisional]	*Populus balsamifera* ssp. *trichocarpa* – *Populus tremuloides* / *Lupinus latifolius* ssp. *latifolius* Forest [Provisional]

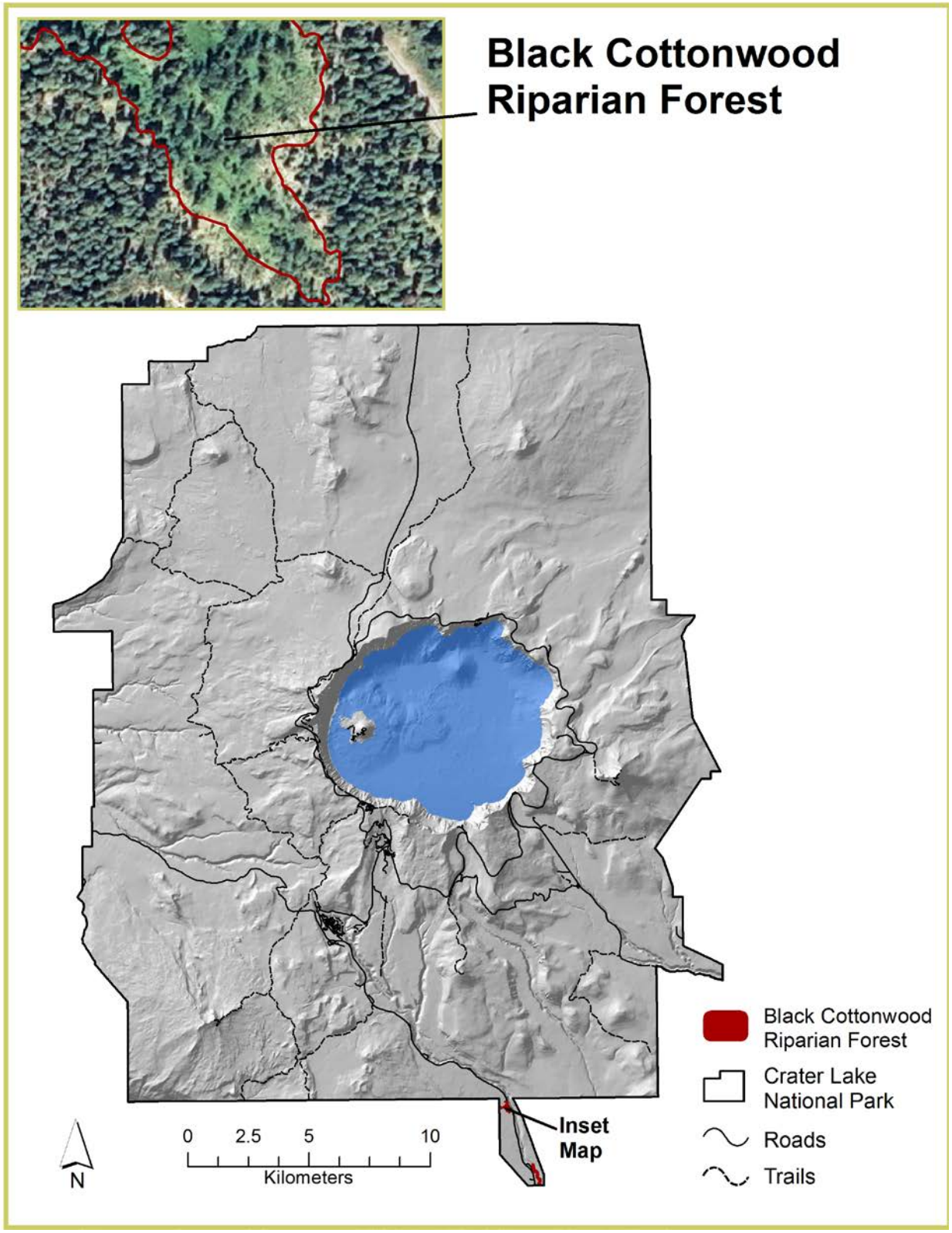
Total Hectares: 12.2

Percent of Crater Lake National Park: 0.02

Elevation (m): 1328 - 1461

Description: Black Cottonwood Riparian Forest is moderately dense to open forest dominated by medium-sized to large broadleaf deciduous trees. Black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) is dominant in the forest overstory or codominant with quaking aspen (*Populus tremuloides*). Gray alder (*Alnus incana*), another deciduous species, is the dominant understory shrub. Broadleaf lupine (*Lupinus latifolius* ssp. *latifolius*) and bluejoint (*Calamagrostis canadensis*) dominate a lush and diverse herb/graminoid layer.

Range and Distribution: Black Cottonwood Riparian Forest is limited to two discreet areas Crater Lake National Park in the Panhandle area, along the riparian corridor on lower Annie Creek, and in a large wetland on the bench above Annie Creek.



Above: Photo signature and range map for Black Cottonwood Riparian Forest at Crater Lake National Park.

Photo Signature and Mapping Considerations: As with all wetland vegetation in the park**,** Black Cottonwood Riparian Forest was visible due to its bright green on the true color imagery and bright red on the color infrared imagery. It was discernible from upland vegetation in the color infrared imagery due to the bright red color of the groundcover of highly productive vegetation whereas the groundcover of upland vegetation is tawny or white. Unlike other wetland areas, Black Cottonwood Riparian Forest has a readily visible deciduous tree cover, which have noticeably rounded crowns that are lighter green compared to the darker green conifer trees. Relevé and validation plots as well as knowledge of vegetation patterns acquired through fieldwork were very helpful in identifying where Black Cottonwood Riparian Forest occurs. The National Wetlands Inventory map of wetlands produced by the U.S. Fish and Wildlife Service was also used to locate and map Black Cottonwood Riparian Forest in Crater Lake National Park.

Representative Ground Photo:



Above: Black Cottonwood Riparian Forest at Crater Lake National Park. The trees in the center and far right are black cottonwoods (*Populus balsamifera* ssp. *trichocarpa*).

22. Subalpine Fir - Lodgepole Pine Riparian Woodland

Map Unit Classification Colloquial Name (USNVC): North Pacific Montane Riparian Woodland
Map Unit Classification Common Name (USNVC): Mountain Hemlock - Fir spp. / Willow spp. Montane Riparian Woodland Group
USNVC Map Unit Code: G507

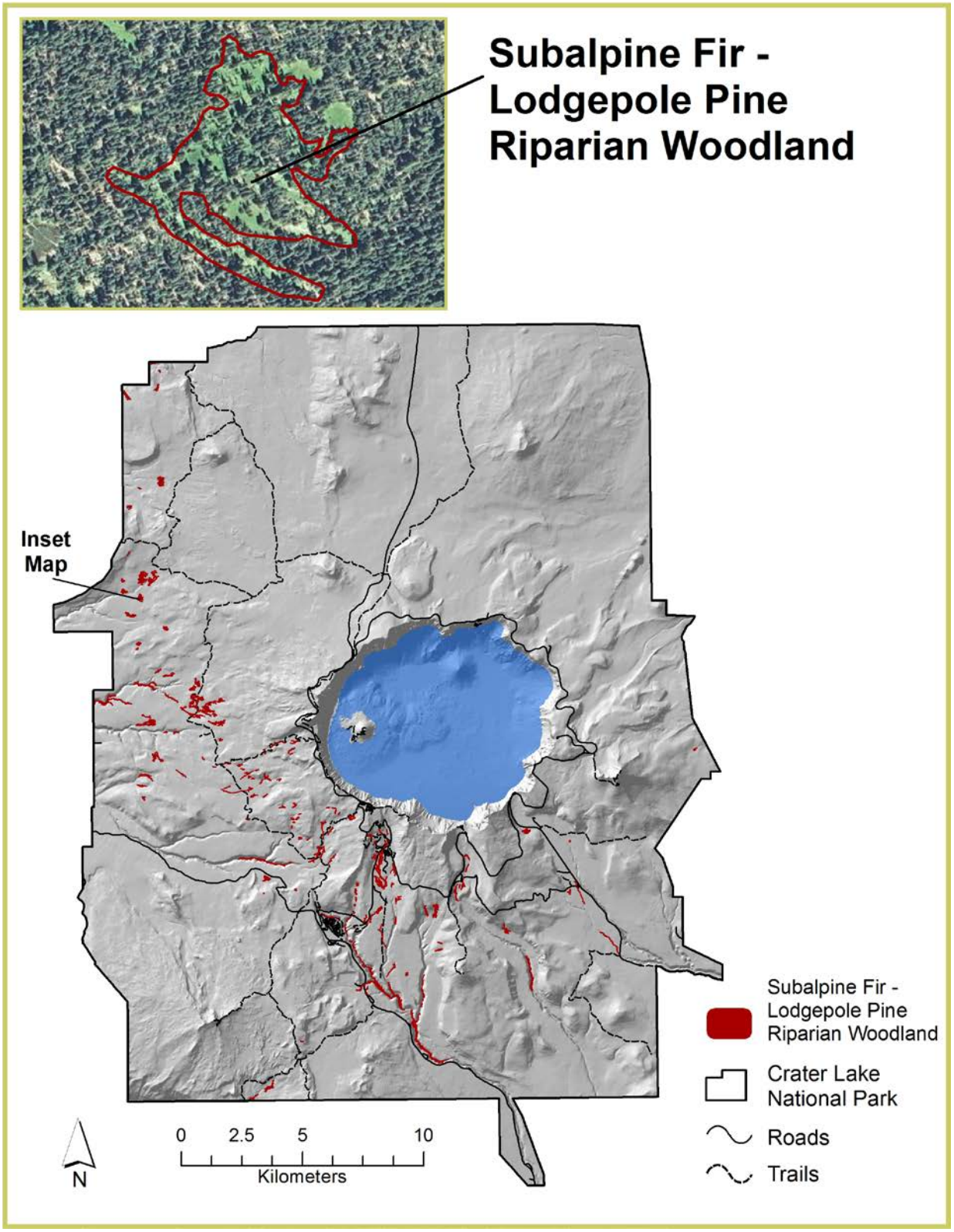
Associations that may dominate the map unit:

Common Name	Scientific Name
Subalpine Fir - Lodgepole Pine / Bluejoint - Sedge spp. Forest [Provisional]	*Abies lasiocarpa* - *Pinus contorta* var. *murrayana* / *Calamagrostis canadensis* - *Carex* spp. Forest [Provisional]
(Tall Lodgepole Pine, Sierra Lodgepole Pine) / Bog Blueberry Forest	*Pinus contorta* (var. *latifolia*, var. *murrayana*) / *Vaccinium uliginosum* Forest

Total Hectares: 323.6
Percent of National Park: 0.4
Elevation (m): 1433 - 2140

Description: Subalpine Fir - Lodgepole Pine Riparian Woodland is a dense to open forest of small to medium sized trees that occurs along riparian areas, or an open forest that occurs in wetlands, seeps and along wet meadow margins. Subalpine fir (*Abies lasiocarpa*) or Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) are individually dominant in the overstory or they are codominant in the overstory sometimes with mountain hemlock (*Tsuga mertensiana*). The understory is dominated by a lush and diverse herb/graminoid layer of wetland vegetation growing in saturated soil. Bluejoint (*Calamagrostis canadensis*), woodrush sedge (*Carex luzulina*), mountain sedge (*Carex scopulorum* var. *bracteosa*), arrowleaf ragwort (*Senecio triangularis*), and/or Sitka sedge (*Carex aquatilis* var. *dives*) may be common and abundant. The deciduous shrub, bog blueberry (*Vaccinium uliginosum*) can dominate the understory in Subalpine Fir - Lodgepole Pine Riparian Woodland at relatively low elevations in the park.

Range and Distribution: Subalpine Fir - Lodgepole Pine Riparian Woodland occurs in riparian areas and floodplains along stream courses as well as in wetlands and seeps, mainly in the western and southern part of Crater Lake National Park.



Above: Photo signature and range map for Subalpine Fir - Lodgepole Pine Riparian Woodland at Crater Lake National Park.

Photo Signature and Mapping Considerations: Subalpine Fir - Lodgepole Pine Riparian Woodland was identifiable by its visible understory that is bright green on the true color imagery and bright red on the color infrared imagery. It was discernible from upland vegetation in the color infrared imagery by the bright red color of the groundcover of highly productive vegetation whereas the groundcover of upland vegetation is tawny or white. Unlike the often associated Montane Wet Meadow & Marsh and shrub dominated wetland vegetation, Subalpine Fir - Lodgepole Pine Riparian Woodland has a readily visible conifer tree cover. Subalpine fir trees were distinctly recognizable on the true color imagery by their very narrow conical, almost columnar crown shape and dark blue-green color. Subalpine Fir - Lodgepole Pine Riparian Woodland was distinguishable from Engelmann Spruce Swamp Woodland on the true color imagery because Engelmann spruce have a broader crown shape than both subalpine fir and Sierra lodgepole pine and are darker forest green with slightly brownish tree tops due to the high density of female cones. The conical crown shape and dark green color of the conifer trees distinguish it from Black Cottonwood Riparian Forest with its cover of deciduous trees that have noticeably rounded crowns that are lighter green. In addition, Black Cottonwood Riparian Forest only occurs at relatively low elevations in the Panhandle area of the park. Relevé and validation plots as well as knowledge of vegetation patterns acquired through fieldwork were very helpful in identifying where Subalpine Fir - Lodgepole Pine Riparian Woodland occurs. The National Wetlands Inventory map of wetlands produced by the U.S. Fish and Wildlife Service was also used to locate and map Subalpine Fir - Lodgepole Pine Riparian Woodland in Crater Lake National Park.

Representative Ground Photo:



Above: Subalpine Fir – Lodgepole Pine Riparian Woodland at Crater Lake National Park. The abundant sedge in the understory is mountain sedge (*Carex scopulorum* var. *bracteosa*). Subalpine fir trees are on right and far left sides of the photo. Sierra lodgepole pine trees are in the background.

23. Engelmann Spruce Swamp Woodland

Map Unit Classification Colloquial Name (USNVC): Cascadian Engelmann Spruce Swamp Woodland
Map Unit Classification Common Name (USNVC): Engelmann Spruce Cascadian Swamp Woodland Alliance
USNVC Code: A3767

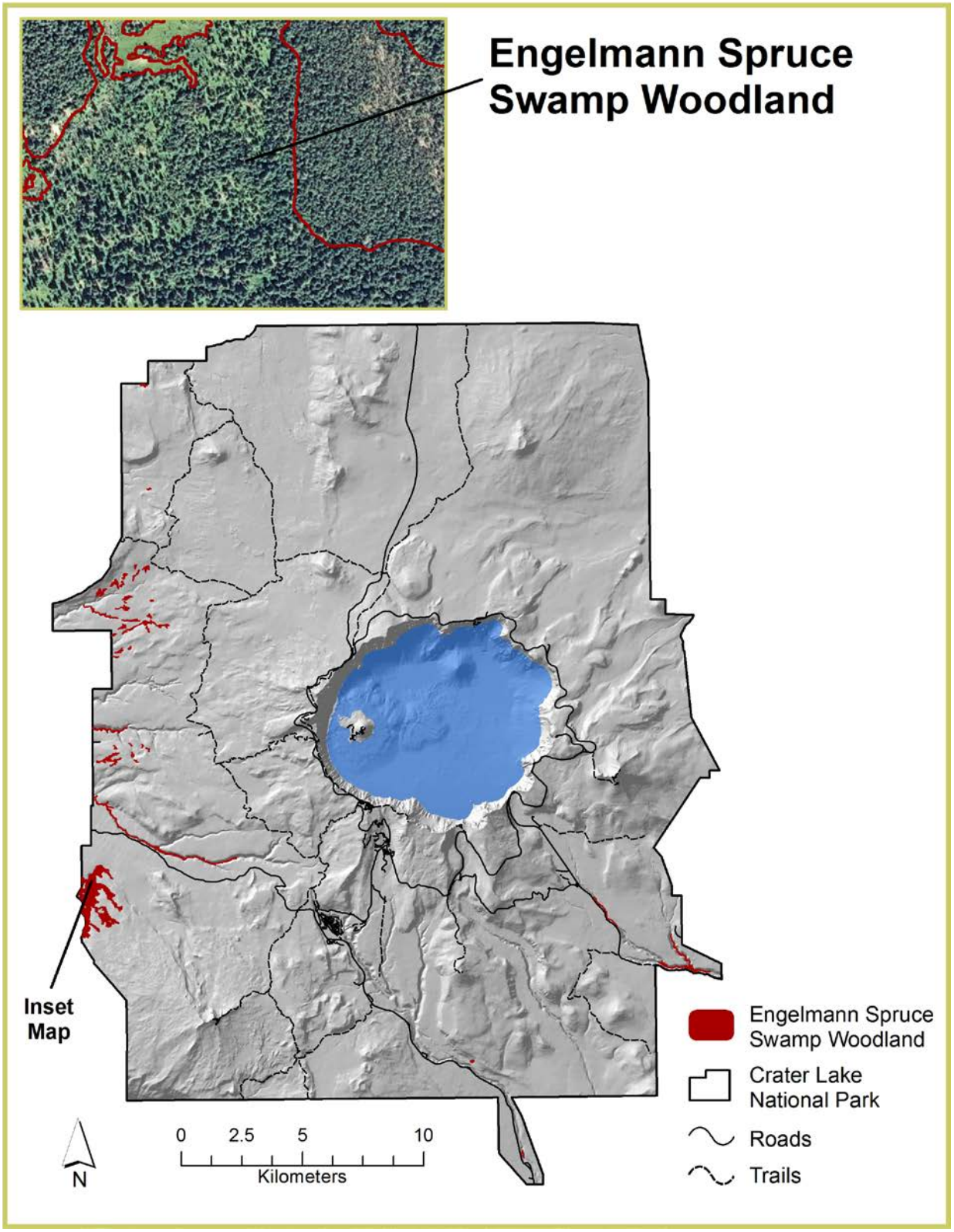
Associations that may dominate the map unit:

Common Name	Scientific Name
Western Hemlock - Engelmann Spruce Forest [Provisional]	*Tsuga heterophylla* - *Picea engelmannii* Forest [Provisional]
Engelmann Spruce / Blueberry spp. Forest [Provisional]	*Picea engelmannii* / *Vaccinium* spp. Forest [Provisional]

Total Hectares: 313.8
Percentage of Crater Lake National Park: 0.43
Elevation (m): 1342 - 1780

Description: Engelmann Spruce Swamp Woodland is a dense, relatively tall conifer forest that occurs in riparian areas and floodplains along streams, in and around wetlands, and in areas of seeps and springs where soils are saturated year-round. The forest is dominated by Engelmann spruce (*Picea engelmannii*) usually with a subordinate cover of subalpine fir (*Abies lasiocarpa*). Mountain hemlock (*Tsuga mertensiana*) is sometimes present in the overstory. At Thousand Springs, western hemlock (*Tsuga heterophylla*) is sometimes codominant in the overstory. Gray alder (*Alnus incana* ssp. *tenuifolia*) can be common in some stands. The understory is strongly dominated by a lush herb/graminoid layer along with one or more of the following *Vaccinium* species: grouse whortleberry (*Vaccinium scoparium*), bog blueberry (*Vaccinium uliginosum*) and thinleaf huckleberry (*Vaccinium membranaceum*). The shrub western teaberry (*Gaultheria ovatifolia*) is often a common understory plant. The wetland grass, bluejoint (*Calamagrostis canadensis*), is often abundant in the understory. A diversity of wetland/mesic site herbs, grasses and sedges may be present, including, Gray's licorice root (*Ligusticum grayi*), arrowleaf ragwort (*Senecio triangularis*) and field horsetail (*Equisetum arvense*). Trees often grown on hummocks that are relatively drier than the surrounding saturated soil and mesic upland herbaceous plant species may be common there.

Range and Distribution: Engelmann Spruce Swamp Woodland occurs in riparian areas and floodplains along streams, in and around wetlands, and in areas of seeps and springs mainly at lower elevations in the western and southeast portions of Crater Lake National Park. Some extensive and noteable stands occur along lower Sand Creek and in Thousand Springs.



Above: Photo signature and range map for Engelmann Spruce Swamp Woodland at Crater Lake National Park.

Photo Signature and Mapping Considerations: Engelmann Spruce Swamp Woodland was identifiable by its visible understory that is bright green on the true color imagery and bright red on the color infrared imagery. It was discernible from upland vegetation in the color infrared imagery by the bright red color of the groundcover of highly productive vegetation whereas the groundcover of upland vegetation is tawny or white. Unlike the often associated Montane Wet Meadow & Marsh and shrub dominated wetland vegetation, Engelmann Spruce Swamp Woodland has a readily visible conifer tree cover. Engelmann spruce trees were recognizable on the true color imagery by their dark forest green color with slightly brownish tree tops due to the high density of female cones. Engelmann Spruce Swamp Woodland was distinguishable from Subalpine Fir - Lodgepole Pine Riparian Woodland on the true color imagery because Engelmann spruce have a broader crown shape whereas subalpine fir have are very narrow conical, almost columnar crown shape and dark blue-green color. The conical crown shape and dark green color of the conifer trees distinguish it from Black Cottonwood Riparian Forest with its cover of deciduous trees that have noticeably rounded crowns that are lighter green. Engelmann Spruce Swamp Woodland was often distinguishable from the upland forest because the Engelmann spruce trees were often more widely spaced. Relevé and validation plots as well as knowledge of vegetation patterns acquired through fieldwork were also very helpful in identifying where Engelmann Spruce Swamp Woodland occurs. The National Wetlands Inventory map of wetlands produced by the U.S. Fish and Wildlife Service was also used to locate and map Engelmann Spruce Swamp Woodland in Crater Lake National Park.

Representative Ground Photo:



Above: Engelmann Spruce Swamp Woodland at Crater Lake National Park. The forest is dominated by Engelmann spruce (*Picea engelmannii*). Grouse whortleberry (*Vaccinium scoparium*) is common in the foreground.

24. Mountain Hemlock Forest - Lodgepole Pine Forest Complex
Map Unit Classification Colloquial Name (USNVC): N/A
Map Unit Classification Common Name (USNVC): N/A
USNVC Map Unit Code: NPSCRLA014

Associations that may co-occur in the map unit:

Common Name	Scientific Name
Mountain Hemlock – (Pacific Silver Fir, Subalpine Fir) / Hitchcock's Smooth Woodrush Woodland	*Tsuga mertensiana* - (*Abies amabilis*, *Abies lasiocarpa*) / *Luzula glabrata* var. *hitchcockii* Woodland
Mountain Hemlock / Sparse Understory Forest	*Tsuga mertensiana* / Sparse Understory Forest
(Tall Lodgepole Pine, Sierra Lodgepole Pine) / Pinemat Manzanita Forest	*Pinus contorta* (var. *latifolia*, var. *murrayana*) / *Arctostaphylos nevadensis* Forest
Sierra Lodgepole Pine / Long-stolon Sedge Forest	*Pinus contorta* var. *murrayana* / *Carex inops* ssp. *inops* Forest
Lodgepole Pine / Antelope Bitterbrush / Long-stolon Sedge Forest	*Pinus contorta* / *Purshia tridentata* / *Carex inops* ssp. *inops* Forest
Sierra Lodgepole Pine / Sparse Understory Forest	*Pinus contorta* var. *murrayana* / Sparse Understory Forest
Sierra Lodgepole Pine – (Mountain Hemlock) / Pinemat Manzanita / Davidson's Penstemon Woodland	*Pinus contorta* var. *murrayana* - (*Tsuga mertensiana*) / *Arctostaphylos nevadensis* / *Penstemon davidsonii* Woodland
Sierra Lodgepole Pine / Snowbrush Ceanothus Forest	*Pinus contorta* var. *murrayana* / *Ceanothus velutinus* Forest

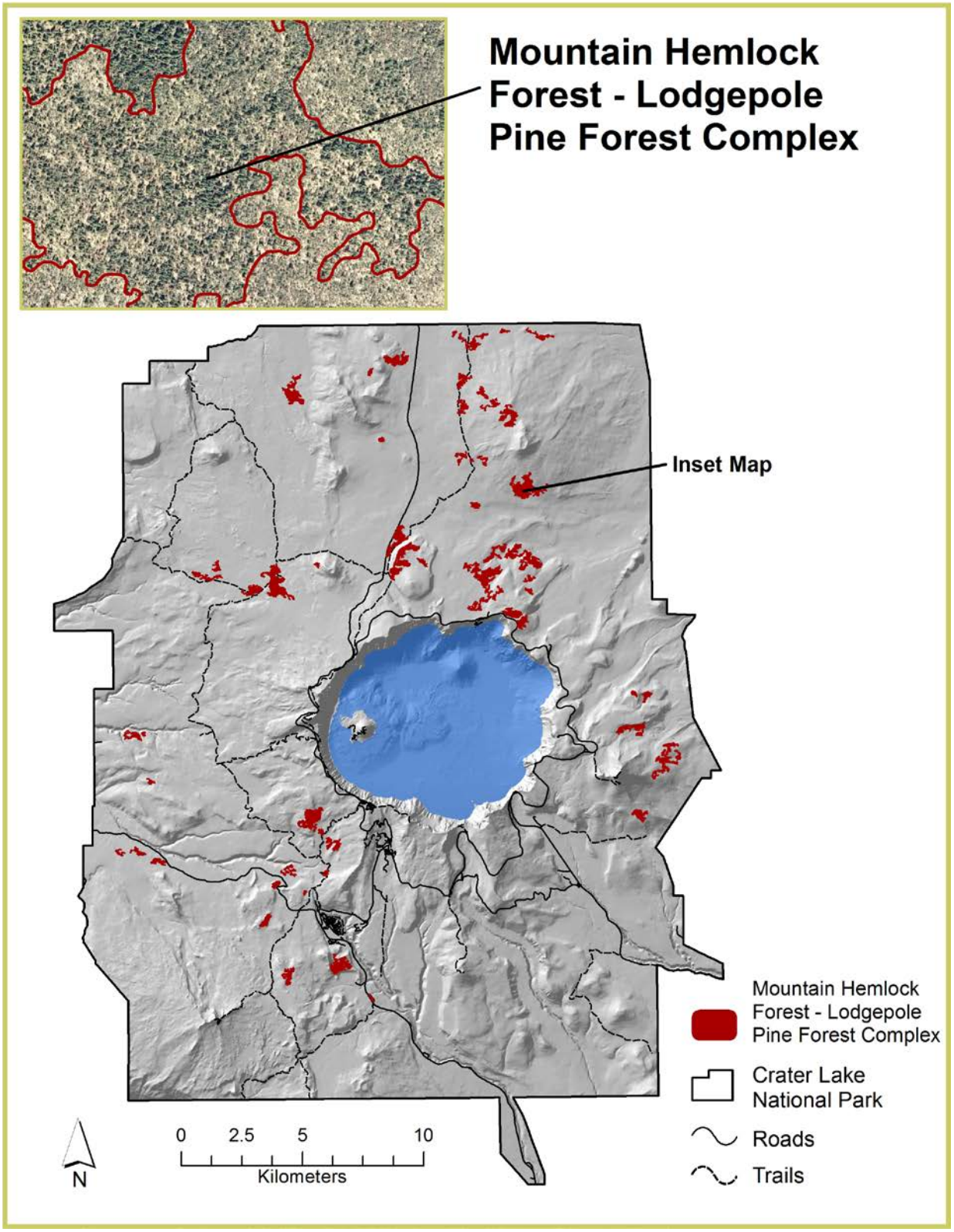
Total Hectares: 924.5
Percentage of Crater Lake National Park: 1.3
Elevation (m): 1541 - 2266

Description: The Mountain Hemlock Forest - Lodgepole Pine Forest Complex is a sparse to moderately dense evergreen coniferous forest dominated by patches of mountain hemlock (*Tsuga mertensiana*) and patches of Sierra lodgepole pine (*Pinus contorta* var. *murrayana*). It occurs where distinct patches of these two species are too finely mixed to be partitioned into either Lodgepole Pine Forest or Mountain Hemlock Forest at the scale of the 0.5 ha minimum mapping. Relevé sampling did not identify vegetation associations comprised of mixed stands of mountain hemlock and Sierra lodgepole pine. However, this vegetation pattern was encountered during mapping. Therefore, the Mountain Hemlock Forest - Lodgepole Pine Forest Complex map unit was created in order to map forests dominated by both patches of mountain hemlock and patches of Sierra lodgepole pine.

The overstory is comprised of patches of mountain hemlock and patches of Sierra lodgepole pine. The understory is sometimes dominated by saplings of mountain hemlock. Herbaceous cover is sparse and dominated by graminoids, such as long-stolon sedge (*Carex inops* ssp. *inops*).

Range and Distribution: The Mountain Hemlock Forest - Lodgepole Pine Forest Complex is a complex of two map units, Mountain Hemlock Forest and Lodgepole Pine Forest, which occurs

throughout the north and west parts of the park. Mountain Hemlock Forest - Lodgepole Pine Forest Complex is most common in and around large, homogeneous areas of both Mountain Hemlock Forest and Lodgepole Pine Forest.



Above: Photo signature and range map for Mountain Hemlock Forest - Lodgepole Pine Forest Complex at Crater Lake National Park.

Photo Signature and Mapping Considerations: The Mountain Hemlock Forest - Lodgepole Pine Forest Complex is recognizable in the true color imagery by the sparse tree crowns and brownish color of stands of Sierra lodgepole pine punctuated by patches of mountain hemlock with their broader crowns and green color. It is therefore not as brownish as pure Lodgepole Pine Forest and not as solid green as pure Mountain Hemlock Forest. The Mountain Hemlock Forest - Lodgepole Pine Forest Complex was distinguishable from sparse stands of Shasta Red Fir Forest because the conical crown shape and blue-green color of Shasta red fir (*Abies magnifica* var. *shastensis*) was easily discernible in the true color imagery. However, it was revealed through the accuracy assessment that the Mountain Hemlock Forest - Lodgepole Pine Forest Complex was frequently confused with Shasta Red Fir Forest. Mountain Hemlock Forest and Lodgepole Pine Forest occurred in distinct patches that were so intermixed that they could not be reasonably delineated and separated from each in the mapping. Therefore, these two map units were grouped together and mapped as the Mountain Hemlock Forest - Lodgepole Pine Forest Complex.

Representative Ground Photo:



Above: Mountain Hemlock - Lodgepole Pine Forest Complex at Crater Lake National Park.

V. Sparsely Vegetated or Unvegetated

25. Cliff, Scree & Rock Vegetation

Map Unit Classification Colloquial Name (USNVC): Southern Vancouverian Cliff, Scree & Rock Vegetation
Map Unit Classification Common Name (USNVC): Western White Pine / Pinemat Manzanita Cliff, Scree & Rock Vegetation Group
USNVC Map Unit Code: G573

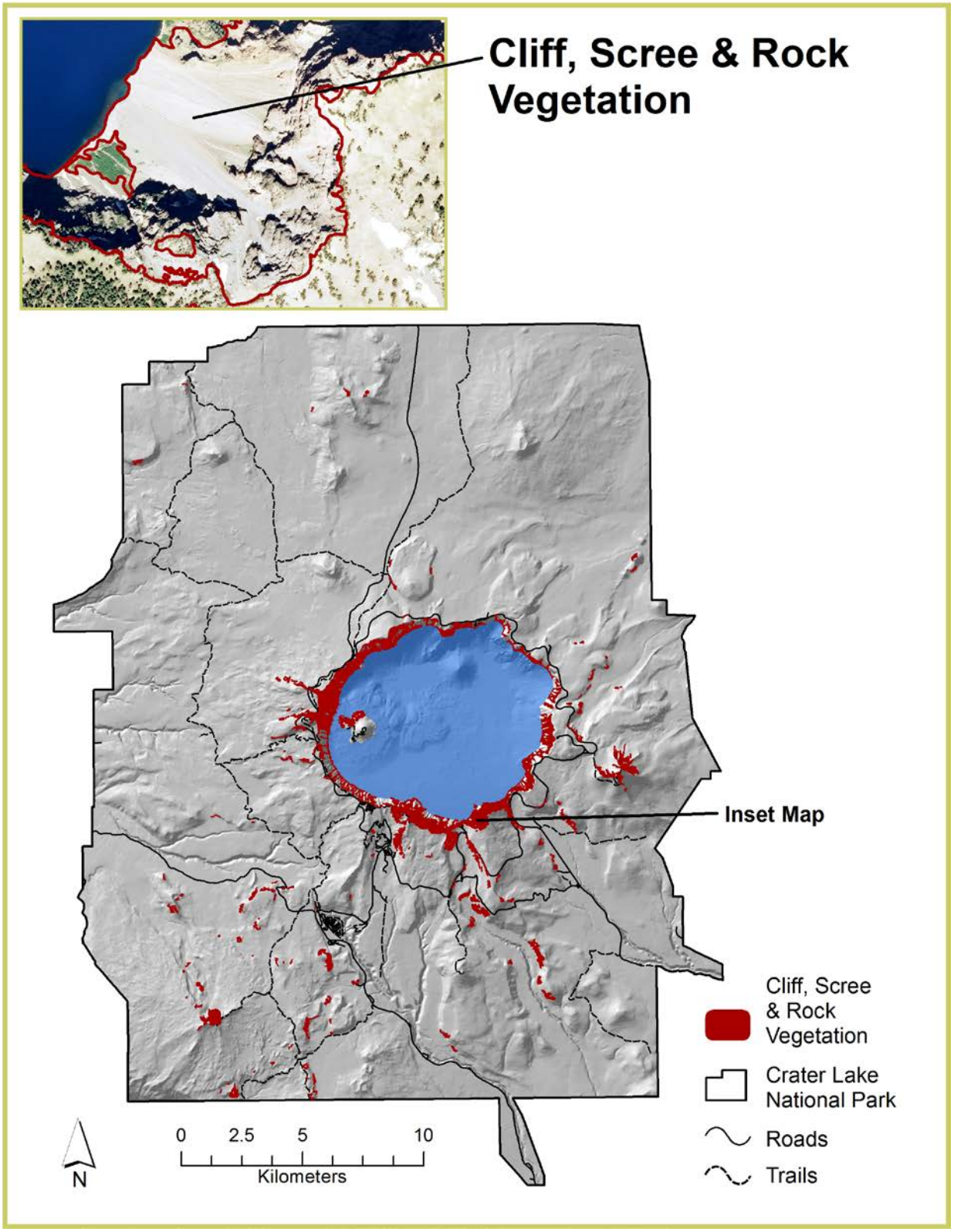
Associations that may dominate the map unit:

Common Name	Scientific Name
Davidson's Penstemon Sparse Vegetation	*Penstemon davidsonii* Sparse Vegetation
White Pasqueflower - Davidson's Penstemon Sparse Vegetation	*Pulsatilla occidentalis* - *Penstemon davidsonii* Sparse Vegetation

Total Hectares: 1,201.4
Percentage of Crater Lake National Park: 1.6
Elevation (m): 1570 - 2722

Description: Cliff, Scree & Rock Vegetation is scree slopes, barren rock and cliff faces that have little or no vegetation. The cover of vegetation is less than or equal to five percent. A very sparse cover of oceanspray (*Holodiscus discolor*), bitter cherry (*Prunus emarginata*), white pasqueflower (*Pulsatilla occidentalis*), Davidson's penstemon (*Penstemon davidsonii*), pinemat manzanita (*Arctostaphylos nevadensis*), and variety of other herbs and woody shrubs may be present. Very scattered conifer trees may also be present. Cliff, Scree & Rock Vegetation that includes associations dominated by white pasqueflower and Davidson's penstemon can have a vegetated cover higher than five percent. Cliff, Scree & Rock Vegetation often occurs in a mosaic with Bitter Cherry – Oceanspray Shrubland and/or Greenleaf Manzanita - Pinemat Manzanita Shrubland. As such, Cliff, Scree & Rock Vegetation may include patches of Bitter Cherry – Oceanspray Shrubland or Greenleaf Manzanita - Pinemat Manzanita Shrubland.

Range and Distribution: Cliff, Scree & Rock Vegetation occurs mainly inside the Crater Lake caldera, however, it also occurs on major peaks, buttes and bluffs throughout Crater Lake National Park.



Above: Photo signature and range map for Cliff, Scree, & Rock Vegetation at Crater Lake National Park.

Photo Signature and Mapping Considerations: Cliff, Scree & Rock Vegetation is white or nearly white in the true color imagery and the infrared imagery due to the absence of vegetation and the whitish color of the bare rock. There is often a conspicuous texture due to the talus rock and the cliff faces. Cliff, Scree & Rock Vegetation also is identifiable by its occurance at the steepest locations in the park.

Representative Ground Photo:



Above**:** Cliff, Scree & Rock Vegetation at Crater Lake National Park. Plants visible among the rocks are white pasqueflower (*Pulsatilla occidentalis*).

26. Pumice/Sand
Map Unit Classification Common Name: Pumice/Sand
Map Unit Code: NPSCRLA015

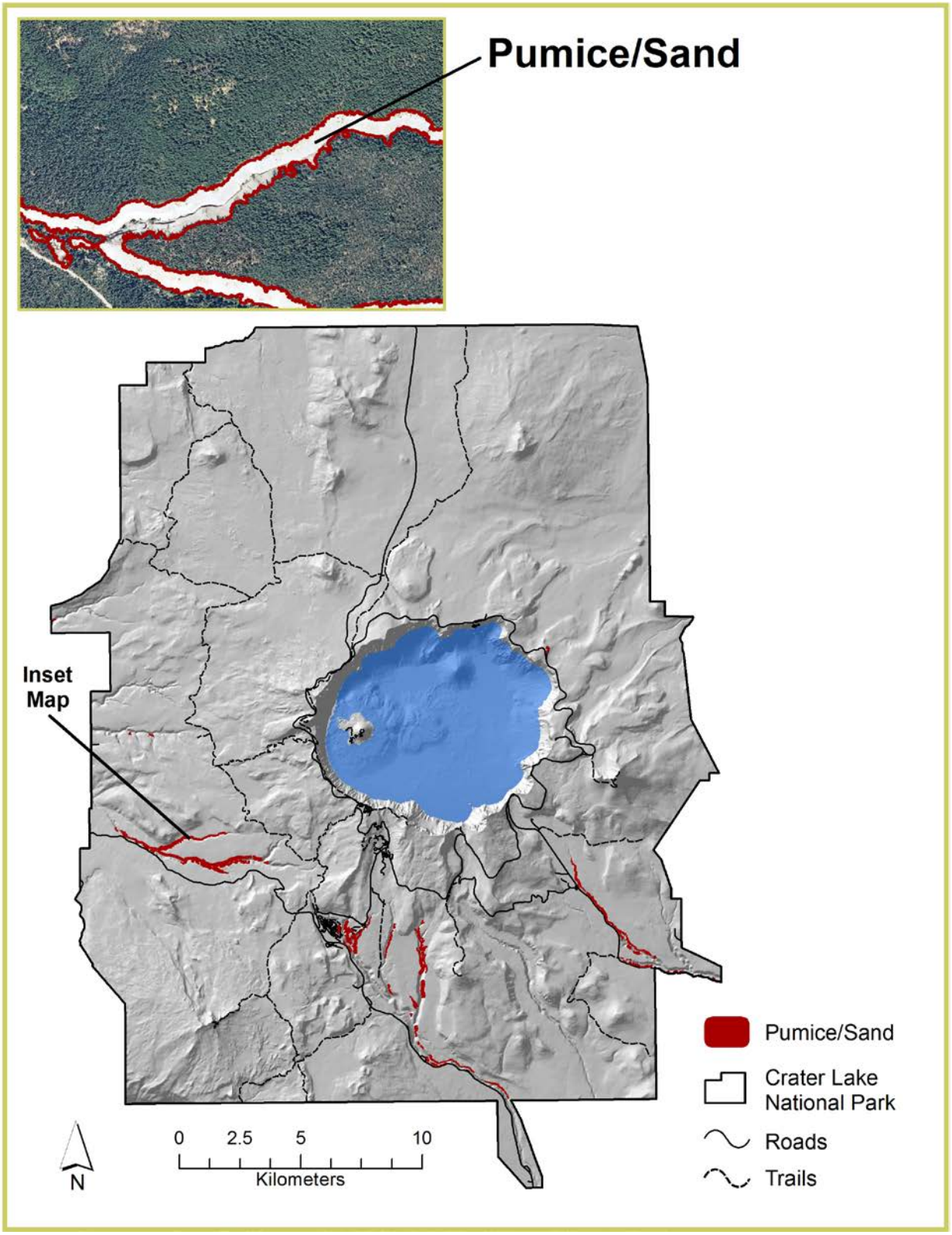
Associations that may dominate the map unit:

Common Name	Scientific Name
N/A	N/A

Total Hectares: 239
Percentage of Crater Lake National Park: 0.3
Elevation (m): 1375 - 2076

Description: Pumice/Sand is areas of bare granular substratum. Pumice pieces are often marble sized and sand is coarse. The pumice is unconsolidated in the upper layers, and hence is very unstable. Very little vegetation, if any, occurs on Pumice/Sand. It is not uncommon to see pumice sliding downhill because it often occurs at the angle of repose. It was deemed to be unsafe to sample Pumice/Sand directly. Sampling was often done for the accuracy assessment using binoculars from nearby vantage points. The instability of pumice, in addition to its virtual lack of water retention are probably the main factors explaining the lack of vegetation on Pumice/Sand.

Range and Distribution: Pumice/Sand occurs almost exclusively along the three the main drainages in the southern or southwestern part of the park. From west to east, these are Castle Creek (two main forks), Annie Creek and several tributaries in its upper watershed, and Sand Creek (mainstem and one tributary). The creeks have incised deeply into the pumice along these drainages.



Above: Photo signature and range map for Pumice/Sand at Crater Lake National Park.

Photo Signature and Mapping Considerations: Pumice/Sand is white in the imagery and it always parallels creeks. It is conspicuous in both the true color imagery and the color infrared imagery.

Representative Ground Photo:

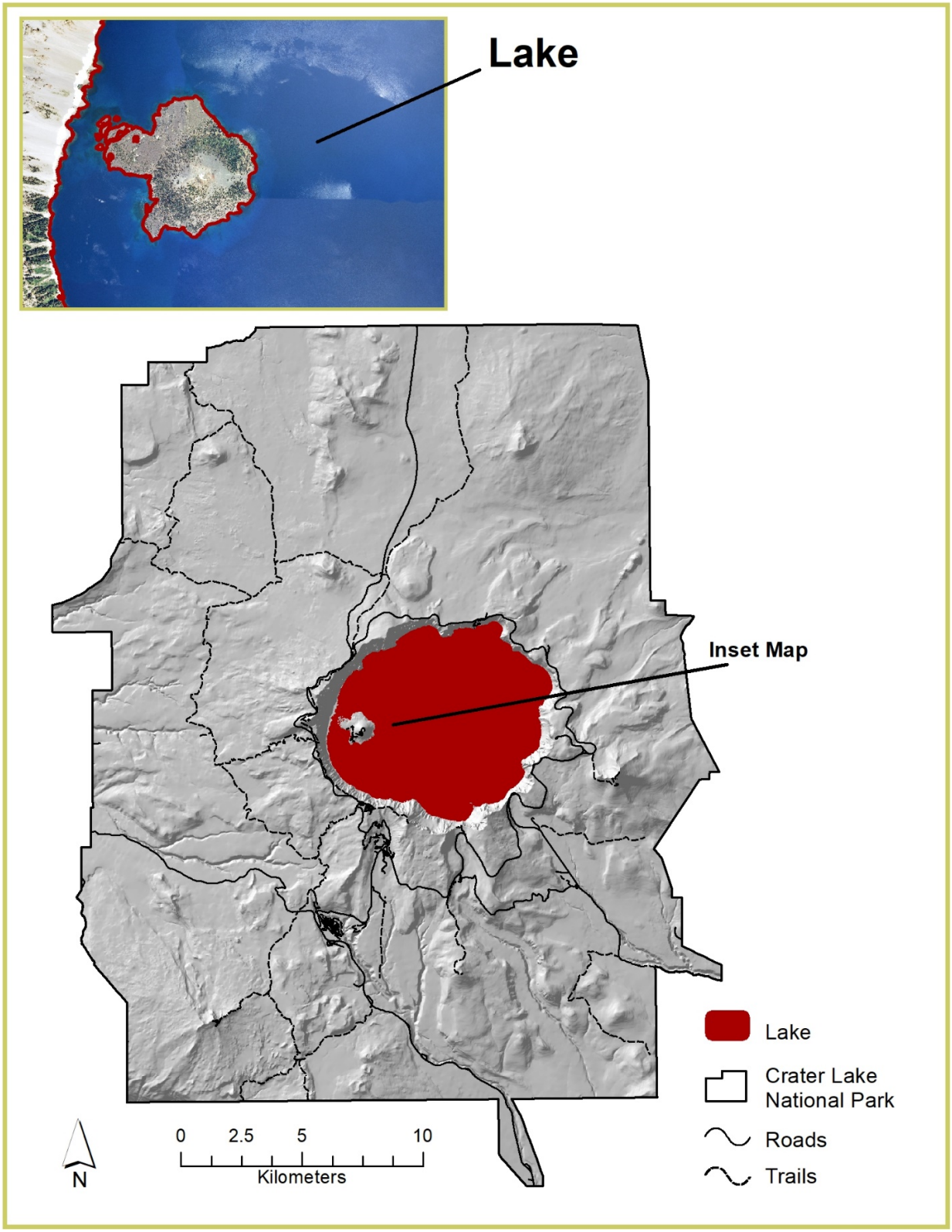


Above: Pumice/Sand along a creek in Crater Lake National Park.

27. Lake
Map Unit Classification Common Name (LULC): Lakes
Map Unit Code: LULC52

Total Hectares: 5,333
Percentage of Crater Lake National Park: 7.2
Elevation (m): 1883

Description: Crater Lake.



Above: Photo signature and range map for Crater Lake at Crater Lake National Park.

Photo Signature and Mapping Considerations: Crater Lake was mapped using lidar imagery. This resulted in a very accurate mapping of the lake area for the date of the 2011 imagery. It should be noted that the lake level fluctuates seasonally by 122 cm, and has decreased by about 4m in the last 40 years.

Representative Ground Photo:



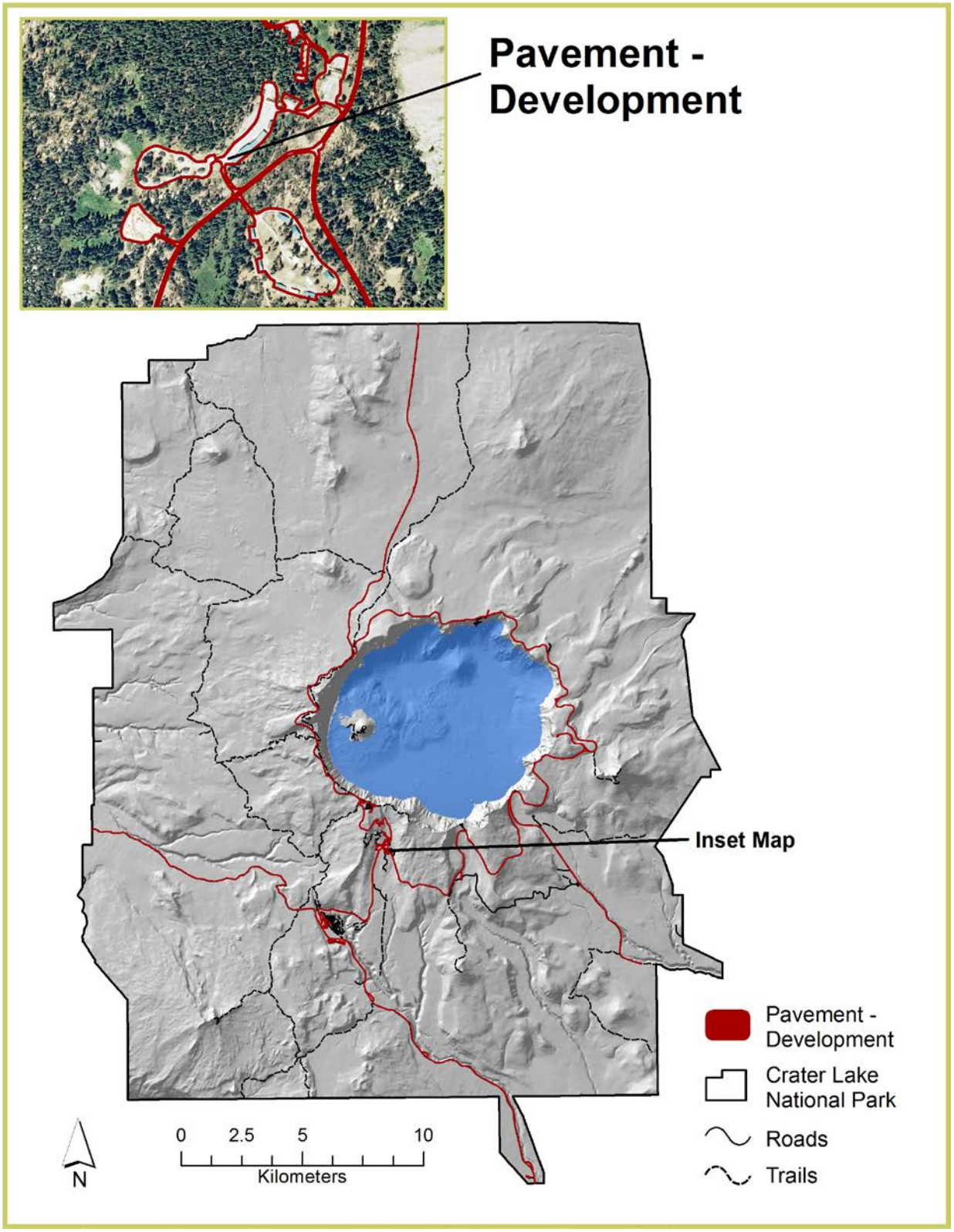
Above: Representative photo of Crater Lake in Crater Lake National Park. It is mapped as Lake in this report.

28. Pavement – Development

Map Unit Classification Common Name (LULC): Mixed Urban or Built-up Land
Map Unit Code: LULC16

Total Hectares: 110.6
Percentage of Crater Lake National Park: 0.2

Description: Pavement – Development is the paved surfaces of major roads and parking lots and the visible footprints of buildings.



Above: Photo signature and range map for Pavement - Development at Crater Lake National Park.

Photo Signature and Mapping Considerations: Pavement - Development was mapped based on the known location and the visible area of roads, car parks, park facilities, and adjacent infastructure. Lidar was used to map road surfaces.

Representitive Ground Photo: None.

Appendix B. Vegetation Association Descriptions

U.S. NATIONAL VEGETATION CLASSIFICATION

Crater Lake National Park
2018

By Dominic A. DiPaolo, Southern Oregon University

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[Provisional] = park specific association, i.e., not in the United States National Vegetation Classification (USNVC).

HERBACEOUS VEGETATION

1. ROCKY MOUNTAIN POND-LILY AQUATIC VEGETATION

Nuphar polysepala Aquatic Vegetation

USNVC CLASSIFICATION:
Class: 5 Aquatic Vegetation
Subclass: 5.B Freshwater Aquatic Vegetation
Formation: 5.B.2 Temperate to Polar Freshwater Aquatic Vegetation
Division: 5.B.2.Na - D049 North American Freshwater Aquatic Vegetation
Macrogroup: 5.B.2.Na.2 - M109 Western North American Freshwater Aquatic Vegetation
Group: 5.B.2.Na.2.a - G544 Western North American Temperate Freshwater Aquatic Vegetation
Alliance: A3926 Western Pond-lily Aquatic Vegetation
Association: *Nuphar polysepala* Aquatic Vegetation

USNVC Identifier: CEGL002001

LOCAL INFORMATION

Environmental Description: This aquatic, herbaceous vegetation occurs in permanently flooded ponds scattered across the western half of the park at all elevations in relatively level areas. It occurs near large wetland complexes and at or near the Cascade crest south of Crater Lake well below the rim of the caldera on areas of shallow bedrock.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1685	0	0	0
Range	1556-1906	0-0	0-0	0-0

Vegetation Description: Rocky Mountain Pond-lily Aquatic Vegetation is characterized by the submerged aquatic plant Rocky Mountain pond-lily (*Nuphar lutea* ssp. *polysepala*) with its leaves floating at the surface of water. It may occupy much of the surface of a pond or can be relatively sparse. The cover of the Rocky Mountain pond-lily, including submerged parts, is about 50-75% when dense. Associated species at Crater Lake National Park can include suspended aquatic pondweed species (*Potamogeton* spp.) and the carnivorous plant, common bladderwort (*Utricularia macrorhiza*). On the margins of ponds, the emergent small floating mannagrass (*Glyceria borealis*), common spikerush (*Eleocharis palustris*) and small bur-reed (*Sparganium natans*) can be common.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Aquatic herb (floating & submergent)	*Nuphar lutea* ssp. *polysepala*	2-75	39.8	100
	Aquatic herb (floating & submergent)	*Potamogeton gramineus*	0-25	6.0	33
	Aquatic herb (floating & submergent)	*Utricularia macrorhiza*	0-10	2.3	33
	Aquatic herb (floating & submergent)	*Polygonum amphibium*	0-1	0.1	33
	Graminoid	*Glyceria borealis*	0-10	2.8	67
	Graminoid	*Sparganium natans*	0-5	2.3	67
	Graminoid	*Eleocharis palustris*	0-5	2.3	67
	Graminoid	*Carex utriculata*	0-2	0.8	67
	Moss	*Fontinalis antipyretica*	0-25	6.8	67

Species Richness:
Plot Vascular Plant Species Richness Average: 3
Plot Vascular Plant Species Richness Range: 1-8

Diagnostic Species: *Eleocharis palustris, Glyceria borealis, Utricularia macrorhiza, Sparganium nutans, Nuphar lutea* ssp. *polysepala*
Constant Species: *Nuphar lutea* ssp. *polysepala*
Other Noteworthy Species: *Potamogeton gramineus*
Local Range: This association can be found across the western half of the park at all elevations, particularly near large wetland complexes and at or near the Cascade crest south of Crater Lake.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 3. Relevés 323; 512; 556
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This association is composed of floating aquatic vegetation. It occurs on permanently flooded ponds, lakes, deeper beaver ponds, and glacial kettle lakes, from sea level to 3140 m (10,300 feet) elevation. Soils are usually organic Histosols, on anoxic muck or peat. Water is 40 to 200 cm (1.25-6.5 feet) deep, although stands have been observed where water levels fluctuate seasonally, leaving *Nuphar* high and dry on exposed mudflats, especially in drought years. Stands can fill smaller ponds, or stands may be only as large as the water depth allows and are part of a larger mosaic of other freshwater emergent marsh communities.

Global Vegetation Description: *Nuphar polysepala* (= *Nuphar lutea* ssp. *polysepala; = Nuphar polysepalum*) is often the only species present. Cover is continuous, intermittent, or open. Other aquatic and emergent herbs present may include *Menyanthes* spp., *Potamogeton* spp., *Glyceria* spp., *Eleocharis* spp., *Carex* spp., *Equisetum* spp., *Typha* spp., and *Lemna* spp. Many of these associates are in shallower, adjacent water.

DISTRIBUTION

Range: This association occurs throughout northern California, from the Central Valley into the Sierra-Nevada, in Oregon, on the western Olympic Peninsula and the northern lowlands of the Puget Trough of Washington, throughout eastern Washington, north into British Columbia, and in the mountains of northwestern Montana, Idaho, northwestern Wyoming, and northern Colorado.
States/Provinces: BC, CA, CO, ID, MT, OR, WA, WY?

Global Description References: Western Ecology Group, mod. K. A. Schulz. 2009. *Nuphar polysepala* Aquatic Vegetation [10Mar2009]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Rocky Mountain Pond-lily Aquatic Vegetation (foreground) at Crater Lake National Park. This pond has a dense cover of the association. Floating leaves are Rocky Mountain pond-lily (*Nuphar lutea* ssp. *polysepala*). Most of the emergent graminoids are common spikerush (*Eleocharis palustris*) and Northwest Territory Sedge (*Carex utriculata*).

2. COLUMBIA NEEDLEGRASS – WESTERN CONEFLOWER GRASSLAND [PROVISIONAL]

Achnatherum nelsonii – Rudbeckia occidentalis Grassland [Provisional]

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.B Temperate & Boreal Grassland & Shrubland
Formation: 2.B.2 Temperate Grassland & Shrubland
Division: 2.B.2.Na - D022 Western North American Grassland & Shrubland
Macrogroup: 2.B.2.Na.2 - M048 Central Rocky Mountain Montane-Foothill Grassland & Shrubland
Group: 2.B.2.Na.2.a - G267 Central Rocky Mountain Montane Grassland
Alliance: A4254 Cascadian Subalpine - Montane Grassland

NPS Unique Identifier: NPSCRLA001

LOCAL INFORMATION

Environmental Description: This herbaceous mesic meadow vegetation association occurs on the central west side of Crater Lake National Park. It occurs at relatively low elevations (~1600m) in the park on high level topographic positions. Slopes are very slight. Soils are loamy and moderately well-drained. It often occurs near wetlands on the drier, well-drained margins between wetlands and the upland forest.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1604.5	1.5	58	80
Range	1593-1616	1-2	140-336	75-85

Vegetation Description: This vegetation association is often species rich. The dense herbaceous cover is dominated by a mix of graminoid and non-graminoid species, with Columbia needlegrass (*Achnatherum nelsonii* ssp. *dorei*) generally occupying 2-25% cover. Western coneflower (*Rudbeckia occidentalis*) is almost always present. The graminoid, Kentucky bluegrass (*Poa pratensis*) can occur and may be dominant (25% cover). The very common wet meadow species, arrowleaf ragwort (*Senecio triangularis*), is absent or rare in this association.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Perennial herb	*Mimulus guttatus*	0-25	8.8	50
	Perennial herb	*Trifolium longipes*	0-10	3.8	50
	Perennial herb	*Veratrum viride*	0-10	3.8	50
	Perennial herb	*Viola adunca*	0-10	3.8	50
	Perennial herb	*Fragaria vesca*	0-5	1.8	50
	Perennial herb	*Rudbeckia occidentalis*	1-5	1.8	100
	Perennial herb	*Ligusticum grayi*	1-2	1.5	100
	Graminoid	*Carex hoodii*	0-50	18.8	50
	Graminoid	*Achnatherum nelsonii* ssp. *dorei*	1-25	9.5	100
	Graminoid	*Poa pratensis*	0.01-25	9.0	100
	Graminoid	*Carex inops* ssp. *inops*	0-5	1.8	50

Species Richness:
Plot Vascular Plant Species Richness Average: 26.5
Plot Vascular Plant Species Richness Range: 24-29

Diagnostic Species: *Achnatherum nelsonii* ssp. *dorei, Carex raynoldsii, Deschampsia elongata, Epilobium brachycarpum, Poa pratensis, Sisyrinchium idahoense, Botrychium multifidum*
Constant Species: *Achnatherum nelsonii* ssp. *dorei, Rudbeckia occidentalis, Ligusticum grayi, Poa pratensis*
Other Noteworthy Species: None
Local Range: This association occurs on the central west side of Crater Lake National Park at relatively low elevations.

Classification Comments: We classified our association 2. Columbia Needlegrass – Western Coneflower Grassland [Provisional] under the USNVC's Central Rocky Mountain Montane Grassland (G267). However, it is also possible that our association should be classified under the USNVC's Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh Group (G271). This would relate Columbia Needlegrass – Western Coneflower Grassland [Provisional] to wet meadow associations described in the park in this classification. Further inquiry should confirm the best USNVC placement for this provisional association.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 2. Relevés 201; 356
Crater Lake National Park Notes: None



Above: Columbia Needlegrass – Western Coneflower Grassland [Provisional] at Crater Lake National Park.

3. CALIFORNIA NEEDLEGRASS - ANDERSON'S LUPINE GRASSLAND

Achnatherum occidentale ssp. californicum – Lupinus andersonii Grassland

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.B Temperate & Boreal Grassland & Shrubland
Formation: 2.B.2 Temperate Grassland & Shrubland
Division: 2.B.2.Na - D022 Western North American Grassland & Shrubland
Macrogroup: 2.B.2.Na.2 - M048 Central Rocky Mountain Montane-Foothill Grassland & Shrubland
Group: 2.B.2.Na.2.a - G267 Central Rocky Mountain Montane Grassland
Alliance: A4254 Cascadian Subalpine - Montane Grassland
Association: *Achnatherum occidentale* ssp. *californicum – Lupinus andersonii* Grassland

USNVC Identifier: CEPP007204

LOCAL INFORMATION

Environmental Description: This vegetation association occurs in a wide variety of circumstances, from low to high topographic positions, and from level to fairly steep slopes. Soils, on the other hand, are consistently loamy sand, with only one plot out of 14 with soil described as sand. Soils are also well-drained to rapidly-drained. This grassland association occurs as openings in the forest that are open due to edaphic factors, mainly rapidly drained and sandy soils. In some cases, these grassland openings occur as a result of historic high severity fire events in combination with edaphic controls. This association often occurs on deep pumice deposited by the Mount Mazama eruption.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1952.8	8.5	233.1	12.3
Range	1823-2121	1-20	150-30	3-50

Vegetation Description: This low, moderately open herbaceous vegetation association is dominated by western needlegrass (*Achnatherum occidentale*) and Anderson's lupine (*Lupinus andersonii*) each typically occupying 5-25 percent cover. Long-stolon sedge (*Carex inops* ssp. *inops*), squirreltail (*Elymus elymoides* ssp. *elymoides*), and Hall's sedge (*Carex halliana*) are frequently common associated species.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Subshrub	*Phlox diffusa*	0-10	1.8	64
	Perennial herb	*Lupinus andersonii*	2-25	7.2	100
	Perennial herb	*Cistanthe umbellata*	0-2	0.4	86
	Graminoid	*Carex inops* ssp. *inops*	0-50	7.9	64
	Graminoid	*Achnatherum occidentale* ssp. *californicum*	0.1-25	5.9	100
	Graminoid	*Elymus elymoides* ssp. *elymoides*	0-10	1.9	86
	Graminoid	*Carex halliana*	0-5	1.4	86

Species Richness:
Plot Vascular Plant Species Richness Average: 10
Plot Vascular Plant Species Richness Range: 8-12

Diagnostic Species: None
Constant Species: *Lupinus andersonii*, *Achnatherum occidentale* ssp. *californicum*
Other Noteworthy Species: None
Local Range: This association occurs at middle elevations across the entire park except the northeast corner. It is particularly abundant on the slopes surrounding Union Peak and Crater Peak as well as on the deep pumice deposits surrounding the Crater Lake caldera just downslope from the subalpine fell-fields.

Classification comments: This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 14. Relevés 226; 227; 229; 232; 234; 277; 278; 310; 378; 379; 380; 381; 400; 430
Crater Lake National Park Notes: None



Above: California Needlegrass - Anderson's Lupine Grassland at Crater Lake National Park.

4. LONG-STOLON SEDGE - WESTERN NEEDLEGRASS GRASSLAND

Carex inops ssp. *inops – Achnatherum occidentale* Grassland

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.B Temperate & Boreal Grassland & Shrubland
Formation: 2.B.2 Temperate Grassland & Shrubland
Division: 2.B.2.Na - D022 Western North American Grassland & Shrubland
Macrogroup: 2.B.2.Na.2 - M048 Central Rocky Mountain Montane-Foothill Grassland & Shrubland
Group: 2.B.2.Na.2.a - G267 Central Rocky Mountain Montane Grassland
Alliance: A4254 Cascadian Subalpine - Montane Grassland
Association: *Carex inops* ssp. *inops – Achnatherum occidentale* Grassland

USNVC Identifier: CEPP007243

LOCAL INFORMATION

Environmental Description: This vegetation association occurs at low to middle elevations in the park. Topographic positions are lower slopes and level. The soils are well-drained and sandy. This grassland association occurs as openings in the forest that are open due to edaphic factors, mainly rapidly drained and sandy soils. In some cases, these grassland openings occur as a result of historic high severity fire events in combination with edaphic controls. This grassland association is relatively drier than other grassland associations in the park. This association sometimes occurs on deep pumice deposited by the Mount Mazama eruption.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1654	2.5	147.0	20.4
Range	1584-1850	2-4	80-203	3-46

Vegetation Description: This low, open herbaceous vegetation association is often equally dominated by long-stolon sedge (*Carex inops* ssp. *inops*) and western needlegrass (*Achnatherum occidentale*), each typically occupying 5-25 percent cover. Common associated species include Hall's sedge (*Carex halliana*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0-5	0.9	40
		Pinus ponderosa	0-2	0.2	10
Herb	Graminoid	*Carex inops* ssp. *inops*	1-50	10.9	100
	Graminoid	*Achnatherum occidentale* ssp. *californicum*	1-25	1.8	100
	Graminoid	*Carex halliana*	0-25	3.2	60

Species Richness:
Plot Vascular Plant Species Richness Average: 9
Plot Vascular Plant Species Richness Range: 7-14

Diagnostic Species: None
Constant Species: *Carex inops* ssp. *inops*, *Achnatherum occidentale* ssp. *californicum*
Other Noteworthy Species: None
Local Range: This association occurs at scattered locations across the entire park at low to middle elevations.

Classification comments: This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 10. Relevés 45; 49; 57; 76; 233; 330; 331; 338; 344; 346
Crater Lake National Park Notes: None



Above: Long-stolon Sedge - Western Needlegrass Grassland at Crater Lake National Park.

5. LONG-STOLON SEDGE - RYDBERG'S PENSTEMON GRASSLAND

Carex inops ssp. *inops – Penstemon rydbergii* Grassland

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.B Temperate & Boreal Grassland & Shrubland
Formation: 2.B.2 Temperate Grassland & Shrubland
Division: 2.B.2.Na - D022 Western North American Grassland & Shrubland
Macrogroup: 2.B.2.Na.2 - M048 Central Rocky Mountain Montane-Foothill Grassland & Shrubland
Group: 2.B.2.Na.2.a - G267 Central Rocky Mountain Montane Grassland
Alliance: A4254 Cascadian Subalpine - Montane Grassland
Association: *Carex inops* ssp. *inops – Penstemon rydbergii* Grassland

USNVC Identifier: CEPP007248

LOCAL INFORMATION

Environmental Description: This vegetation association occurs on the west side of the park at low to middle elevations. Topographic position at these locations ranges from low level to high slope. Slopes are nearly level to moderate. Soils are well-drained or moderately well-drained and are sandy loam or loamy sand. This moderately dense grassland association occurs as openings in the forest that are open due to edaphic factors sometimes in combination with historic high severity fire events. Sites containing this association are often more mesic than is typical for other common montane grassland associations found in the park.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1654.6	9.2	187.3	72.2
Range	1560-1759	1-15	140-225	50-78

Vegetation Description: Long-stolon sedge (*Carex inops* ssp. *inops*) and Rydberg's penstemon (*Penstemon rydbergii* var. *oreocharis*) are common in this grassland association. The total herbaceous cover can be abundant. Other common species include the herbs scarlet gilia (*Ipomopsis aggregata*), western needlegrass (*Achnatherum occidentale*), California brome (*Bromus carinatus*), and mountain owl's-clover (*Orthocarpus imbricatus*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Shrub	Broad-leaved deciduous shrub	*Ribes roezlii*	0-25	2.2	20
Herb	Perennial herb	*Penstemon rydbergii* var. *oreocharis*	2-75	18.9	100
	Perennial herb	*Lupinus andersonii*	0-10	1.8	60
	Graminoid	*Carex inops* ssp. *inops*	5-50	19.5	100
	Graminoid	*Elymus glaucus*	0-25	7.6	80
	Graminoid	*Achnatherum occidentale* ssp. *californicum*	0-25	5.6	80
	Graminoid	*Achnatherum nelsonii* ssp. *dorei*	0-5	1	40

Species Richness:
Plot Vascular Plant Species Richness Average: 16
Plot Vascular Plant Species Richness Range: 10-28

Diagnostic Species: *Penstemon rydbergii* var. *oreocharis*, *Orthocarpus imbricatus*
Constant Species: *Carex inops* ssp. *inops*, *Penstemon rydbergii* var. *oreocharis*
Other Noteworthy Species: None
Local Range: This association occurs on the central west side of the park north of Castle Creek and on Crescent Ridge.

Classification Comments: This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 5. Relevés 214; 252; 395; 396; 412



Above: Long-stolon Sedge – Rydberg's Penstemon Grassland at Crater Lake National Park. The purple flowered plant is Rydberg's penstemon (*Penstemon rydbergii* var. *oreocharis*).

6. BIGLEAF LUPINE - COMMON COWPARSNIP MEADOW [PROVISIONAL]

Lupinus polyphyllus - Heracleum maximum Meadow [Provisional]

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.B Temperate & Boreal Grassland & Shrubland
Formation: 2.B.2 Temperate Grassland & Shrubland
Division: 2.B.2.Na - D022 Western North American Grassland & Shrubland
Macrogroup: 2.B.2.Na.3 - M168 Rocky Mountain-Vancouverian Subalpine-High Montane Mesic Meadow
Group: 2.B.2.Na.3.b - G271 Rocky Mountain-North Pacific Subalpine-Montane Mesic Grassland & Meadow
Alliance: A3951 Montane Licorice-root - Lupine - Larkspur Mesic Meadow

NPS Unique Identifier: NPSCRLA002

LOCAL INFORMATION

Environmental Description: This herbaceous wet meadow association occurs on saturated environments fed by seeps on steep slopes. It occurs at somewhat high elevations on high topographic slope positions. Soils are saturated, mucky and clayey. This association is known from a single wetland located on the headwall of Trapper Creek southwest of the Crater Lake caldera.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1876.5	34.5	208	32
Range	1870-1883	34-35	200-216	30-34

Vegetation Description: This is a dense, tall (1m or more) and species rich herbaceous vegetation association. Cow parsnip (*Heracleum maximum*) and bigleaf lupine (*Lupinus polyphyllus*) are consistently found at modest cover (1-10% and 2-25% respectively). Columbian monkshood (*Aconitum columbianum*) is also a constant species with moderate cover (2-5%). Other species vary widely. For example, either hairy brackenfern (*Pteridium aquilinum*) or Pacific onion (*Allium validum*) may be present at high cover or they are absent.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Shrub	Broad-leaved deciduous shrub	*Salix commutata*	0-5	1.75	50
Herb	Fern or fern ally	*Pteridium aquilinum* var. *pubescens*	0-25	8.75	50
	Fern or fern ally	*Athyrium filix-femina*	0.1-2	1	100
	Perennial herb	*Heracleum maximum*	1-10	4.5	100
	Perennial herb	*Lupinus polyphyllus*	2-25	10.5	100
	Perennial herb	*Aconitum columbianum* ssp. *viviparum*	2-5	3.5	100
	Perennial herb	*Allium validum*	0-50	18.75	50
	Perennial herb	*Senecio triangularis*	2-5	3.5	100
	Perennial herb	*Viola glabella*	0.1-2	1	100
	Graminoid	*Carex microptera*	0-5	1.75	50
	Graminoid	*Carex athrostachya*	0.1-2	1	100

Species Richness:
Plot Vascular Plant Species Richness Average: 20
Plot Vascular Plant Species Richness Range: 17-23

Diagnostic Species: *Lupinus polyphyllus, Athyrium filix-femina, Heracleum maximum, Deschampsia danthonioides, Cornus sericea, Chamaesyce serpyllifolia, Epilobium glaberrimum* spp. *glaberrimum, Thalictrum sparsiflorum, Carex athrostachya*
Constant Species: *Senecio triangularis, Aconitum columbianum* ssp. *viviparum, Lupinus polyphyllus, Athyrium filix-femina, Heracleum maximum, Viola glabella, Carex athrostachya*
Other Noteworthy Species: None
Local Range: This association is known from a single location at the headwall of Trapper Creek at somewhat high elevations in the park. It may occur in wet meadows at other locations within Crater Lake National Park.

Classification Comments: We classified our association 6. Bigleaf Lupine - Common Cowparsnip Meadow [Provisional] under the USNVC's Montane Licorice-root - Lupine - Larkspur Mesic Meadow Alliance (A3951) due to the similarity of our association and a USNVC association in that alliance: *Lupinus latifolius* Meadow (CEGL003491). *Lupinus latifolius* ssp. *latifolius* also occurs in riparian areas, wetlands, and wet meadows throughout the park and is easily mistaken for *Lupinus polyphyllus.*

It is also possible that our association 6. Bigleaf Lupine - Common Cowparsnip Meadow [Provisional] fits better under the USNVC's Common Cow-parsnip - California False Hellebore - Yellowcress species Wet Meadow Alliance (A3809) in the Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh Group (G521). Placing it there would relate our association to the similar USNVC *Heracleum maximum* Wet Meadow (CEGL005857) and *Heracleum maximum - Rudbeckia*

occidentalis Wet Meadow (CEGL001940) associations. This would also place it with vegetation that grows on more saturated soils. Further inquiry should confirm the best USNVC placement for this provisional association.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 2. Relevés 497; 498
Crater Lake National Park Notes: None



Above: Bigleaf lupine – Common Cowparsnip Meadow [Provisional] at Crater Lake National Park.

7. SHASTA SEDGE GRASSLAND

Carex straminiformis Grassland

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.B Temperate & Boreal Grassland & Shrubland
Formation: 2.B.2 Temperate Grassland & Shrubland
Division: 2.B.2.Na - D022 Western North American Grassland & Shrubland
Macrogroup: 2.B.2.Na.3 - M168 Rocky Mountain-Vancouverian Subalpine-High Montane Mesic Meadow
Group: 2.B.2.Na.3.b - G271 Rocky Mountain-North Pacific Subalpine-Montane Mesic Grassland & Meadow
Alliance: A4119 Shasta Sedge - Canada Goldenrod Meadow
Association: *Carex straminiformis* Grassland

USNVC Identifier: CEGL001793

LOCAL INFORMATION

Environmental Description: This seasonally wet meadow vegetation association occurs near wetlands often at the transition between wet and dry meadows as well as between wet meadows and the upland forest. Elevations are relatively low for in the park and slopes are very slight.

Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
1633	4	302	86

Vegetation Description: This seasonally wet meadow vegetation association has a dense cover of mostly graminoid species. Shasta sedge (*Carex straminiformis*) is abundant. Forbs are also common, such as green false hellebore (*Veratrum viride*) and Gray's licorice-root (*Ligusticum grayi*). The most abundant species, a grass, was not identified during the wetlands surveys, but appears in the field photos to be blue wildrye (*Elymus glaucus*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	–	6	100
Herb	Perennial herb	*Veratrum viride*	–	17	100
	Perennial herb	*Ligusticum grayi*	–	8	100
	Perennial herb	*Ranunculus occidentalis*	–	7	100
	Perennial herb	*Viola adunca*	–	7	100
	Perennial herb	*Mimulus primuloides* var. *primuloides*	–	5	100
	Graminoid	*Poaceae* spp.	–	30	100
	Graminoid	*Carex straminiformis*	–	22	100
	Graminoid	*Carex microptera*	–	15	100

Species Richness:
Plot Vascular Plant Species Richness Average: 19
Plot Vascular Plant Species Richness Range: N/A

Diagnostic Species: *Carex straminiformis, Taraxacum officinale, Phleum alpinum, Carex microptera, Veronica serpyllifolia* ssp. *humifusa, Viola adunca, Ranunculus occidentalis*
Constant Species: N/A
Other Noteworthy Species: *Elymus glaucus*
Local Range: This association is know from only one location on the eastern edge of Sphagnum Bog. Meadows dominated by *Carex straminiformis* were encountered during field work but were not sampled during relevé sampling.

Classification Comments: Our Shasta Sedge Grassland association appears to fit with the Shasta Sedge Grassland (CEGL001793) association described in the USNVC. However, confidence in this placement is low given that our association is described from only one relevé.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 1. Relevés 501
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This association is reported from the central Sierra Nevada of Nevada and possibly California. The known occurrences are on the dry, well-drained, gently sloping margins of subalpine meadows south and northeast of Lake Tahoe. Elevation ranges from 2658 to 2853 m (8720-9360 feet), and the soils are very acidic (pH 4.7).

Global Vegetation Description: Vegetative cover averages 70%. Stands are dominated by *Carex straminiformis*, usually with *Achnatherum lettermanii* and *Achnatherum nelsonii* ssp. *dorei*. The forb component is significant and may include *Gayophytum diffusum, Cistanthe umbellata* (= *Calyptridium umbellatum*), and *Draba albertina*.

DISTRIBUTION

Range: This association is reported from the central Sierra Nevada of Nevada and possibly California.

States/Provinces: CA?, NV

Global Description References: J.J. Coles. 2004. *Carex straminiformis* Grassland [01Sep2004]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Shasta Sedge Grassland at Crater Lake National Park.

8. MUD SEDGE FEN

Carex limosa Fen

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.2 Temperate to Polar Bog & Fen
Division: 2.C.2.Na - D029 North American Bog & Fen
Macrogroup: 2.C.2.Na.2 - M877 North American Boreal & Sub-boreal Alkaline Fen
Group: 2.C.2.Na.2.c - G516 Rocky Mountain Alkaline Fen
Alliance: A3435 Rocky Mountain Alkaline Sedge Graminoid Fen
Association: *Carex limosa* Fen

USNVC Identifier: CEGL001811

LOCAL INFORMATION

Environmental Description: This wetland vegetation association occurs on the western edge of Sphagnum Bog at the far western edge of the park. Elevations are relatively low in the park. The topographic positions are on the lower slope or are level. The soil may be peat and is very poorly drained and saturated year round. This association occupies the most inundated areas of wetlands where emergent vegetation emerges from standing water.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1610.5	0.5	300.0	17.5
Range	1607-1614	0-1	0-240	0-35

Vegetation Description: This wetland vegetation association is fairly dense to dense. Mud sedge (*Carex limosa*) and slender cottongrass (*Eriophorum gracile*) are codominant and together are strongly dominant. Buckbean (*Menyanthes trifoliata*), water sedge (*Carex aquatilis* var. *dives*) and the carnivorous flatleaf bladderwort (*Utricularia intermedia*) are fairly common.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Perennial herb	*Menyanthes trifoliata*	2-5	4.3	100
	Perennial herb	*Hypericum anagalloides*	1-5	2.8	100
	Perennial herb	*Epilobium oregonense*	0.1-1	0.8	100
	Perennial herb	*Drosera rotundifolia*	0.1-1	0.4	100
	Graminoid	*Carex limosa*	10-75	43.8	100
	Graminoid	*Eriophorum gracile*	25-50	41.3	100
	Graminoid	*Carex aquatilis* var. *dives*	1-25	8.3	100
	Graminoid	*Eleocharis quinqueflora*	0.1-1	0.8	100
	Aquatic herb (floating & submergent)	*Utricularia intermedia*	0.1-1	0.4	100

Species Richness:
Plot Vascular Plant Species Richness Average: 17
Plot Vascular Plant Species Richness Range: 16-17

Diagnostic Species: *Carex limosa, Eriophorum gracile, Menyanthes trifoliata, Spiranthes romanzoffiana, Utricularia intermedia, Berula erecta, Cicuta douglasii, Drosera rotundifolia*
Constant Species: *Carex limosa, Eriophorum gracile, Carex aquatilis* var. *dives, Menyanthes trifoliata, Spiranthes romanzoffiana, Utricularia intermedia, Drosera rotundifolia, Hypericum anagalloides, Eleocharis quinqueflora, Epilobium oregonense, Spiranthes romanzoffiana*
Other Noteworthy Species: None
Local Range: This association occurs on the western edge of Sphagnum Bog at the far western edge of the park.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 2. Relevés 482; 584

Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This association is currently reported from the Rocky Mountains west into Utah, California, and Washington at mid to high elevations ranging from 1787-3235 m (5860-10,600 feet). However, one occurrence in Glacier National Park, Montana, is found at 1010 m (3320 feet). *Carex limosa* is widespread, occurring at mid to high elevations in boreal regions of the Northern Hemisphere. Stands occur in some of the wettest sites in fens that have formed in glacial kettles, on pond margins, along low-gradient lake inlets or outlets, in association

with springs in broad valleys. It often occurs as floating organic mats held together by long rhizomes and roots of mostly graminoids (Padgett et al. 1989, Cooper 1990). Soils are typically highly organic and composed of deep fibric peat, with very little decomposition because of saturated conditions (Hansen et al. 1995). If a site gets drier from water diversion, etc., *Carex aquatilis* will become more competitive and abundant (Padgett et al. 1989). Soils are classified as Borofibrists or Cryohemists.

Carex limosa is important in primary succession, spreading onto the water and shading out submergent and floating aquatic plants (Cooper 1990). As succession proceeds the species composition likely become more diverse.

Global Vegetation Description: Vegetation is characterized by the dominance of *Carex limosa* with 50% or greater cover (often occurring as a as a near monoculture) and may form floating organic mats held together by long rhizomes and roots of mostly graminoids (Padgett et al. 1989, Cooper 1990). Several other species that are adapted to nutrient-poor conditions, including *Drosera linearis*, *Drosera rotundifolia*, *Eriophorum scheuchzeri*, *Eriophorum chamissonis*, *Menyanthes trifoliata*, and *Trichophorum caespitosum* (= *Scirpus cespitosus*), are sometimes present. In addition, *Carex aquatilis*, *Carex buxbaumii*, *Carex lasiocarpa*, *Carex rostrata*, *Carex utriculata*, and *Comarum palustre* (= *Potentilla palustris*) may be present. A dense layer of moss that often includes *Sphagnum* spp. occurs in some stands. Scattered shrubs of *Betula glandulosa*, *Dasiphora fruticosa* ssp. *floribunda*, *Salix candida*, or *Salix planifolia* may be present (Hansen et al. 1995).

DISTRIBUTION

Range: This association is known from scattered locations across the Rocky Mountains and parts of western North America from western Montana west to Washington and possibly British Columbia, south into California, Utah, Colorado and New Mexico. *Carex limosa* is widespread, occurring at mid to high elevations in boreal regions of the Northern Hemisphere, so range may be wider yet.
States/Provinces: AK?, BC?, CA, CO, ID, MT, NM, OR, UT, WA, WY.

Global Description References: M. Jankovsky-Jones, mod. K. A. Schulz. 2007. *Carex limosa* Fen [25Apr2007]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Mud Sedge Fen at Crater Lake National Park. Mud sedge (*Carex limosa*) is the dominant graminoid in the foreground. The white inflorescences are the codominant cottongrass (*Eriophorum gracile*).

9. SITKA SEDGE FEN

Carex aquatilis var. *dives* Fen

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.2 Temperate to Polar Bog & Fen
Division: 2.C.2.Na - D029 North American Bog & Fen
Macrogroup: 2.C.2.Na.3 - M063 North Pacific Bog & Fen
Group: 2.C.2.Na.3.a - G285 North Pacific Alkaline Open Fen
Alliance: A3433 North Pacific Sedge Graminoid Fen
Association: *Carex aquatilis* var. *dives* Fen

USNVC Identifier: CEGL001826

LOCAL INFORMATION

Environmental Description: This wetland vegetation association occurs on rich organic soils that are completely saturated during the growing season. Organic matter accumulates beneath the protective cover of the interwoven roots of Sitka sedge (*Carex aquatilis* var. *dives*). This association occurs in seeps and riparian area wetlands along larger streams and in wetland basins. The topographic positions are midslope, toeslope, low slope or low level. Slopes are relatively moderate to level terrain.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1680.2	4.1	309.7	53.3
Range	1574-1932	2-9	230-131	11-85

Vegetation Description: The total vegetation cover is very high. Graminoids form dense swards of meadow vegetation. Sitka sedge (*Carex aquatilis* var. *dives*) is the most abundant species, occurring in some stands as monotypic swards and sometimes exceeding 90% cover. Trees such as Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) are occasional, particularly near the meadow margins, and often stunted. Other graminoids such as alpine nerve sedge (*Carex neurophora*) and Jones' sedge (*Carex jonesii*) can sometimes be common. American bistort (*Polygonum bistortoides*) is constant but not abundant. A variety of other wet site forbs can be present and sometimes common.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Perennial herb	*Oxypolis occidentalis*	0-25	2.0	44
	Perennial herb	*Ranunculus gormanii*	0-50	10.2	78
	Perennial herb	*Caltha leptosepala* ssp. *howellii*	0-75	8.2	33
	Perennial herb	*Polygonum bistortoides*	0.1-5	1.4	100
	Graminoid	*Carex aquatilis* var. *dives*	10-95	66.2	100
	Graminoid	*Muhlenbergia filiformis*	0-50	7.0	67
	Graminoid	*Carex neurophora*	0-50	5.3	33
	Graminoid	*Carex echinata* ssp. *echinata*	0-25	2.2	22
	Graminoid	*Eleocharis quinqueflora*	0-10	2.0	33
	Graminoid	*Carex jonesii*	0-25	1.9	33

Species Richness:
Plot Vascular Plant Species Richness Average: 21.6
Plot Vascular Plant Species Richness Range: 14-28

Diagnostic Species: None
Constant Species: *Carex aquatilis* var. *dives, Polygonum bistortoides*
Other Noteworthy Species: None
Local Range: This association occurs on saturated areas in seeps and riparian area wetlands along larger streams, particularly Annie Creek and Sun Creek, and in wetland basins on the west side of the park.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 9. Relevés 253; 468; 509; 515; 521; 541; 553; 573; 576
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: Stands may occur on old beaver terraces on seepage slopes and also in sag ponds on slopes prone to slumping. *Carex aquatilis* var. *dives* can intermix with forest ecotone or meadow taxa as long as enough soil moisture is present. Plants become progressively dwarfed as conditions become drier.

Global Vegetation Description: From Christy (2004): Habitat is usually montane fens. The association is widespread and important in the Cascade Range and, like ~*Carex aquatilis* Wet Meadow (CEGL001802), includes a heterogeneous mix of species that do not segregate in any meaningful way. Trees and shrubs are scarce, although many different species are present. The herb

layer is astonishingly diverse with more than 120 species recorded, but most of these have relatively low constancy and reflect the patchy distribution of many different taxa. *Carex aquatilis* var. *dives* is the primary species, averaging 54% cover, and many stands occur as monotypic reed swamp with cover ranging from 5 to 99%. Some of these stands intergrade with ~*Carex utriculata* Wet Meadow (CEGL001562) in seasonally flooded depressions. *Dodecatheon jeffreyi*, *Carex utriculata*, and *Hypericum anagalloides* are the only other species with constancy higher than 20%. Species with significant patches include *Caltha leptosepala* ssp. *howellii*, *Eleocharis quinqueflora*, *Equisetum fluviatile*, *Viola macloskeyi*, *Cicuta douglasii*, and *Agrostis humilis* (= *Agrostis thurberiana*).

DISTRIBUTION

Range: This association occurs from northern California to Alaska (Christy 2004).
States/Provinces: AK, BC, CA?, OR, WA.

Global Description References: J. A. Christy. 2004. *Carex aquatilis* var. *dives* Fen [10Jun2006]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Sitka Sedge Fen at Crater Lake National Park. Most of the herbaceous cover is Sitka sedge (*Carex aquatilis* var. *dives*).

10. NORTHWEST TERRITORY SEDGE WET MEADOW

Carex utriculata Wet Meadow

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland
Division: 2.C.4.Nb - D031 Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
Macrogroup: 2.C.4.Nb.2 - M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland
Group: 2.C.4.Nb.2.b - G521 Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh
Alliance: A3804 Water Sedge - Northwest Territory Sedge - Tufted Hairgrass Wet Meadow
Association: *Carex utriculata* Wet Meadow

USNVC Identifier: CEGL001562

LOCAL INFORMATION

Environmental Description: This herbaceous wetland association occurs on the wetland edges of existing ponds and in former ponds that have largely filled in with sediment. It also occurs in fully inundated wetland basins and swales. Sites are level or nearly level and the water table is at or near the surface. Soils are saturated and poorly drained. Standing water is often present and often supports suspended aquatic species where this association occurs next to ponds. Standing water may remain for most or all of the growing season. However, where this association occurs at the edge of ponds, standing water recedes as the water level of the adjacent pond recedes.

Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
1553	0	0	0

Vegetation Description: This association is a dense sward of intertwined cyperaceous species. Northwest Territory sedge (*Carex utriculata*) is codominant with common spikerush (*Eleocharis palustris*) and together account for most of the vegetation cover. The suspended aquatic species variable leaf pondweed (*Potamogeton gramineus*) occurs, reflecting the year-round occurrence of some standing water.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Graminoid	*Eleocharis palustris*	–	70	100
	Graminoid	*Carex utriculata*	–	55	100
	Graminoid	*Carex exsiccata*	–	4	100
	Graminoid	*Glyceria borealis*	–	2	100
	Graminoid	*Eleocharis quinqueflora*	–	0.3	100
	Aquatic herb (floating & submergent)	*Polygonum amphibium*	–	5	100
	Aquatic herb (floating & submergent)	*Potamogeton gramineus*	–	2	100

Species Richness:
Plot Vascular Plant Species Richness Average: 7
Plot Vascular Plant Species Richness Range: N/A

Diagnostic Species: *Eleocharis palustris, Carex utriculata, Glyceria borealis, Polygonum amphibium, Potamogeton gramineus, Carex exsiccata*
Constant Species: *Eleocharis palustris, Carex utriculata*
Other Noteworthy Species: None
Local Range: This is an uncommon herbaceous wetland association known from only a few location on the west side of the park: on the wetland edges of ponds near Sphagnum Bog and in wetlands along National Creek near Oasis Springs.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 1. Relevé 557
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This herbaceous wetland association is found throughout much of the western U.S. Elevation ranges from near sea level in California to more than 3400 m (0-11,150 feet) in the Rocky Mountains. Stands typically occur in montane and subalpine areas around the edges of lakes and beaver ponds, along the margins of slow-moving reaches of streams and rivers, and in marshy swales and overflow channels on broad floodplains (Kittel et al. 1999b). Sites are flat to undulating, often with a hummocky microtopography (Kovalchik 1993). The water table is usually near the surface for most of the growing season. There are a wide variety of soil types for this association ranging from saturated organics or fine silty clays to clays over cobbles and alluvium to fine-loamy and sandy-skeletal, with an organic surface layer. Many stands occur on organic muck or peat soils. Mottling and gleying often occur near the surface because of the high water table.

Carex utriculata is a widespread species that colonizes recently formed pond edges and seasonally flooded areas near streams. Once established it is long-lived and will dominate sites unless disturbed by changes in site hydrology. Soil development (over time) may decrease soil moisture and allow other species to replace it (Manning and Padgett 1995).

Global Vegetation Description: The vegetation is characterized by a moderately dense to dense perennial graminoid layer dominated or codominated by *Carex utriculata* (20-99% cover). Stands often appear to be nearly pure *Carex utriculata*, but a variety of other graminoid species may be present as well. Other *Carex* species present include *Carex aquatilis, Carex canescens, Carex lenticularis, Carex aquatilis*, and *Carex microptera*, but usually with low cover. Other graminoid species that may be present include *Calamagrostis canadensis, Eriophorum angustifolium, Glyceria striata*, and *Juncus balticus*. The sparse forb cover can include *Geum macrophyllum, Fragaria virginiana, Mentha arvensis*, and *Mimulus guttatus*. Scattered *Salix* spp. shrubs may be present because these riparian shrublands are often adjacent. *Salix* species vary depending on elevation and geography. This association is distinguished from *~Carex aquatilis - Carex utriculata* Wet Meadow (CEGL001803) by the dominance of *Carex utriculata*. *Carex aquatilis*, if present, is not more than one-third of the total cover.

DISTRIBUTION

Range: This wetland association is found at montane and subalpine elevations throughout much of the western U.S.

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

Global Description References: K. A. Schulz, mod. G. Kittel. 2009. *Carex utriculata* Wet Meadow [24Feb2009]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Northwest Territory Sedge Wet Meadow at Crater Lake National Park.

11. TUFTED HAIRGRASS WET MEADOW

Deschampsia cespitosa Wet Meadow

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland
Division: 2.C.4.Nb - D031 Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
Macrogroup: 2.C.4.Nb.2 - M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland
Group: 2.C.4.Nb.2.b - G521 Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh
Alliance: A3804 Water Sedge - Northwest Territory Sedge - Tufted Hairgrass Wet Meadow
Association: *Deschampsia cespitosa* Wet Meadow

USNVC Identifier: CEGL001599

LOCAL INFORMATION

Environmental Description: This herbaceous association occurs in seasonally wet meadows in wetland basins located at the headwaters of larger creeks on the west side of the park. This association is classified from only one relevé plot in the northwest portion of the park. The soil is saturated and poorly drained muck. The slope is moderate. The topographic position is midslope. The elevation is relatively low for in the park.

Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
1656	12	330	36

Vegetation Description: This seasonally wet meadow vegetation association has a dense cover of mostly graminoid species. Tufted hairgrass (*Deschampsia cespitosa*) is the dominant species present. Other graminoid species are present, including lakeshore sedge (*Carex lenticularis*) and bluejoint (*Calamagrostis canadensis*), but not abundant. A variety of perennial herbs are also present with low cover, including arrowleaf ragwort (*Senecio triangularis*), fringed grass of Parnassus (*Parnassia fimbriata* var. *hoodiana*), and western cowbane (*Oxypolis occidentalis*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Shrub	Broad-leaved deciduous shrub	*Ribes lacustre*	1-2	1.5	100
Herb	Perennial herb	*Senecio triangularis*	2-5	3.5	100
	Perennial herb	*Oxypolis occidentalis*	1-2	1.5	100
	Perennial herb	*Parnassia fimbriata* var. *hoodiana*	1-2	1.5	100
	Graminoid	*Deschampsia cespitosa*	10-25	17.5	100
	Graminoid	*Calamagrostis canadensis*	2-5	3.5	100
	Graminoid	*Carex lenticularis*	2-5	3.5	100
	Graminoid	*Carex echinata* ssp. *echinata*	1-2	1.5	100
	Fern or fern ally	*Cystopteris fragilis*	2-5	1.5	100

Species Richness:
Plot Vascular Plant Species Richness Average: 24
Plot Vascular Plant Species Richness Range: N/A

Diagnostic Species: *Deschampsia cespitosa, Galium aparine, Cystopteris fragilis, Parnassia fimbriata* var. *hoodiana, Cinna latifolia*
Constant Species: N/A
Other Noteworthy Species: None
Local Range: This association is known from only two locations in the park, a wetland near the headwaters of the middle fork of Copeland Creek and a wetland near the headwaters of Minnehaha Creek in the far northwest corner of the park.

Classification Comments: Our association 11. Tufted Hairgrass Wet Meadow was considered equivalent to the USNVC's Tufted Hairgrass Wet Meadow (CEGL001599), classified under the USNVC's Water Sedge - Northwest Territory Sedge - Tufted Hairgrass Wet Meadow Alliance (A3804). However, this placement is unreliable given that this association was classified from just one relevé. It is possible our association fits better under the USNVC's Greenleaf Fescue - Tufted Hairgrass - Licorice-root species Rocky Mountain-Vancouverian Grassland & Meadow Group (G271). Further inquiry should reveal the best USNVC placement for this park association.
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots. 1. Relevé 492
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This herbaceous vegetation is dominated by a circumboreal species that is common in alpine wet meadows and wetland margin habitats. Stands are found in

moist, low-gradient valley bottoms and along streams throughout the mountainous areas of the western U.S. at elevations ranging from 800 to 3550 m (2625-11,650 feet). *Deschampsia caespitosa* requires relatively cool, moist conditions. Typically, these communities occur in areas of abundant snowfall where snowmelt saturates soils from late spring through early summer. In the alpine tundra, this association is commonly found in snowmelt basins and around the edges of alpine wetlands. At lower elevations, the communities are typically wetlands, requiring wet or moist soils throughout most of the growing season. Soils are variable. Fine-textured soils retain soil moisture longer in areas of seasonal drought, and coarse substrates allow aeration in areas with perennial high water tables. In perennially wet soils, stands of this association occur on sand or gravel lenses, which allow adequate aeration of roots. In sites with seasonal drought, the vegetation generally occurs on finer-textured soils, which drain slowly and retain moisture. Ground cover is variable, with litter and duff ranging from 1-90% cover. Stands in rocky alpine areas can contain up to 50% exposed large and small rock, and many stands have 1-50% bare soil. Moss is also variable and can have up to 40% cover in wet meadow stands.

This association is adapted to moist and wet soils, which are seasonally flooded by snowmelt and retain moisture throughout the growing season. However, stands usually occur on sites without permanent surface water. Stands appear to be tolerant of moderate-intensity surface fires and late-season livestock grazing.

Global Vegetation Description: This association is typified by a lush growth of *Deschampsia caespitosa*, a perennial bunchgrass which forms an open canopy of culms and nodding panicles. Typically *Deschampsia caespitosa* strongly dominates the herbaceous layer without significant codominants. Commonly associated graminoid species include *Agrostis scabra, Carex aquatilis, Carex nebrascensis, Carex microptera, Carex utriculata, Carex vesicaria, Danthonia intermedia, Elymus trachycaulus, Juncus balticus, Juncus alpinoarticulatus, Phleum alpinum, Poa* spp., *Trisetum spicatum,* and *Trisetum wolfii*. Common forbs include *Geum rossii, Ligusticum tenuifolium, Polygonum bistortoides, Ranunculus flammula*, and low cover of *Caltha leptosepala*. The vegetation often occurs adjacent to perennially saturated sedge wetlands dominated by *Carex aquatilis, Carex simulata, Carex utriculata*, and others. Stands also generally grade into drier meadows of forbs (*Senecio integerrimus, Achillea millefolium*, and others) and grasses (*Festuca, Muhlenbergia, Poa* spp.). *Poa pratensis* may be codominant in disturbed stands. Diagnostic of this herbaceous association is the dominance or codominance of *Deschampsia caespitosa* and the presence of surface water for extended periods during the growing season.

DISTRIBUTION

Range: This association is known throughout the western U.S. and Alberta, Canada.
States/Provinces: AB, AZ, CA, CO, ID, MT, NM, NV, OR, UT, WA, WY.

Global Description References: G. Kittel, mod. K. A. Schulz. 2005. *Deschampsia caespitosa* Wet Meadow [13Jan2005]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Tufted Hairgrass Wet Meadow at Crater Lake National Park.

12. WATER SEDGE WET MEADOW

Carex aquatilis Wet Meadow

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland
Division: 2.C.4.Nb - D031 Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
Macrogroup: 2.C.4.Nb.2 - M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland
Group: 2.C.4.Nb.2.b - G521 Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh
Alliance: A3804 Water Sedge - Northwest Territory Sedge - Tufted Hairgrass Wet Meadow
Association: *Carex aquatilis* Wet Meadow

USNVC Identifier: CEGL001802

LOCAL INFORMATION

Environmental Description: This herbaceous vegetation association occurs in seasonally saturated soil or standing water on the edges of existing ponds, throughout ephemeral ponds, in former ponds that have largely filled in with sediment, and in small basins with poor drainage. It is found at scattered locations at or near the Cascade crest in the southwest portion of the park. Soils are mucky and poorly drained. Slopes are level. Elevations are moderately high.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1950.3	1	231.8	6.1
Range	1903-2006	0-2	0-225	0.3-10

Vegetation Description: The wet meadow vegetation is open to moderately dense and dominated by water sedge (*Carex aquatilis* var. *aquatilis*). Other species of *Carex* may or may not be present. Co-occurring species include black alpine sedge (*C. nigricans*) and mountain sedge (*C. scopulorum* var. *bracteosa*) at low cover values. Sierra hare sedge (*C. leporinella*) can sometimes be abundant and may codominate with water sedge. The aquatic plants Rocky Mountain pond-lily (*Nuphar lutea* ssp. *polysepala*) and spiny-spore quillwort (*Isoetes tenella*) may be present with water sedge in inundated areas at the ponds margins.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Graminoid	*Carex aquatilis* var. *aquatilis*	10-50	29.5	100
	Graminoid	*Carex leporinella*	0-75	22	33
	Graminoid	*Isoetes tenella*	0-2	0.5	33
	Graminoid	*Carex nigricans*	0-1	0.1	33
	Graminoid	*Carex scopulorum* var. *bracteosa*	0-1	0.1	33
	Graminoid	*Carex subfusca*	0-1	0.1	33
	Moss	*Polytrichum commune*	0-25	6.0	33
	Aquatic herb (floating & submergent)	*Nuphar lutea* ssp. *polysepala*	0-1	0.2	33

Species Richness:
Plot Vascular Plant Species Richness Average: 4.7
Plot Vascular Plant Species Richness Range: 4-6

Diagnostic Species: *Carex aquatilis* var. *aquatilis, Isoetes tenella*
Constant Species: *Carex aquatilis* var. *aquatilis*
Other Noteworthy Species: None
Local Range: This association occurs at the margins of high elevation ponds and in depressions at or near the Cascade crest in the southwest portion of the park.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 3. Relevés 324, 528, 539
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This common, widespread herbaceous vegetation occurs as large, mesic meadows in high montane valleys or as narrow strips bordering ponds and streams at lower elevations throughout the western U.S. It occurs in a variety of environmental settings in the montane and subalpine zones. Presence of *Carex aquatilis* typically indicates wet soils with high organic matter or histic epipedons. This plant association occurs in a variety of valley types, but the largest expanses occur in broad, low-gradient valleys where large snowmelt-fed swales and slopes dominate the landscape. It can also grow in fine sediments at the margins of lakes and beaver ponds. These palustrine wetlands have a range of hydrologic regimes, though all stands are saturated for a significant enough period during the growing season to cause a build up of organic material in the soil. Soils are organic mucks and peats and are poorly to very poorly drained.

Overgrazing by livestock can dry the site, increase non-native grass cover, and reduce the vigor of root structure. The wet and often saturated soils of this plant association are also vulnerable to compaction by livestock and heavy equipment. In order to maintain productivity and vigor of the plants and prevent damage to the soils, livestock grazing should be deferred until soils dry (Hansen et al. 1995). Deferred and rest rotation grazing systems are recommended for maintaining the vigor and productivity of this plant association. Rest periods are recommended in order to provide time for plant establishment. Late summer and fall grazing is not recommended because if there are adjacent willows, they are vulnerable to pruning damage due to limited regrowth before the end of the growing season (Kovalchik and Elmore 1992, Hansen et al. 1995).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams aid in controlling channel downcutting, streambank erosion, and downstream movement of sediment. Beaver dams raise the water table and provide water for hydrophytic plants including willows and sedges. The trapping of sediment behind beaver dams, along with plant reproduction, raises the channel bed and creates a wetland environment. Land managers should consider maintaining beaver activity in an area versus their removal (Hansen et al. 1995).

Burning of this plant association temporarily increases the productivity of *Carex utriculata* and *Carex aquatilis*. However, livestock grazing needs to be eliminated for the year prior to burning and for at least 2-3 years after burning. This is necessary in order to keep livestock from damaging young, palatable regrowth and to allow for root reserve build up. Prescribed burning is also an effective method of rejuvenating decadent clumps of willows. The willow species in this plant association vigorously sprout following quick, hot fires. Slow-burning fires can actually damage the plants (Hansen et al. 1995).

Presence of *Carex utriculata* may indicate the site has progressed from the more wet *Carex utriculata* community to the current less mesic conditions, and may become dominated by *Salix planifolia* or *Salix wolfii* (Youngblood et al. 1985a). Wilson (1969) reports that *Carex aquatilis* associations trap sediment from overbank flows, which forms a clay pan, eventually raising the water table. This process drives retrogressive succession, and a plant association dominated by *Carex utriculata* takes over on these sites (Wilson 1969).

Global Vegetation Description: This plant association is characterized by a dense rhizomatous meadow of *Carex aquatilis* (10-80% cover), usually accompanied by a few other graminoids species such as *Calamagrostis canadensis* (1-40%) or *Deschampsia caespitosa* (1-16%), *Juncus balticus*, and *Poa palustris*. *Eleocharis quinqueflora* can be abundant on organic substrates (1-49% cover) at high elevations. *Carex utriculata* (1-20% cover) may be present. When present, *Carex utriculata* is usually not more than one-third the cover of *Carex aquatilis* cover. If it is more than that, the stand may be classified as ~*Carex aquatilis* - *Carex utriculata* Wet Meadow (CEGL001803) or ~*Carex utriculata* Wet Meadow (CEGL001562). Forbs are often present, although sometimes inconspicuous (generally <10%, but can be as high as 40%). Species include *Epilobium* spp., *Pedicularis groenlandica, Caltha leptosepala, Menyanthes trifoliata, Cardamine cordifolia,* and *Mertensia ciliata*. Woody species rarely occur in these sites. Shrubs and trees have been observed invading the

wetland from surrounding areas, including *Betula nana*, *Salix maccalliana*, and *Picea engelmannii*. A clear dominance by *Carex aquatilis* and low cover of *Carex utriculata* or *Pedicularis groenlandica* set this plant association apart from closely related types.

DISTRIBUTION

Range: This association is common and located in mountainous areas throughout the western U.S. and Canada.

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

Global Description Refer

ences: G. Kittel. 2004. *Carex aquatilis* Wet Meadow [03Feb2004]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Water Sedge Wet Meadow at Crater Lake National Park.

13. LAKESHORE SEDGE WET MEADOW

Carex lenticularis Wet Meadow

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland
Division: 2.C.4.Nb - D031 Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
Macrogroup: 2.C.4.Nb.2 - M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland
Group: 2.C.4.Nb.2.b - G521 Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh
Alliance: A3804 Water Sedge - Northwest Territory Sedge - Tufted Hairgrass Wet Meadow
Association: *Carex lenticularis* Wet Meadow

USNVC Identifier: CEPP007249

LOCAL INFORMATION

Environmental Description: This wetland vegetation association occurs on organic soils that are completely saturated during the growing season. It occurs over a wide range of elevations in the park, from relatively low to middle elevations on the west side to moderately high elevations south of the Crater Lake caldera rim. This association occurs in riparian area wetlands along larger streams and wetland basins. The slopes are mostly gentle. Topographic positions range from lower to upper slopes but are mostly mid slopes. Soils range from mucky to silty clay and are mostly poorly drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1771.2	4.4	276.1	34.2
Range	1503 - 1998	0-16	142 - 0	0 - 72

Vegetation Description: This association is a dense, graminoid dominated, herbaceous wetland. Lakeshore sedge (*Carex lenticularis*) is the dominant sedge species present. It sometimes occurs in monotypic stands but may also occur with a variety of other wetland sedges and grass including woodrush sedge (*Carex luzulina*) and bluejoint (*Calamagrostis canadensis*). A variety of wetland forb species may also present including arrowleaf ragwort (*Senecio triangularis*), American bistort (*Polygonum bistortoides*), tinker's penny (*Hypericum anagalloides*), and primrose monkeyflower (*Mimulus primuloides*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Perennial herb	*Senecio triangularis*	0-10	2.5	85
	Perennial herb	*Mimulus guttatus*	0-5	0.7	62
	Perennial herb	*Polygonum bistortoides*	0-5	1.6	92
	Perennial herb	*Viola macloskeyi*	0-50	4.9	62
	Perennial herb	*Mimulus primuloides*	0-75	6.3	54
	Graminoid	*Carex lenticularis*	1-50	22.8	100
	Graminoid	*Carex luzulina*	0-25	3.1	62
	Graminoid	*Eleocharis quinqueflora*	0-10	1.2	46
	Graminoid	*Carex utriculata*	0-50	3.3	15
	Graminoid	*Carex laeviculmis*	0-10	1.0	31

Species Richness:
Plot Vascular Plant Species Richness Average: 29.2
Plot Vascular Plant Species Richness Range: 2-80

Diagnostic Species: None
Constant Species: *Carex lenticularis*
Other Noteworthy Species: None
Local Range: This association occurs in wetlands scattered across the west side of the park north of Castle Creek as well as along Sun Creek near its headwaters.

Classification Comments: This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 13. Relevés 485; 486; 487; 489; 491; 496; 511; 533; 534; 548; 558; 552; 596
Crater Lake National Park Notes: None



Above: Lakeshore Sedge Wet Meadow at Crater Lake National Park.

14. WOODRUSH SEDGE WET MEADOW

Carex luzulina Wet Meadow

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland
Division: 2.C.4.Nb - D031 Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
Macrogroup: 2.C.4.Nb.2 - M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland
Group: 2.C.4.Nb.2.b - G521 Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh
Alliance: A3804 Water Sedge - Northwest Territory Sedge - Tufted Hairgrass Wet Meadow
Association: *Carex luzulina* Wet Meadow

USNVC Identifier: CEPP007253

LOCAL INFORMATION

Environmental Description: This wetland vegetation association occurs on organic soils that are completely saturated during the growing season. It occurs over a wide range of elevations, from relatively low to middle elevations on west and south portions of the park to moderately high elevations south of the Crater Lake caldera rim. This association occurs in riparian area wetlands along larger streams, in wetland basins, and in seeps on slopes. Plots are on level to moderately sloping ground. Soils are organic-rich and saturated.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1883.3	12.3	141.2	33
Range	1705-2005	3-37	30-90	5-75

Vegetation Description: This is an herbaceous wet meadow association with a dense cover of graminoids and forbs. It is strongly dominated by the graminoids woodrush sedge (*Carex luzulina*) and pullup muhly (*Muhlenbergia filiformis*), and the forbs primrose monkeyflower (*Mimulus primuloides*), Gorman's buttercup (*Ranunculus gormanii*), and tinker's penny (*Hypericum anagalloides*). Occasional small coniferous trees grow in these meadows, particularly Sierra lodgepole pine (*Pinus contorta* var. *murrayana*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Perennial herb	*Allium validum*	0-75	11.7	33
	Perennial herb	*Mimulus primuloides*	0.1-50	9.0	100
	Perennial herb	*Ranunculus gormanii*	0-25	5.8	67
	Perennial herb	*Lotus oblongifolius* var. *oblongifolius*	0-25	4.6	50
	Perennial herb	*Hypericum anagalloides*	0-10	3.1	83
	Perennial herb	*Senecio triangularis*	0.1-10	2.9	100
	Graminoid	*Muhlenbergia filiformis*	1-50	9.8	100
	Graminoid	*Carex luzulina*	2-50	18.4	100
	Graminoid	*Carex jonesii*	0-50	5.0	17
	Graminoid	*Carex preslii*	0-25	4.2	17

Species Richness:
Plot Vascular Plant Species Richness Average: 32.7
Plot Vascular Plant Species Richness Range: 17-40

Diagnostic Species: *Kyhosia bolanderi*
Constant Species: *Senecio triangularis, Mimulus primuloides, Carex luzulina, Muhlenbergia filiformis*
Other Noteworthy Species: None
Local Range: This association occurs in wetlands scattered across the west side of the park north of Castle Creek, along Annie Creek, and along Sun Creek near its headwaters.

Classification Comments: Sawyer et al. (2009) describe a *Carex luzulina* Provisional Herbaceous Alliance that is equivalent to our 14. Woodrush Sedge Wet Meadow association.

This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 6. Relevés 490; 520; 525; 549; 587; 590
Crater Lake National Park Notes: None



Above: Woodrush Sedge Wet Meadow at Crater Lake National Park.

15. MOUNTAIN SEDGE WET MEADOW

Carex scopulorum Wet Meadow

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland
Division: 2.C.4.Nb - D031 Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
Macrogroup: 2.C.4.Nb.2 - M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland
Group: 2.C.4.Nb.2.b - G521 Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh
Alliance: A3806 Clustered Field Sedge - Mountain Sedge - Few-flower Spikerush Wet Meadow
Association: *Carex scopulorum* Wet Meadow

USNVC Identifier: CEGL001822

LOCAL INFORMATION

Environmental Description: This wetland vegetation association occurs on organic soils that are completely saturated during the growing season. It occurs at middle to relatively high elevations on the southwest side (outside) of the Crater Lake caldera rim. Soils are organic (muck) and are poorly drained. This association occurs in riparian area wetlands along larger streams, in wetland basins, and in seeps on slopes. Plots are on level to slightly sloping ground.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1927.5	2.8	121.8	32.5
Range	1876-2059	1-6	326 - 186	7-58

Vegetation Description: This dense wet meadow vegetation association is strongly dominated by graminoids, particularly sedge (*Carex*) species, along with an abundance of perennial herbs. Mountain sedge (*Carex scopulorum* var. *bracteosa*) is the primary sedge species present and is strongly dominant. A variety of perennial herb species is present at low constancy, apart from American bistort (*Polygonum bistortoides*) which can be quite abundant in some stands. Other notable herbs include primrose monkeyflower (*Mimulus primuloides* var. *primuloides*), pioneer violet (*Viola glabella*), and alpine shootingstar (*Dodecatheon alpinum*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Perennial herb	*Polygonum bistortoides*	1-25	4.8	100
	Perennial herb	*Mimulus primuloides* var. *primuloides*	0-25	3.8	50
	Perennial herb	*Ranunculus gormanii*	0-25	3	25
	Perennial herb	*Viola glabella*	0-10	2	50
	Graminoid	*Carex scopulorum* var. *bracteosa*	25-75	59.3	100
	Graminoid	*Carex neurophora*	0-10	2.8	50
	Graminoid	*Muhlenbergia filiformis*	0-10	2.5	75
	Graminoid	*Torreyochloa pallida* var. *pauciflora*	0-10	2.3	50
	Graminoid	*Calamagrostis canadensis*	0-5	1.8	50

Species Richness:
Plot Vascular Plant Species Richness Average: 26.3
Plot Vascular Plant Species Richness Range: 20-33

Diagnostic Species: *Carex scopulorum* var. *bracteosa*, *Carex canescens* ssp. *canescens*, *Salix boothii*
Constant Species: *Polygonum bistortoides*, *Carex scopulorum* var. *bracteosa*, *Dodecatheon alpinum*
Other Noteworthy Species: None
Local Range: This association is particularly abundant in Munson Valley along Munson Creek, but also occurs at the headwaters of Sun, Castle and Bybee Creeks, as well as in seeps on Munson Ridge.

Classification Comments: Our association 15. Mountain Sedge Wet Meadow is equivalent to the Mountain Sedge Wet Meadow (CEGL001822) classified under the Clustered Field Sedge - Mountain Sedge - Few-flower Spikerush Wet Meadow Alliance (A3806) in the USNVC. Some relevés classified with our Mountain Sedge Wet Meadow association are similar to the *Carex scopulorum* var. *bracteosa* - *Pedicularis groenlandica* Wet Meadow (CEGL008664) association in the USNVC. Further inquiry and additional sampling should reveal the best USNVC placement for this park association.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 4. Relevés 320; 321; 540; 572
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: Habitat is depressions and seepy alluvial fans in subalpine heath. Stands of this association occur in transitional areas between the slightly wetter ~*Carex nigricans* Wet Meadow (CEGL001816) and slightly drier associations of *Carex spectabilis* and

upland *Phyllodoce* heath, and intergrade with both. Stands on alluvial fans occur below springs and seeps and may be laced with rivulets and/or irrigated by sheetflow.

Global Vegetation Description: Trees are absent. Shrubs are sparse, *Salix commutata* being the most abundant in 25% of the plots, but with a very low cover. *Carex scopulorum* is the primary herbaceous species with an average cover of 49% and ranging from 10-90%. Other species with significant patches include *Deschampsia caespitosa, Eleocharis quinqueflora, Muhlenbergia filiformis, Eleocharis palustris,* and *Juncus balticus*. The other 40 species occur at low constancy and cover and are mostly wetland taxa indicative of perennial saturation.

DISTRIBUTION

Range: This association occurs from California to British Columbia (Christy 2004) and eastward.
States/Provinces: BC?, CA, CO, ID, MT, NV, OR, UT?, WA, WY.

Global Description References: J. A. Christy. 2004. *Carex scopulorum* Wet Meadow [11Jun2006]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Mountain Sedge Wet Meadow at Crater Lake National Park.

16. FEW-FLOWER SPIKERUSH FEN

Eleocharis quinqueflora Fen

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland
Division: 2.C.4.Nb - D031 Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
Macrogroup: 2.C.4.Nb.2 - M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland
Group: 2.C.4.Nb.2.b - G521 Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh
Alliance: A3806 Clustered Field Sedge - Mountain Sedge - Few-flower Spikerush Wet Meadow
Association: *Eleocharis quinqueflora* Fen

USNVC Identifier: CEGL001836

LOCAL INFORMATION

Environmental Description: This wetland vegetation association occurs on organic soils that are completely saturated during the growing season. It occurs on the west side of the park at relatively low to middle elevations in the park. It occupies level areas in basins, at the base of topographic slopes or a step in slopes. Sub-surface seepage keeps areas shallowly flooded or saturated. Surface water is usually slow moving or stagnant. This association often occurs in the most inundated areas of wetlands and soils are likely nutrient poor and acidic. Soils are mucky and poorly drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1697	2.5	261	9
Range	1618-1911	2-3	179-290	2-15

Vegetation Description: This is a low, moderately dense herbaceous vegetation association dominated by fewflower spikerush (*Eleocharis quinqueflora*), star sedge (*Carex echinata*), and pullup muhly (*Muhlenbergia filiformis*). Moss cover is typically high. Other sedge species may be present including Sitka sedge (*Carex aquatilis* var. *aquatilis*) and Jones' sedge (*Carex jonesii*), but they are typically low in cover. Perennial herbs species may include primrose monkeyflower (*Mimulus primuloides*), tinker's penny (*Hypericum anagalloides*), and alpine shootingstar (*Dodecatheon alpinum*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Perennial herb	*Mimulus primuloides*	0-50	11.3	75
	Perennial herb	*Hypericum anagalloides*	0-25	3.2	75
	Perennial herb	*Polygonum bistortoides*	0-10	2.8	75
	Graminoid	*Eleocharis quinqueflora*	5-75	26.9	100
	Graminoid	*Carex echinata* ssp. *echinata*	1-75	20.1	100
	Graminoid	*Muhlenbergia filiformis*	2-25	14.1	100
	Graminoid	*Carex jonesii*	0-25	3.8	25
	Graminoid	*Carex aquatilis* var. *aquatilis*	0-10	2.5	75
	Graminoid	*Carex luzulina*	0-5	1.9	75

Species Richness:
Plot Vascular Plant Species Richness Average: 20.5
Plot Vascular Plant Species Richness Range: 14-28

Diagnostic Species: *Agrostis idahoensis, Scirpus congdonii, Spiranthes romanzoffiana*
Constant Species: *Eleocharis quinqueflora, Carex echinata* ssp. *echinata, Muhlenbergia filiformis, Dodecatheon alpinum, Juncus ensifolius*
Other Noteworthy Species: None
Local Range: This association occurs in the central west portion of the park, most notably in Sphagnum Bog, but also in wetlands adjacent to the north fork of Copeland Creek, and near the headwaters of National Creek and Bybee Creek.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 4. Relevés 481; 517; 536; 574
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This wetland association is found in the upper subalpine and lower alpine in the western United States and forms uniform peatland communities. Elevation ranges from 1430 to 3800 m (4700-12,300 feet).Sites can occur in wet basins, stream terraces, ponds, cirque basins, and marshy meadows associated with seeps. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996). Adjacent stream channels are narrow and sinuous headwater rivulets (Rosgen's Channel Type: E4-5) with lateral seepage from surrounding toeslopes. Substrates are typically poorly drained, nutrient-poor, organic soils that are wet or saturated throughout the summer. Surface layers may dry out in late summer on some sites. Peat layers range from thin peat over quartzite sands to deep peat occasionally as deep as 2 m.

Global Vegetation Description: The vegetation is characterized by a moderately dense to dense herbaceous layer that is strongly dominated by *Eleocharis quinqueflora*. *Carex aquatilis* is a common graminoid associate that may codominate some stands. Vegetation growth is relatively sparse compared to other wetlands, especially in higher elevation stands. Other graminoids may include *Carex buxbaumii, Carex illota, Carex jonesii, Carex lachenalii* (on extremely nutrient-poor sites), *Carex scopulorum, Carex utriculata, Deschampsia cespitosa*, and *Eleocharis rostellata*. Forb cover is generally low but often includes *Caltha leptosepala, Dodecatheon alpinum, Oreostemma alpigenum* (= *Aster alpigenus*), *Pedicularis groenlandica*, and *Polygonum bistortoides*. Scattered shrubs may also be present, such as *Betula glandulosa* or *Salix planifolia*. Rare species *Carex lachenalii* and *Eriophorum angustifolium* grow locally on sites too nutrient-poor for other species. Diagnostic of this herbaceous wetland community is the dominance or codominance of *Eleocharis quinqueflora* and the presence of surface water for extended periods during the growing season.

Adjacent riparian vegetation may include marshes and wet meadows dominated by various species such as *Carex aquatilis*, *Carex utriculata*, *Eleocharis palustris*, and *Caltha leptosepala*, or shrublands dominated by *Salix planifolia* or *Betula glandulosa*. Drier sites include mesic spruce-fir forests, *Salix brachycarpa* shrublands, and *Deschampsia caespitosa* meadows. Upland vegetation is often alpine talus slopes, krummholz, dry-mesic spruce-fir or lodgepole pine forests, and subalpine *Festuca thurberi* grasslands that occur on adjacent hillslopes (Manning and Padgett 1995, Kittel et al. 1999b).

Eleocharis quinqueflora is an early colonizer and persists under wet conditions (Padgett et al. 1989). *Carex aquatilis* can be a codominant in this plant association (Padgett et al. 1989). Grazing in this association can increase the cover of increaser and invader species such as *Agrostis stolonifera* and *Juncus balticus* and will damage the wet soils (Kittel et al. 1999b). If conditions become drier, *Carex scopulorum* may dominate and replace this association (Manning and Padgett 1995).

DISTRIBUTION

Range: This vegetation type is found in the upper subalpine and lower alpine in the western United States.

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

Global Description References: T. Keeler-Wolf, mod. K. A. Schulz. 2009. *Eleocharis quinqueflora* Fen [25Feb2009]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Few-flower Spikerush Fen at Crater Lake National Park.

17. PANICLED BULRUSH MARSH

Scirpus microcarpus Marsh

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland
Division: 2.C.4.Nb - D031 Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
Macrogroup: 2.C.4.Nb.2 - M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland
Group: 2.C.4.Nb.2.b - G521 Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh
Alliance: A3808 Western Mannagrass Wet Meadow
Association: *Scirpus microcarpus* Marsh

USNVC Identifier: CEGL003322

LOCAL INFORMATION

Environmental Description: This wetland vegetation association occurs on rich organic soils that are completely saturated during the growing season. It occurs in seeps on slopes and riparian area wetlands along larger streams, streamside marshes, springs, and in wetland basins. It is found in the south and west portions of the park. It occurs in permanently saturated soils that are poorly drained. Soils are organic and muck. Slopes are highly variable and may be level to fairly steep for a wetland. Standing water may be present for at least part of the growing season and may flow with slight velocity.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1624.8	12	166.0	26.8
Range	1485-1821	1-21	120 - 208	0.3 - 64

Vegetation Description: This is an herbaceous wetland association comprised of emergent wetland vegetation. Panicled bulrush (*Scirpus microcarpus*) is the primary species present often occurring in monotypic stands. It is strongly dominant, typically accounting for over 50% cover. A variety of other wetland graminoid and perennial herb species may be present, however, no other species is a strongly consistent associate with panicled bulrush, and most other species have low cover.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Perennial herb	*Senecio triangularis*	0-25	3.5	75
	Perennial herb	*Lotus oblongifolius* var. *oblongifolius*	0-50	9.5	50
	Perennial herb	*Hypericum anagalloides*	0-10	3.1	50
	Perennial herb	*Mimulus guttatus*	0-25	3.9	50
	Graminoid	*Scirpus microcarpus*	10-75	35.6	100
	Graminoid	*Carex lenticularis*	0-25	5.4	50
	Graminoid	*Carex jonesii*	0-25	4.4	50
	Graminoid	*Agrostis exarata*	0-10	2.0	25
	Graminoid	*Carex neurophora*	0-10	2.0	25
	Fern or fern ally	*Equisetum arvense*	0-50	8.4	50

Species Richness:
Plot Vascular Plant Species Richness Average: 26.3
Plot Vascular Plant Species Richness Range: 18-30

Diagnostic Species: *Scirpus microcarpus*, *Arnica amplexicaulis*
Constant Species: *Scirpus microcarpus*
Other Noteworthy Species: None
Local Range: This association occurs across the south and west portions of the park and is particularly common along Annie Creek, Bybee Creek, and Copeland Creek.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots 4. Relevés 240; 532; 567; 588
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: From Christy (2004): Habitat is marshes, fens, or springs. Data from these plots is highly variable, and a number of different phases could be segregated with further study.

Global Vegetation Description: Stands are usually monotypic and may reach heights of 1 m (3 feet). Trees are peripheral to the wetlands and can be both deciduous and coniferous. Eight shrubs are reported from these stands, but all have negligible constancy and cover. Almost 80 species are reported from the herb layer, presumably because of the great variety of habitats and elevations in which the association occurs. *Scirpus microcarpus* is the primary species, with average cover of 75% and ranging from 15-98%. Most other species have much lower constancy and cover. Associated

species with significant patches include *Lysichiton americanus, Athyrium filix-femina, Oenanthe sarmentosa, Stachys ajugoides* var. *rigida, Carex aquatilis* var. *dives*, and *Senecio triangularis*.

DISTRIBUTION

Range: This association occurs from northern California to Alaska and eastward.
States/Provinces: CA, ID, OR, WA.

Global Description References: J. A. Christy. 2004. *Scirpus microcarpus* Marsh [14Jun2006]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Panicled Bulrush Marsh at Crater Lake National Park.

18. ARROWLEAF RAGWORT WET MEADOW

Senecio triangularis Wet Meadow

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland
Division: 2.C.4.Nb - D031 Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
Macrogroup: 2.C.4.Nb.2 - M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland
Group: 2.C.4.Nb.2.b - G521 Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh
Alliance: A3810 Brook Saxifrage - Arrowleaf Ragwort - Mountain Bluebells Wet Meadow
Association: *Senecio triangularis* Wet Meadow

USNVC Identifier: CEGL001987

LOCAL INFORMATION

Environmental Description: This association occurs in wet meadows, wetland margins, saturated riparian areas, streambanks, seeps, and springs. It occurs throughout the south and west portions of the park at low to high elevations. Elevations range from just under 1500 to 2122 m. Soils are silty and often have high clay content. Soils are often saturated most or all of the year but in many cases, this association is only seasonally wet. Slopes range from level to fairly steep. Topographic positions vary, with midslopes being the most common, followed by toeslopes (the base of slopes) and level.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1819.3	7.1	255.0	45.4
Range	1498-2122	0-26	122-10	3-89

Vegetation Description: This is an herbaceous wetland association comprised mainly of broad-leaved perennial forbs. Arrowleaf ragwort (*Senecio triangularis*) is very dominant, sometimes forming almost pure stands. The graminoid blue wildrye (*Elymus glaucus*) is often present and sometimes abundant. A number of different sedges (*Carex*) and grasses (*Poaceae*) may also be present, often, but not always, with low cover. A variety of perennial herbs may be present and sometimes abundant, but none are constant in this association. These can include Columbian monkshood (*Aconitum columbianum* ssp. *viviparum*), Gray's licorice-root (*Ligusticum grayi*), green false hellebore (*Veratrum viride*), muskflower (*Mimulus moschatus*), Gorman's buttercup (*Ranunculus gormanii*), and small white violet (*Viola macloskeyi*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Perennial herb	*Senecio triangularis*	5-95	37.7	100
	Perennial herb	*Veratrum viride*	0-50	8.8	67
	Perennial herb	*Mimulus primuloides*	0-50	3.4	33
	Perennial herb	*Lupinus latifolius*	0-25	2.8	17
	Perennial herb	*Ranunculus gormanii*	0-25	2.4	39
	Perennial herb	*Viola macloskeyi*	0-50	2.0	22
	Graminoid	*Cinna latifolia*	0-50	4.8	41
	Graminoid	*Elymus glaucus*	0-50	3.5	82
	Graminoid	*Carex angustata*	0-50	2.2	6

Species Richness:
Plot Vascular Plant Species Richness Average: 27.4
Plot Vascular Plant Species Richness Range: 17-41

Diagnostic Species: None
Constant Species: *Senecio triangularis*
Other Noteworthy Species: None
Local Range: This association occurs in wetlands throughout the west and south portions of Crater Lake National Park and becomes particularly common at middle to moderately high elevations.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots 18**.** Relevés 238; 357; 469; 483; 488; 493; 495; 505; 518; 523; 527; 535; 544; 547; 555; 565; 578; 593
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This association has large gaps in its documented range, occurring in the alpine/subalpine of Colorado and reported again in the mountains of Montana, eastern Oregon and northward into Alberta. This broadly distributed wetland type occurs in small and often linear patches. In Montana and Oregon this type has been well-documented as a riparian stringer of high-gradient, ephemeral, first- or second-order streams; water tables are at the surface throughout the summer. This type also occurs as a species-rich herb meadow on fluvial, residual and colluvial landforms, many of which are subject to snow avalanches. Its documented elevation range in Montana-Alberta is from 1225 to 2181 m (4020-7150 feet). In Oregon, it occupies similar habitats, occurring on alluvial bars and streambanks (Crowe and Clausnitzer 1997). It also occupies midslope

to toeslope positions of talus and scree slopes, as well as glacio-fluvial deposits that receive late-melting runoff (subsurface). All substrates are apparently relatively medium- to coarse-textured and well-drained. However, the unifying factor of all these seemingly disparate environments is that sites are subirrigated, ostensibly with oxygenated water through most of the growing season.

Global Vegetation Description: The vegetation is characterized by a dense herbaceous layer dominated by *Senecio triangularis*. Graminoid are also a minor presence, with *Poa alpina, Phleum alpinum, Juncus drummondii, Trisetum spicatum,* and *Elymus glaucus* being at least 40% constant but seldom exhibiting more than 2-3% cover (Hansen et al. 1995) In Oregon, Crowe and Clausnitzer (1997) report that *Glyceria striata* (= *Glyceria elata*) and *Carex disperma* occur in most stands. Shrubs are virtually absent; only *Ribes* spp. associated with wetlands are present in trace amounts. The diagnostic forb *Senecio triangularis* is 100% constant and almost always the dominant, the only recorded exceptions being *Chamerion* spp. (= *Epilobium* spp.) which may increase markedly following disturbance. Other moderate- to high-constancy forbs indicative of wet-site conditions include *Trollius laxus, Parnassia fimbriata, Mimulus lewisii, Veratrum viride, Mertensia* spp., and *Equisetum arvense*. In Oregon common forbs include *Thalictrum occidentale, Geum macrophyllum, Canadanthus modestus* (= *Aster modestus*), *Arnica cordifolia,* and *Ranunculus* spp. Species more associated with the diverse forb meadow condition include *Allium schoenoprasum, Arnica mollis, Angelica arguta, Castilleja rhexiifolia, Castilleja miniata, Chamerion angustifolium* (= *Epilobium angustifolium*), *Erigeron peregrinus, Epilobium* spp. (including *Epilobium ciliatum, Epilobium anagallidifolium* (= *Epilobium alpinum*)), and *Valeriana sitchensis*. In Wyoming, *Agrostis exarata* is constant, and *Mimulus guttatus* or *Mimulus lewisii*, *Platanthera dilatata* (= *Habenaria dilatata*), *Epilobium anagallidifolium*, and *Mitella pentandra* are common and sometimes abundant (Mattson 1984).

The riparian examples of this association are envisioned by Hansen et al. (1995) to be early-seral communities destined to become conifer-dominated sites but, with repeated flooding and scouring, rarely mature beyond the sapling stage. Achuff et al. (1997) identify the meadow portion and scree slope portion of the type as successionally mature.

In Oregon, this association may succeed to *Alnus sinuata* / Mesic Forb Association (Crowe et al. 2004) if the site remains stable for a long enough period of time. Some sample sites in the Strawberry Mountains were located in watersheds that had been severely burned two years prior to sampling. All upland trees were killed in the fire, and the sideslopes were still depauperate. Subalpine fir forests heavily shaded these sites prior to the fire, and once the forests regrow and shade the sites again, this association will undoubtedly succeed to another association.

DISTRIBUTION

Range: This association is reported from the mountains of Montana, eastern Oregon and northward into Alberta and British Columbia, Canada.

States/Provinces: AB, AK?, CA?, ID, MT, OR, WA, WY

Global Description References: K. A. Schulz. 2005. *Senecio triangularis* Wet Meadow [01Aug2005]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Arrowleaf Ragwort Wet Meadow (foreground) at Crater Lake National Park.

19. WESTERN BLUEJOINT WET MEADOW

Calamagrostis canadensis Western Wet Meadow

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland
Division: 2.C.4.Nb - D031 Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
Macrogroup: 2.C.4.Nb.2 - M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland
Group: 2.C.4.Nb.2.b - G521 Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh
Alliance: A3815 Bluejoint - Slimstem Reedgrass - Bluegrass Wet Meadow
Association: Western Bluejoint Wet Meadow

USNVC Identifier: CEGL001559

LOCAL INFORMATION

Environmental Description: This wetland vegetation association occurs on seasonally wet areas as well as on rich organic soils that are saturated during the growing season. It occurs in riparian area wetlands along larger streams, streamside marshes, springs, and in wetland basins. It occurs throughout the south and west portions of the park at low to moderately high elevations. Topographic positions include toeslopes, midslopes, and basin floor. Soils are somewhat poorly drained and organic. Slopes range from level to fairly steep.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1684.6	7.1	44.9	59.1
Range	1453 - 1965	0 - 32	0 - 264	21 - 84

Vegetation Description: This herbaceous association is wet meadow vegetation comprised of a dense herbaceous graminoid cover, generally over a meter tall. It is dominated by a high cover of bluejoint (*Calamagrostis canadensis*), which typically occurs in dense monotypic swards but may also occur with arrowleaf ragweed (*Senecio triangularis*) and fowl mannagrass (*Glyceria striata*). A variety of other graminoids and perennial herbs may be present and are sometimes abundant. These can include brown sedge (*Carex subfusca*), alpine nerve sedge (*Carex neurophora*), blue wildrye (*Elymus glaucus*), Columbian monkshood (*Aconitum columbianum* ssp. *viviparum*), muskflower (*Mimulus moschatus*), Gorman's buttercup (*Ranunculus gormanii*), and tinker's penny (*Hypericum anagalloides*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Perennial herb	*Senecio triangularis*	0.1-50	10.4	100
	Perennial herb	*Polygonum bistortoides*	0-50	4.4	56
	Perennial herb	*Lupinus latifolius*	0-50	5.8	22
	Perennial herb	*Ranunculus gormanii*	0-10	2.8	78
	Graminoid	*Calamagrostis canadensis*	10-95	55.0	100
	Perennial herb	*Glyceria striata*	0-75	16.1	67
	Perennial herb	*Carex subfusca*	0-50	5.4	33
	Perennial herb	*Deschampsia cespitosa*	0-50	3.4	22
	Perennial herb	*Carex neurophora*	0-25	2.4	67

Species Richness:
Plot Vascular Plant Species Richness Average: 30.1
Plot Vascular Plant Species Richness Range: 18-42

Diagnostic Species: None
Constant Species: *Calamagrostis canadensis, Senecio triangularis*
Other Noteworthy Species: None
Local Range: This association occurs in wetlands throughout the west and south portions of Crater Lake National Park.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 9. Relevés 504; 507; 561; 564; 568; 569; 580; 586; 597
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This wet grassland association occurs widely throughout mountainous areas of the western United States and Canada. These grasslands are a relatively small, meadow association that occurs in broad glaciated valleys, openings in moist forests, silted-in beaver ponds, and narrow floodplains of lower montane canyons. Elevations range from 670 to 3415 m (2200-11,200 feet). Sites are flat to gently sloping. Parent material is generally coarse alluvium or fine glacial tills. Soils are Inceptisols, Entisols, and occasionally Mollisols. Textures range from clay loam, silty clay and silt loam to sand. Occurrences may have an organic layer on the surface as well as significant amounts of sand and rock in the lower layers. Stands are poorly to moderately well-drained. Stands generally stay relatively wet to moist throughout the growing season, are often flooded in the spring, and the water table drops 50-80 cm from the surface by late summer.

Global Vegetation Description: This association is typically a dense sward of graminoid cover dominated by *Calamagrostis canadensis*. Other graminoid species usually present include *Carex aquatilis* and *Glyceria* spp. Other *Carex* spp. that can be present in low amounts, depending on geographic location, include *Carex utriculata, Carex nebrascensis, Carex canescens* and *Carex saxatilis*. Forb cover is variable, from nearly absent to over 25%. Species include *Caltha leptosepala, Senecio triangularis, Heracleum maximum, Mentha arvensis, Geum macrophyllum, Epilobium* spp., plus many other species, depending on location. Shrubs may be present with 1-5% cover and may include *Alnus incana, Symphoricarpos* spp., and *Salix* spp. Trees are rare but can include 1-3% cover of *Pinus contorta, Abies lasiocarpa,* and *Picea engelmannii*. *Chamerion angustifolium* may be abundant (10%) reflecting recent disturbance (fire).

Moderate to heavy grazing reduces the vigor of *Calamagrostis canadensis*, and other mostly non-native graminoids and forbs will dominate the site. Species include *Poa pratensis, Agrostis stolonifera, Juncus balticus,* and *Achillea millefolium*. Prescribed burning may increase the cover of rhizomatous species, such as *Calamagrostis canadensis*, an aggressive invader of burned sites while reducing the abundance of other associated species. However, with repeated burning, non-native, rhizomatous *Poa pratensis* may be favored. Burning should be postponed if livestock grazing is necessary in the area. This is because of the high palatability of young *Calamagrostis canadensis* shoots that revegetate burned sites (Hansen et al. 1995).

Calamagrostis canadensis and the associated *Carex* species are effective streambank stabilizers due to their rhizomatous growth habit. Many *Carex* species tend to form a dense, thick sod highly resistant to erosion. *Deschampsia caespitosa*, another associated species, is not an effective streambank stabilizer due to its weak, fibrous root system (Hansen et al. 1995).

DISTRIBUTION

Range: This type occurs widely throughout mountainous areas of the western United States and probably into Canada.

States/Provinces: AB, BC, CA, CO, ID, MT, ND, OR, SD, UT, WA, WY.

Global Description References: D. Faber-Langendoen, mod. G. Kittel and K. A. Schulz. 2005. *Calamagrostis canadensis* Western Wet Meadow [05Jan2005]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Western Bluejoint Wet Meadow at Crater Lake National Park.

20. BLACK ALPINE SEDGE WET MEADOW

Carex nigricans Wet Meadow

USNVC CLASSIFICATION:

Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland
Division: 2.C.4.Nb - D031 Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
Macrogroup: 2.C.4.Nb.2 - M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland
Group: 2.C.4.Nb.2.c - G520 Vancouverian-Rocky Mountain Subalpine-Alpine Snowbed, Wet Meadow & Dwarf-shrubland
Alliance: A3832 Black Alpine Sedge - Sibbaldia - Globeflower Wet Meadow
Association: *Carex nigricans* Wet Meadow

USNVC Identifier: CEGL001816

LOCAL INFORMATION

Environmental Description: This is a rare wetland vegetation association occurring on seeps among the subalpine fell-fields just below the Crater Lake caldera rim (outside), on the northwest side. Elevations at these locations are relatively high within the park. Topographic position is mid slope down from the caldera rim. Soils are moderately well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	2132.3	6.3	331.7	52
Range	2102-2140	5-8	298-356	22-84

Vegetation Description: This association is a low (< 25 cm tall) turf vegetation dominated by black alpine sedge (*Carex nigricans*) with high mountain cinquefoil (*Potentilla flabellifolia*) and pink mountain heath (*Phyllodoce empetriformis*) interspersed at a fine scale. Mountain hemlock trees among the open subalpine fell-fields often ring this herbaceous wet meadow association. Pink mountain heath is often most abundant near the margins of the association. Other forbs such as green false hellebore (*Veratrum viride*), Gray's licorice-root (*Ligusticum grayi*), partridgefoot (*Luetkea pectinata*), may be common. There are also areas of bare soil.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Shrub	Subshrub	*Phyllodoce empetriformis*	0.1-10	3.8	100
	Subshrub	*Luetkea pectinata*	0-25	8.3	67
Herb	Perennial herb	*Veratrum viride*	0-50	17.2	67
	Perennial herb	*Ligusticum grayi*	1-10	3.3	100
	Perennial herb	*Erigeron peregrinus*	0.1-2	1.1	100
	Graminoid	*Carex nigricans*	10-95	46.7	100
	Graminoid	*Carex scopulorum* var. *bracteosa*	0-10	3.0	33
	Graminoid	*Vahlodea atropurpurea*	0.1-1	0.5	100
	Graminoid	*Juncus drummondii*	0.1-1	0.3	100

Species Richness:
Plot Vascular Plant Species Richness Average: 17.3
Plot Vascular Plant Species Richness Range: 17-18

Diagnostic Species: *Phyllodoce empetriformis, Antennaria media, Vahlodea atropurpurea, Carex nigricans, Epilobium anagallidifolium, Juncus drummondii, Agrostis variabilis, Potentilla flabellifolia, Polytrichastrum alpinum*
Constant Species: *Carex nigricans, Potentilla flabellifolia, Phyllodoce empetriformis, Vahlodea atropurpurea, Juncus drummondii, Erigeron peregrinus*
Other Noteworthy Species: None
Local Range: This association occurs on the northwest side of the Crater Lake caldera (outside) just below the rim road**.**

Classification Comments: Our association 20. Black Alpine Sedge Wet Meadow was considered equivalent to the USNVC's Black Alpine Sedge Wet Meadow (CEGL001816) association type classified under the USNVC's Black Alpine Sedge - Sibbaldia - Globeflower Wet Meadow Alliance (A3832). Our association 20. Black Alpine Sedge Wet Meadow is also very similar to the USNVC association *Carex nigricans - Luetkea pectinata* Wet Meadow (CEGL001819); however, *Luetkea pectinata* is not constant in our association. At Crater Lake, our association is also highly intermixed with *Phyllodoce empetriformis* and has a very high cover of *Potentilla flabellifolia*, thereby highlighting some minor differences it has with the USNVC's Black Alpine Sedge Wet Meadow. Further inquiry should reveal the most similar USNVC association to ours.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 3. Relevés 508; 522; 598
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: From Christy (2004): Habitat is depressions and seepy alluvial fans in subalpine heath. This association is somewhat drier than ~*Salix commutata / Carex scopulorum* Wet Shrubland (CEGL001189) but intergrades with it. It also intergrades with ~*Carex scopulorum* Wet Meadow (CEGL001822) and upland *Phyllodoce empetriformis* heath. Stands on alluvial fans occur below springs and seeps and may be laced with rivulets or irrigated by sheetflow. Trees are absent and shrubs are confined to hummocks.

Global Vegetation Description: *Salix commutata* is the primary shrub but averages only 10% cover and does not exceed 20% cover. *Kalmia microphylla* is also present with about half as much constancy and cover. The herb layer has over 35 different species present, but most occur at low constancy and cover. *Carex nigricans* is present in all plots with an average cover of 33%, ranging from 5-95%. Other herbs with significant patches include *Carex scopulorum*, *Ligusticum grayi*, and *Caltha leptosepala* ssp. *howellii*. About half of the remaining herbs are wet lawn species and half are drier meadow species. This is not a productive habitat and considerable bare ground may be present in plots.

DISTRIBUTION

Range: This association ranges from northern California to British Columbia (Christy 2004).
States/Provinces: BC, CA?, ID, MT, OR, WA, WY.

Global Description Reference: J. A. Christy. 2006. *Carex nigricans* Wet Meadow [11Jun2006]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Black Alpine Sedge Wet Meadow at Crater Lake National Park.

21. BREWER'S SEDGE ALPINE MEADOW

Carex breweri Alpine Meadow

USNVC CLASSIFICATION:
Class: 4 Polar & High Montane Scrub, Grassland & Barrens
Subclass: 4.B Temperate to Polar Alpine & Tundra Vegetation
Formation: 4.B.1 Temperate & Boreal Alpine Tundra
Division: 4.B.1.Nb - D043 Western North American Alpine Tundra
Macrogroup: 4.B.1.Nb.3 - M101 Vancouverian Alpine Tundra
Group: 4.B.1.Nb.3.b - G320 North Pacific Alpine-Subalpine Tundra
Alliance: A3337 North Pacific Fescue Alpine Meadow
Association: *Carex breweri* Alpine Meadow

USNVC Identifier: CEGL001805

LOCAL INFORMATION

Environmental Description: This vegetation association occurs in a variety of settings at high elevations within the park. These include: the large open areas around the rim of the Crater Lake caldera on the fine grained, sandy pumic soils that were deposited during the Mount Mazama eruption; on coarse pumice and areas of stabilized scree on the steep slopes around some taller peaks, particularly Mount Scott and Llao Rock; in snowmelt basins, especially on the inside of the calderas of some buttes such as Red Cone and Timber Crater; in and around the Pumice Desert, particularly in low lying areas where snowmelt runoff collects; and in some high elevation forest openings. Topographic positions are variable but are most commonly high slope, midslope, summit, and level. Slopes are level to steep. Soils are most often sand but can sometimes be loamy sand or loam. Soils are well-drained to rapidly drained but occasionally are poorly drained. Soils are somewhat more stable relative to that of the surrounding pumice fields, allowing some organic material to accumulate. Soil stability may be due in part to the thick rhizomatous cover of Brewer's sedge (*Carex breweri*).

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	2331.8	9.1	340.6	13.5
Range	1824-2694	1-27	221-151	1-40

Vegetation Description: This herbaceous vegetation association is comprised of low-growing vegetation strongly dominated by Brewer's sedge (*Carex breweri*), which is often present with between 5 and 50% cover. A variety of perennial herbs may be present and are sometimes abundant, including Pacific lupine (*Lupinus lepidus*), Davis' knotweed (*Polygonum davisiae*), and silky raillardella (*Raillardella argentea*). Additional graminoids may also be present, including Parry's rush (*Juncus parryi*), western needlegrass (*Achnatherum occidentale*), and squirreltail (*Elymus elymoides* ssp. *elymoides*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Subshrub	*Phlox diffusa*	0-5	0.5	24
	Subshrub	*Eriogonum marifolium*	0-5	0.5	47
	Perennial herb	*Raillardella argentea*	0-25	2.1	29
	Perennial herb	*Lupinus lepidus*	0-25	1.9	65
	Perennial herb	*Polygonum davisiae*	0-25	1.5	71
	Graminoid	*Carex breweri*	0.1-50	14.4	100
	Graminoid	*Juncus parryi*	0-25	1.6	35
	Graminoid	*Achnatherum occidentale* ssp. *californicum*	0-10	0.5	18
	Graminoid	*Luzula piperi*	0-5	0.4	12
	Graminoid	*Elymus elymoides* ssp. *elymoides*	0-2	0.4	71

Species Richness:
Plot Vascular Plant Species Richness Average: 11.2
Plot Vascular Plant Species Richness Range: 7-20

Diagnostic Species: *Carex breweri*
Constant Species: *Carex breweri*
Other Noteworthy Species: *Lupinus lepidus, Polygonum davisiae*
Local Range: This association occurs in the open pumice fields found around the rim of the Crater Lake caldera and is particularly abundant on and around Llao Rock and Hillman Peak. It is also common on the slopes surrounding Mount Scott, on the tops of Red Cone, Timber Crater and Grouse Hill, and is occasional in and around the Pumice Desert.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 17. Relevés 140; 142; 155; 157; 158; 159; 257; 266; 281; 313; 442; 446; 464; 471; 472; 475; 476
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This herbaceous association is known from the vicinity of Yosemite National Park, and extends north into the North Cascades of Washington. The dominant species ranges north through the Klamath Mountains of northwestern California to the high mountains of Oregon and Washington. It is currently only described from Yosemite National Park in California. Additional global information will be added as it becomes available. This alpine grassland prefers moderate to steep slopes on northern to western aspects. Elevations range from 3110-3415 m (10,200-11,200 feet). Stands grow on middle to upper slopes in concave snowbeds with late

snowmelt. The soils are stony, sandy loams and well-drained. The snowmelt seasonally saturates sites, but summers are dry. These stands must endure several months of drought.

Global Vegetation Description: This association forms a patchy sward of graminoids and forbs heavily dominated by *Carex breweri*. *Juncus parryi* is also important. Other graminoids that may provide a trace of cover include *Trisetum spicatum, Poa fendleriana, Poa stebbinsii, Carex subnigricans, Carex vernacula*, and/or *Calamagrostis breweri*. *Antennaria media* and *Lupinus lepidus* are the most constant forbs. Other common forb associates providing traces of cover may include *Arabis platysperma, Silene sargentii*, and/or *Selaginella watsonii*.

DISTRIBUTION

Range: This association is known from the vicinity of Yosemite National Park, and extends north into the North Cascades of Washington. The dominant species ranges north through the Klamath Mountains of northwestern California to the high mountains of Oregon and Washington.
States/Provinces: CA, OR, WA.

Global Description References: T. Keeler-Wolf, mod. M.J. Russo. 2010. *Carex breweri* Alpine Meadow [06May2010]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Brewer's Sedge Alpine Meadow at Crater Lake National Park.

22. GRANITE PRICKLY PHLOX - COMMON WOOLLY SUNFLOWER ALPINE FELL-FIELD [PROVISIONAL]

Linanthus pungens – Eriophyllum lanatum Alpine Fell-field [Provisional]

USNVC CLASSIFICATION:
Class: 4 Polar & High Montane Scrub, Grassland & Barrens
Subclass: 4.B Temperate to Polar Alpine & Tundra Vegetation
Formation: 4.B.1 Temperate & Boreal Alpine Tundra
Division: 4.B.1.Nb - D043 Western North American Alpine Tundra
Macrogroup: 4.B.1.Nb.3 - M101 Vancouverian Alpine Tundra
Group: 4.B.1.Nb.3.b - G320 North Pacific Alpine-Subalpine Tundra
Alliance: A4255 Southern Cascadian Pumice Desert Fell-field

NPS Unique Identifier: NPSCRLA003

LOCAL INFORMATION

Environmental Description: This vegetation association occurs directly on the Crater Lake caldera rim at high elevation in the northeast section of the caldera. This association was classified from only one relevé plot. This vegetation association may be more widespread inside the caldera, where it was not considered safe to sample. Soil at the plot sampled is coarse pumice, and is sandy and rapidly drained. Topographic position is high on slopes.

Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
2258	10	220	1

Vegetation Description: This herbaceous vegetation association is dominated by granite prickly phlox (*Linanthus pungens*). Squirreltail (*Elymus elymoides* ssp. *elymoides*), woolly sunflower (*Eriophyllum lanatum* var. *integrifolium*) and Pacific lupine (*Lupinus lepidus*) are also common. Varieties of other forbs are also present at low cover. Overall vegetation cover is sparse.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Shrub	Narrow-leaved evergreen shrub	*Ericameria greenei*	0.1-1	0.5	100
Herb	Subshrub	*Linanthus pungens*	5-10	7.5	100
	Subshrub	*Eriophyllum lanatum* var. *integrifolium*	1-2	1.5	100
	Subshrub	*Eriogonum marifolium*	0.1-1	0.5	100
	Perennial herb	*Cryptantha sobolifera*	0.1-1	0.5	100
	Perennial herb	*Lupinus lepidus*	1-2	1.5	100
	Perennial herb	*Penstemon speciosus*	0.1-1	0.5	100
	Perennial herb	*Phacelia hastata* var. *compacta*	0.1-1	0.5	100
	Graminoid	*Elymus elymoides* ssp. *elymoides*	1-2	1.5	100
	Annual herb	*Mimulus nanus*	0.1-1	0.5	100

Species Richness:
Plot Vascular Plant Species Richness Average: 20
Plot Vascular Plant Species Richness Range: N/A

Diagnostic Species: *Potentilla glandulosa, Arabis lemmonii* var. *lemmonii, Cryptantha sobolifera, Eriophyllum lanatum* var. *integrifolium, Linanthus pungens, Penstemon speciosus, Mimulus nanus, Orobanche fasciculata*
Constant Species: N/A
Other Noteworthy Species: None
Local Range: This association occurs directly on the Crater Lake caldera rim at high elevations in the northeast section of caldera.

Classification comments: We classified our association 22. Granite Prickly Phlox - Common Woolly Sunflower Alpine Fell-field [Provisional] under the USNVC's North Pacific Alpine-Subalpine Tundra (G320) to relate it to other fell-field vegetation associations in the park. It is possible our provisional association should be classified under the Coville's Phlox - White-stem Goldenbush Alpine Fell-field Alliance (A3363) because our association is similar to a USNVC association classified under A3363: the *Calamagrostis purpurascens - Leptodactylon pungens* Alpine Fell-field (CEGL008658).

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 1. Relevé 298
Crater Lake National Park Notes: None



Above: Granite Prickly Phlox – Common Woolly Sunflower Alpine Fell-field [Provisional] at Crater Lake National Park.

23. GREENE'S GOLDENBUSH / DAVIS' KNOTWEED SHRUB GRASSLAND

Ericameria greenei / Polygonum davisiae Shrub Grassland

USNVC CLASSIFICATION:

Class: 4 Polar & High Montane Scrub, Grassland & Barrens
Subclass: 4.B Temperate to Polar Alpine & Tundra Vegetation
Formation: 4.B.1 Temperate & Boreal Alpine Tundra
Division: 4.B.1.Nb - D043 Western North American Alpine Tundra
Macrogroup: 4.B.1.Nb.3 - M101 Vancouverian Alpine Tundra
Group: 4.B.1.Nb.3.b - G320 North Pacific Alpine-Subalpine Tundra
Alliance: A4255 Southern Cascadian Pumice Desert Fell-field
Association: *Ericameria greenei* / *Polygonum davisiae* Shrub Grassland

USNVC Identifier: CEPP007257

LOCAL INFORMATION

Environmental Description: This vegetation association occurs in the large open areas at high elevations around the rim of the Crater Lake caldera on the fine grained, sandy pumice soils that were deposited during the Mount Mazama eruption. Topographic positions are mostly midslope but can also be low slope and high slope. Soils are sandy and sandy loam and thus are well-drained to rapidly-drained. This association tends to occur in areas where the soil appears to be relatively more stable, possibly as a result of these being somewhat wind protected sites.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	2133.0	5.9	200.6	12.2
Range	2007-2237	2-10	90-297	8-33

Vegetation Description: This moderately dense, low shrub and herbaceous vegetation association is dominated by the low shrub Greene's goldenbush (*Ericameria greenei*), along with the forbs Davis' knotweed (*Polygonum davisiae*), Anderson's lupine (*Lupinus andersonii*), the subshrub marumleaf buckwheat (*Eriogonum marifolium*), and the grasses squirreltail (*Elymus elymoides* ssp. *elymoides*) and western needlegrass (*Achnatherum occidentale*). Floristically, this association is very similar to the Davis' Knotweed – Squirreltail Fell-field [Provisional] except for its high cover of Greene's goldenbush.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Shrub	Narrow-leaved evergreen shrub	*Ericameria greenei*	2-50	18.0	100
Herb	Subshrub	*Eriogonum marifolium*	0-5	1.8	91
	Perennial herb	*Polygonum davisiae*	0.01-25	7.5	100
	Perennial herb	*Lupinus andersonii*	0-50	7.8	82
	Perennial herb	*Cistanthe umbellata*	0-1	0.1	82
	Graminoid	*Elymus elymoides* ssp. *elymoides*	1-25	7.3	100
	Graminoid	*Achnatherum occidentale* ssp. *californicum*	0.1-25	5.3	100
	Graminoid	*Carex straminiformis*	0-10	0.8	36
	Graminoid	*Carex halliana*	0-5	0.8	27

Species Richness:
Plot Vascular Plant Species Richness Average: 9.8
Plot Vascular Plant Species Richness Range: 6-16

Diagnostic Species: None
Constant Species: *Ericameria greenei*, *Polygonum davisiae*, *Elymus elymoides* ssp. *elymoides*, *Achnatherum occidentale* ssp. *californicum*
Other Noteworthy Species: None
Local Range: This association occurs in the open pumice fields found around the rim of the Crater Lake caldera. These pumice fields are predominantly on the slopes outside the Crater Lake caldera rim from the eastern side, around the southern slopes to the northwestern portion, and are generally absent from the northeast portion of the caldera rim. This association is also found on the top of Crater Peak.

Classification comments: Some sites where our association 23. Greene's Goldenbush / Davis' Knotweed Shrub Grassland occurs blend with montane grassland associations of lower elevations. As a result, our Greene's Goldenbush / Davis' Knotweed Shrub Grassland shares many of the same constant species as those dominant in our Long-Stolon Sedge - Western Needlegrass Grassland (CEPP007243) and California Needlegrass - Anderson's Lupine Grassland (CEPP007204) associations classified in the USNVC's Central Rocky Mountain Montane Grassland Group (G267). However Davis' knotweed (*Polygonum davisiae*) has very high cover in the relevés in this association 23. Greene's Goldenbush / Davis' Knotweed Shrub Grassland as well as in all of the associations that were placed under North Pacific Alpine-Subalpine Tundra Group (G320).

This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 11. Relevés 89; 91; 92; 145; 146; 255; 282; 300; 303; 417; 451
Crater Lake National Park Notes: None



Above: Greene's Goldenbush / Davis' Knotweed Shrub Grassland at Crater Lake National Park. The yellow flowering low shrub is Greene's goldenbush (*Ericameria greenei*), and the senescing red forb is Davis' knotweed (*Polygonum davisiae*).

24. MARUMLEAF BUCKWHEAT - CRATER LAKE SANDWORT FELL-FIELD

Eriogonum marifolium - Arenaria pumicola Fell-field

USNVC CLASSIFICATION:

Class: 4 Polar & High Montane Scrub, Grassland & Barrens
Subclass: 4.B Temperate to Polar Alpine & Tundra Vegetation
Formation: 4.B.1 Temperate & Boreal Alpine Tundra
Division: 4.B.1.Nb - D043 Western North American Alpine Tundra
Macrogroup: 4.B.1.Nb.3 - M101 Vancouverian Alpine Tundra
Group: 4.B.1.Nb.3.b - G320 North Pacific Alpine-Subalpine Tundra
Alliance: A4255 Southern Cascadian Pumice Desert Fell-field
Association: *Eriogonum marifolium - Arenaria pumicola* Fell-field

USNVC Identifier: CEPP007262

LOCAL INFORMATION

Environmental Description: This vegetation association occurs in the barren pumice field of the Pumice Desert north of the Crater Lake caldera. The sandy pumice soils are deep deposits made during the Mount Mazama eruption. Elevations are moderately high. Topographic position is basin floor. Slopes are level or nearly so. The soils are sand and rapidly drained. Organic material is largely lacking.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1819.8	2	245.5	1.6
Range	1814-1829	1-4	140-28	1-2

Vegetation Description: This very sparse herbaceous vegetation association is comprised of forbs and graminoids that occur with very low cover. The subshrub marumleaf buckwheat (*Eriogonum marifolium*) and the forb Mt. Hood pussy paws (*Cistanthe umbellata*) are always present. Shasta tansyaster (*Machaeranthera canescens* var. *shastensis*), Crater Lake sandwort (*Arenaria pumicola*), cascade desertparsley (*Lomatium martindalei*), and goosefoot violet (*Viola purpurea* ssp. *integrifolia*) are often present. Western needlegrass (*Achnatherum occidentale*) is common and sometimes can be the most abundant species present. Overall vegetation cover is sparse.

Most Abundant Species:

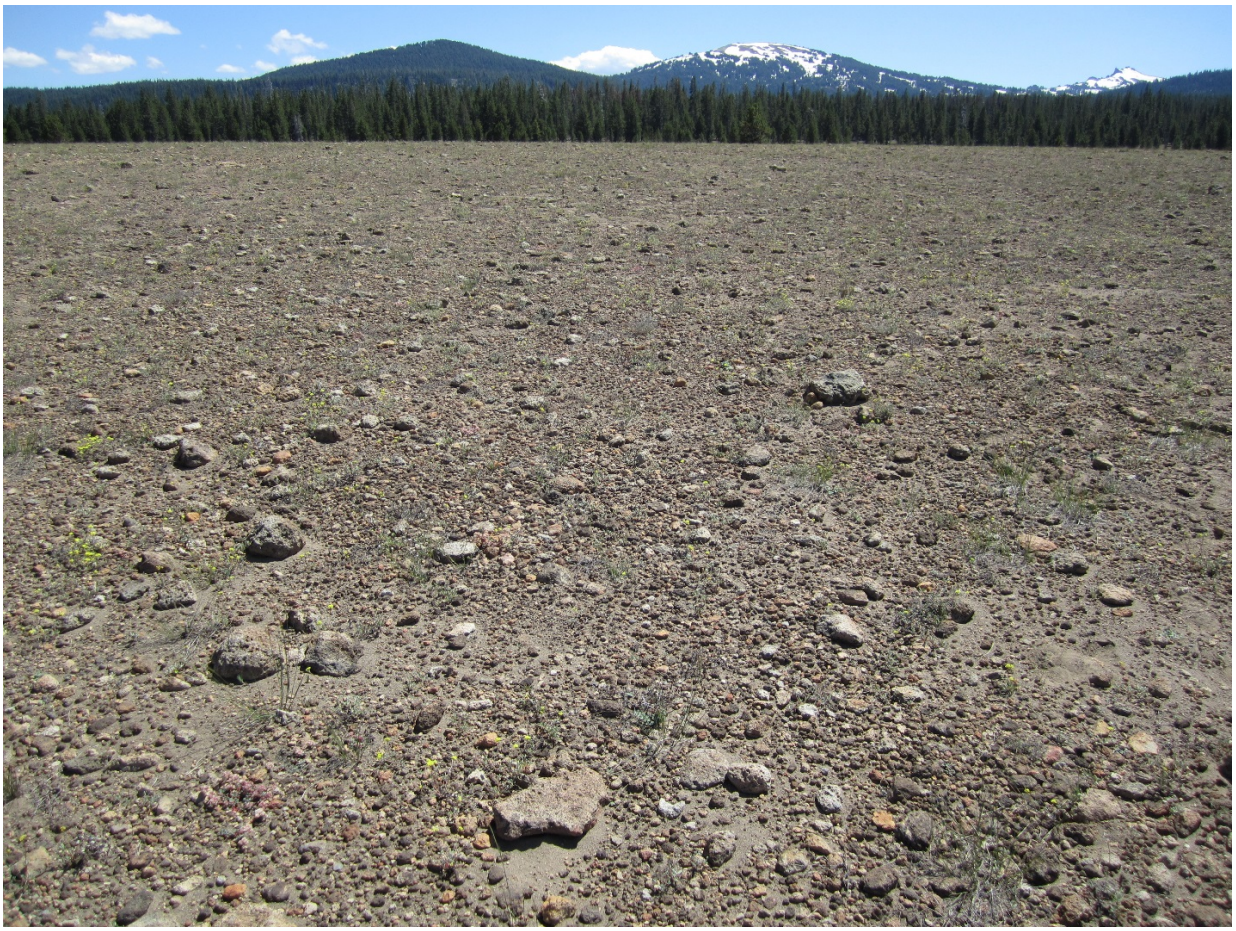
Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Subshrub	*Eriogonum marifolium*	1-5	2.3	100
	Perennial herb	*Arenaria pumicola*	0-2	1.0	80
	Perennial herb	*Lomatium martindalei*	0-1	0.4	80
	Perennial herb	*Machaeranthera canescens* var. *shastensis*	0-1	0.3	80
	Perennial herb	*Cistanthe umbellata*	0.01-1	0.2	100
	Perennial herb	*Viola purpurea* ssp. *integrifolia*	0-1	0.1	80
	Graminoid	*Achnatherum occidentale* ssp. *californicum*	0-5	2.2	80
	Graminoid	*Carex breweri*	0-5	0.8	60

Species Richness:
Plot Vascular Plant Species Richness Average: 7.4
Plot Vascular Plant Species Richness Range: 5-8

Diagnostic Species: None
Constant Species: *Cistanthe umbellata, Eriogonum marifolium*
Other Noteworthy Species: *Arenaria pumicola*
Local Range: This association occurs in the Pumice Desert north of the Crater Lake caldera.

Classification Comments: This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 5. Relevés 65; 66; 68; 69; 70
Crater Lake National Park Notes: None



Above: Marumleaf Buckwheat – Crater Lake Sandwort Fell-field in the Pumice Desert at Crater Lake National Park.

25. DAVIS' KNOTWEED - SQUIRRELTAIL FELL-FIELD

Polygonum davisiae – Elymus elymoides Fell-field

USNVC CLASSIFICATION:

Class: 4 Polar & High Montane Scrub, Grassland & Barrens
Subclass: 4.B Temperate to Polar Alpine & Tundra Vegetation
Formation: 4.B.1 Temperate & Boreal Alpine Tundra
Division: 4.B.1.Nb - D043 Western North American Alpine Tundra
Macrogroup: 4.B.1.Nb.3 - M101 Vancouverian Alpine Tundra
Group: 4.B.1.Nb.3.b - G320 North Pacific Alpine-Subalpine Tundra
Alliance: A4255 Southern Cascadian Pumice Desert Fell-field
Association: *Polygonum davisiae – Elymus elymoides* Fell-field

USNVC Identifier: CEPP007270

LOCAL INFORMATION

Environmental Description: This vegetation association occurs in the large open areas at high elevations around the rim of the Crater Lake caldera on the fine grained, sandy pumice soils that were deposited during the Mount Mazama eruption. The topographic positions are upper slopes. Soils are deep, sandy, loose, and very well-drained. Organic material is largely lacking.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	2325.7	13.2	181.9	18
Range	2194-2368	5-26	135-273	1-36

Vegetation Description: This sparse to moderately dense herbaceous vegetation association is a mix of forbs and graminoids, some of which, such as Davis' knotweed (*Polygonum davisiae*), are only found at high elevations in the park. Davis' knotweed and squirreltail (*Elymus elymoides* ssp. *elymoides*) are always present with low to moderate cover. The subshrubs marumleaf buckwheat (*Eriogonum marifolium*) and spreading phlox (*Phlox diffusa*) are often present as are the perennial forbs Anderson's lupine (*Lupinus andersonii*) and Cascade aster (*Eucephalus ledophyllus*). Western needlegrass (*Achnatherum occidentale*) can also be present and is sometimes abundant. The size, abundance, and cover of some forbs can vary dramatically between years as determined by the amount of snowpack that provides the bulk of soil moisture available to herbaceous plants during the summer months.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Subshrub	*Phlox diffusa*	0-25	6.5	67
	Subshrub	*Eriogonum marifolium*	0-10	1.7	67
	Perennial herb	*Polygonum davisiae*	1-25	6.8	100
	Perennial herb	*Lupinus andersonii*	0-25	4.2	50
	Perennial herb	*Eucephalus ledophyllus*	0-25	3.3	83
	Graminoid	*Achnatherum occidentale* ssp. *californicum*	0-50	6.6	50
	Graminoid	*Carex spectabilis*	0-25	2.9	17
	Graminoid	*Elymus elymoides* ssp. *elymoides*	0.1-5	1.1	100

Species Richness:
Plot Vascular Plant Species Richness Average: 12
Plot Vascular Plant Species Richness Range: 5-25

Diagnostic Species: None
Constant Species: *Polygonum davisiae*, *Elymus elymoides* ssp. *elymoides*
Other Noteworthy Species: None
Local Range: This association occurs in the open pumice fields found around the rim of the Crater Lake caldera. These pumice fields are predominantly on the slopes outside the Crater Lake caldera rim from the eastern side, around the southern slopes to the northwestern portion, and are generally absent from the northeast portion of the caldera rim.

Classification Comments: This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 6. Relevés 137; 143; 285; 445; 448; 449
Crater Lake National Park Notes: None



Above: Davis' Knotweed – Squirreltail Fell-field along the Crater Lake caldera rim at Crater Lake National Park.

26. DAVIS' KNOTWEED - SHASTA BUCKWHEAT FELL-FIELD

Polygonum davisiae – Eriogonum pyrolifolium Fell-field

USNVC CLASSIFICATION:
Class: 4 Polar & High Montane Scrub, Grassland & Barrens
Subclass: 4.B Temperate to Polar Alpine & Tundra Vegetation
Formation: 4.B.1 Temperate & Boreal Alpine Tundra
Division: 4.B.1.Nb - D043 Western North American Alpine Tundra
Macrogroup: 4.B.1.Nb.3 - M101 Vancouverian Alpine Tundra
Group: 4.B.1.Nb.3.b - G320 North Pacific Alpine-Subalpine Tundra
Alliance: A4255 Southern Cascadian Pumice Desert Fell-field
Association: *Polygonum davisiae – Eriogonum pyrolifolium* Fell-field

USNVC Identifier: CEPP007271

LOCAL INFORMATION

Environmental Description: This vegetation association occurs mainly in the large open areas at high elevations around the rim of the Crater Lake caldera on the fine grained, sandy pumice soils that were deposited during the Mount Mazama eruption. It is also found on the barren pumice soils on cinder cone buttes throughout the park, in particular Wizard Island, Red Cone, and Crater Peak. In addition, this association occurs on coarse pumice slopes of some mountain peaks including Mount Scott and Union Peak, as well as on relatively level, barren pumice deposits found across the higher elevations in the park. Topographic positions are mainly high slope but also include midslope, lowslope, step in slope and low level. Elevations are generally high. Soils are rapidly draining sand and pumice. Slopes range from relatively flat to steep. Organic material is largely lacking.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	2137.1	16.1	152.4	3.8
Range	1998-2218	1-35	45-330	0-15

Vegetation Description: This very sparse (<10% cover) herbaceous vegetation association is comprised of a scant cover of low-growing herbs dominated by Davis' knotweed (*Polygonum davisiae*) and Shasta buckwheat (*Eriogonum pyrolifolium* var. *coryphaeum*). Davis' knotweed is a constant species and Shasta buckwheat is nearly so. A limited number of other herb species may be present at low cover and can include Crater Lake sandwort (*Arenaria pumicola*), silky raillardella (*Raillardella argentea*), and white pasqueflower (*Pulsatilla occidentalis*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0-2	0.2	20
Herb	Perennial herb	*Polygonum davisiae*	0.1-10	1.7	100
	Perennial herb	*Eriogonum pyrolifolium* var. *coryphaeum*	0-2	0.9	90
	Perennial herb	*Arenaria pumicola*	0-5	0.7	60
	Perennial herb	*Pulsatilla occidentalis*	0-5	0.5	40
	Perennial herb	*Raillardella argentea*	0-1	0.2	40

Species Richness:
Plot Vascular Plant Species Richness Average: 6.5
Plot Vascular Plant Species Richness Range: 3-13

Diagnostic Species: None
Constant Species: *Polygonum davisiae*
Other Noteworthy Species: *Eriogonum pyrolifolium* var. *coryphaeum*
Local Range: This association occurs at relatively high elevations throughout the park. It is most commonly found in the open pumice fields that occur around the rim of the Crater Lake caldera. These pumice fields are predominantly on the slopes outside the Crater Lake caldera rim from the eastern side, around the southern slopes to the northwestern portion, and are generally absent from the northeast portion of the caldera rim. This association is also found on cinder cone buttes throughout the park, in particular Wizard Island, Red Cone, Bald Crater, and Crater Peak, as well as on the slopes of Mount Scott, Union Peak, Castle Point, and Desert Ridge. It also occurs on the barren pumice deposits found across the higher elevations in the park, particularly near Union Peak and on top of Grouse Hill.

Classification Comments: This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots 10. Relevés 148; 264; 291; 304; 306; 433; 440; 441; 450; 454
Crater Lake National Park Notes: None



Above: Davis' Knotweed – Shasta Buckwheat Fell-field at Crater Lake National Park.

27. SHASTA KNOTWEED - DAVIS' KNOTWEED FELL-FIELD

Polygonum shastense – Polygonum davisiae Fell-field

USNVC CLASSIFICATION:
Class: 4 Polar & High Montane Scrub, Grassland & Barrens
Subclass: 4.B Temperate to Polar Alpine & Tundra Vegetation
Formation: 4.B.1 Temperate & Boreal Alpine Tundra
Division: 4.B.1.Nb - D043 Western North American Alpine Tundra
Macrogroup: 4.B.1.Nb.3 - M101 Vancouverian Alpine Tundra
Group: 4.B.1.Nb.3.b - G320 North Pacific Alpine-Subalpine Tundra
Alliance: A4255 Southern Cascadian Pumice Desert Fell-field
Association: *Polygonum shastense – Polygonum davisiae* Fell-field

USNVC Identifier: CEPP007275

LOCAL INFORMATION

Environmental Description: This vegetation association occurs in the large open areas at high elevations around the rim of the Crater Lake caldera on the fine grained, sandy pumice soils that were deposited during the Mount Mazama eruption. The topographic positions are high level, low level, high slope and summits. Slopes are mostly gentle. Soils are deep, sandy, loose, and rapidly drained. Organic material is largely lacking.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	2139.3	3.6	186.4	2.1
Range	2054-2304	1-11	335-251	1-5

Vegetation Description: This sparse herbaceous vegetation association is dominated by the subshrub Shasta knotweed (*Polygonum shastensis*). Davis' knotweed (*Polygonum davisiae*) is often present and relatively abundant but may be absent. Crater Lake sandwort (*Arenaria pumicola*) is always present. Shasta buckwheat (*Eriogonum pyrolifolium* var. *coryphaeum*), Pacific lupine (*Lupinus lepidus*) and marumleaf buckwheat (*Eriogonum marifolium*) are often present. Many of the common plants in this association, such as Davis' knotweed, Shasta knotweed, and Shasta buckwheat, are only found at high elevations in the park.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Subshrub	*Polygonum shastense*	1-25	7.5	100
	Subshrub	*Eriogonum marifolium*	0-2	0.6	86
	Perennial herb	*Polygonum davisiae*	0-25	4.9	86
	Perennial herb	*Eriogonum pyrolifolium* var. *coryphaeum*	0-5	1.0	86
	Perennial herb	*Arenaria pumicola*	0.01-5	0.9	100
	Perennial herb	*Lupinus lepidus*	0-1	0.4	86

Species Richness:
Plot Vascular Plant Species Richness Average: 7.4
Plot Vascular Plant Species Richness Range: 5-10

Diagnostic Species: *Polygonum shastense*
Constant Species: *Polygonum shastense*, *Arenaria pumicola*
Other Noteworthy Species: *Polygonum davisiae*
Local Range: This association occurs in the open pumice fields found around the rim of the Crater Lake caldera. These pumice fields are predominantly on the slopes outside the Crater Lake caldera rim from the eastern side, around the southern slopes to the northwestern portion, and are generally absent from the northeast portion of the caldera rim.

Classification Comments: This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 7. Relevés 88; 141; 256; 269; 270; 297; 309
Crater Lake National Park Notes: None



Above: Shasta Knotweed – Davis' Knotweed Fell-field at Crater Lake National Park. The low, green subshrubs with white flowers are Shasta knotweed (*Polygonum shastensis*).

28. DAVIDSON'S PENSTEMON SPARSE VEGETATION

Penstemon davidsonii Sparse Vegetation

USNVC CLASSIFICATION:
Class: 6 Open Rock Vegetation
Subclass: 6.B Temperate & Boreal Open Rock Vegetation
Formation: 6.B.1 Temperate & Boreal Cliff, Scree & Other Rock Vegetation
Division: 6.B.1.Nb - D052 Western North American Temperate & Boreal Cliff, Scree & Rock Vegetation
Macrogroup: 6.B.1.Nb.1 - M887 Western North American Cliff, Scree & Rock Vegetation
Group: 6.B.1.Nb.1.c - G573 Southern Vancouverian Cliff, Scree & Rock Vegetation
Alliance: A3787 Lemmon's Needlegrass - Dense Rock Moss Sparse Cliff, Bald & Outcrop
Association: *Penstemon davidsonii* Sparse Vegetation

USNVC Identifier: CEPP007265

LOCAL INFORMATION

Environmental Description: This vegetation association occurs on areas of exposed rock at all elevations in the park. These areas of exposed rock can be extensive, or they can occur as forest openings. They include scree fields, cliffs, a'a lava flows on the west side of Wizard Island, as well as other rock features and areas composed of mostly bare rock. This association also occurs inside the caldera of Wizard Island. Topographic position are high slope and summit. Slopes are steep on average. Soils are often sparse and include loamy sands, sandy loam, and sand. Soils are rapidly drained and sometimes well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1858	19.8	312.9	23.8
Range	1682-2083	1-28	161-12	5-40

Vegetation Description: This sparse herbaceous vegetation association occurs on scree slopes and bare rock. The subshrub Davidson's penstemon (*Penstemon davidsonii* var. *davidsonii*) is always present at low to moderate cover and consistently occurs with the highest cover of any other herb present, or nearly so. Parry's rush (*Juncus parryi*) is often present and may be as similarly abundant as Davidson's penstemon. Other common subshrubs and perennial herbs present may include cliff beardtongue (*Penstemon rupicola*), cream stonecrop (*Sedum oregonense*) and western snakeroot (*Ageratina occidentalis*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0-5	0.9	25
Shrub	Broad-leaved evergreen shrub	*Arctostaphylos nevadensis*	0-2	0.8	50
	Broad-leaved evergreen shrub	*Paxistima myrsinites*	0-5	0.9	25
	Broad-leaved deciduous shrub	*Holodiscus discolor*	0-1	0.3	50
	Broad-leaved deciduous shrub	*Sambucus racemosa*	0-1	0.3	75
Herb	Subshrub	*Penstemon davidsonii* var. *davidsonii*	2-25	8.0	100
	Subshrub	*Ageratina occidentalis*	0-10	1.9	25
	Perennial herb	*Sedum oregonense*	0-5	1.8	50
	Graminoid	*Juncus parryi*	0-25	4.5	75

Species Richness:
Plot Vascular Plant Species Richness Average: 17
Plot Vascular Plant Species Richness Range: 11-25

Diagnostic Species: None
Constant Species: *Penstemon davidsonii* var. *davidsonii*
Other Noteworthy Species: None
Local Range: This association occurs on scree fields, cliffs, and other rock features and areas composed of mostly bare rock at all elevations throughout the park. It is also found on Wizard Island on the a'a lava flows on the west side as well as inside its caldera.

Classification Comments: This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 4. Relevés 249; 250; 390; 453



Above: Davidson's Penstemon Sparse Vegetation at Crater Lake National Park. The green clumps in the foreground, midground, and background are Davidson's penstemon (Penstemon davidsonii var. davidsonii).

29. WHITE PASQUEFLOWER - DAVIDSON'S PENSTEMON SPARSE VEGETATION

Pulsatilla occidentalis - Penstemon davidsonii Sparse Vegetation

USNVC CLASSIFICATION:
Class: 6 Open Rock Vegetation
Subclass: 6.B Temperate & Boreal Open Rock Vegetation
Formation: 6.B.1 Temperate & Boreal Cliff, Scree & Other Rock Vegetation
Division: 6.B.1.Nb - D052 Western North American Temperate & Boreal Cliff, Scree & Rock Vegetation
Macrogroup: 6.B.1.Nb.1 - M887 Western North American Cliff, Scree & Rock Vegetation
Group: 6.B.1.Nb.1.c - G573 Southern Vancouverian Cliff, Scree & Rock Vegetation
Alliance: A3787 Lemmon's Needlegrass - Dense Rock Moss Sparse Cliff, Bald & Outcrop
Association: *Pulsatilla occidentalis - Penstemon davidsonii* Sparse Vegetation

USNVC Identifier: CEPP007276

LOCAL INFORMATION

Environmental Description: This vegetation association occurs on scree slopes at high elevations around the Crater Lake caldera rim and on Mount Scott and Union Peak. The substrate is mostly a collection of broken rock fragments with smaller rock fragments and sand sometimes accumulated in the interspaces. Soils are mostly rapidly-drained and sometimes well-drained. Infrequently this association occurs on fine grained, sandy pumice soils off the scree slopes. Slopes are steep and may include slopes steeper than could be sampled. Topographic positions are upper slopes and midslopes.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	2290.4	28.4	127.4	1.6
Range	2150-2705	23-37	112-281	1-3

Vegetation Description: This is a sparse herbaceous vegetation association that occurs almost exclusively on scree slopes. The total vegetation cover is often low but can be as high as 25% or higher. The predominant species present is white pasqueflower (*Pulsatilla occidentalis*) at somewhat low to relatively high cover. Davidson's penstemon (*Penstemon davidsonii* var. *davidsonii*) is also common but typically with less cover than white pasqueflower. A variety of perennial herbs may be present, most notably Mt. Shasta arnica (*Arnica viscosa*) and sticky cinquefoil (*Potentilla glandulosa*), as well as the fern Cascade rockbrake (*Cryptogramma cascadensis*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Herb	Subshrub	*Penstemon davidsonii* var. *davidsonii*	0.1-5	2.1	100
	Subshrub	*Potentilla glandulosa*	0-5	1.1	60
	Perennial herb	*Pulsatilla occidentalis*	2-25	7.9	100
	Perennial herb	*Arnica viscosa*	0-10	3.3	60
	Graminoid	*Elymus elymoides* ssp. *elymoides*	0-2	0.5	80
	Fern or fern ally	*Cryptogramma cascadensis*	0-2	0.4	40

Species Richness:
Plot Vascular Plant Species Richness Average: 10.4
Plot Vascular Plant Species Richness Range: 6-13

Diagnostic Species: *Pulsatilla occidentalis*, *Arnica viscosa*
Constant Species: *Pulsatilla occidentalis*, *Penstemon davidsonii* var. *davidsonii*
Other Noteworthy Species: *Potentilla glandulosa*
Local Range: This association occurs on scree slopes at high elevations around the south and west portions of the Crater Lake caldera rim and on Mount Scott and Union Peak.

Classification comments: This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 5. Relevés 289; 296; 307; 315; 317
Crater Lake National Park Notes: None



Above: White Pasqueflower – Davidson's Penstemon Sparse Vegetation at Crater Lake National Park.SHRUB VEGETATION

30. GREENLEAF MANZANITA – (SNOWBRUSH CEANOTHUS) / PROSTRATE CEANOTHUS SHRUBLAND

Arctostaphylos patula - (Ceanothus velutinus) / Ceanothus prostratus Shrubland

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.B Temperate & Boreal Grassland & Shrubland
Formation: 2.B.2 Temperate Grassland & Shrubland
Division: 2.B.2.Nd - D061 Western North American Interior Chaparral
Macrogroup: 2.B.2.Nd.1 - M094 Cool Interior Chaparral
Group: 2.B.2.Nd.1.a - G282 Western North American Montane Sclerophyll Scrub
Alliance: A0788 Greenleaf Manzanita - Pinemat Manzanita Shrubland
Association: *Arctostaphylos patula* - (*Ceanothus velutinus*) / *Ceanothus prostratus* Shrubland

USNVC Identifier: CEGL000957

LOCAL INFORMATION

Environmental Description: This vegetation association occurs in forest openings on shallow soils on the far western edge of the park at relatively low park elevations. Topographic positions are midslope and summit. Slopes are moderate to fairly steep. Soils are sandy loam or loamy sand and well-drained to rapidly drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1521	17.5	200.0	22.5
Range	1496-1546	7-28	175-225	15-30

Vegetation Description: This is a moderately open to dense shrub vegetation association in forest openings. It is dominated by 1-2 m tall greenleaf manzanita (*Arctostaphylos patula*) and the decumbent shrub prostrate ceanothus (*Ceanothus prostratus*) at moderate to high cover. Saskatoon serviceberry (*Amelanchier alnifolia* var. *semiintegrifolia*) can sometimes be present. A variety of forbs and graminoids are also present.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pseudotsuga menziesii* var. *menziesii*	0.01-1	0.3	100
Shrub	Broad-leaved evergreen shrub	*Arctostaphylos patula*	10 -50	28.3	100
	Broad-leaved evergreen shrub	*Ceanothus prostratus*	10-25	17.5	100
	Broad-leaved deciduous shrub	*Amelanchier alnifolia* var. *semiintegrifolia*	0-2	1	50
Herb	Annual herb	*Gayophytum diffusum*	0.01-1	0.3	100
	Graminoid	*Carex inops* ssp. *inops*	0.01-10	3.8	100
	Graminoid	*Elymus elymoides* ssp. *elymoides*	0.01-5	1.8	100
	Graminoid	*Achnatherum occidentale* ssp. *pubescens*	0.01-2	0.8	100

Species Richness:
Plot Vascular Plant Species Richness Average: 23.5
Plot Vascular Plant Species Richness Range: 15-32

Diagnostic Species: *Achnatherum lemmonii* var. *lemmonii*, *Arabis rectissima* var. *rectissima*, *Collomia heterophylla*, *Hemizonella minima*, *Mimulus alsinoides*, *Mimulus breweri*, *Mimulus jepsonii*, *Penstemon deustus* var. *deustus*, *Polygonum polygaloides* ssp. *kelloggii*, *Ceanothus prostratus*
Constant Species: *Arctostaphylos patula*, *Ceanothus prostratus*, *Achnatherum occidentale* ssp. *pubescens*, *Carex inops* ssp. *inops*, *Elymus elymoides* ssp. *elymoides*, *Gayophytum diffusum*, *Pseudotsuga menziesii* var. *menziesii*
Other Noteworthy Species: None
Local Range: This association occurs on the far western edge of the park just north of Castle Creek. This association may also occur on rocky bluffs south of the East Rim Drive between the Munson Valley road and the Pinnacles Road, but its occurrence was not confirmed through relevé sampling.

Classification Comments: We consider our association 30. *Arctostaphylos patula* - (*Ceanothus velutinus*) / *Ceanothus prostratus* Shrubland to be equivalent to the USNVC's *Arctostaphylos patula* - (*Ceanothus velutinus*) / *Ceanothus prostratus* Shrubland (CEGL000957); however, our provisional association lacks snowbrush ceanothus (*Ceanothus velutinus*) and was described from only two plots.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 2. Relevés 122; 343
Crater Lake National Park Notes: None



Above: Greenleaf Manzanita – (Snowbrush Ceanothus) / Prostrate Ceanothus Shrubland at Crater Lake National Park.

31. GREENLEAF MANZANITA SIERRAN CHAPARRAL SHRUBLAND

Arctostaphylos patula Sierran Chaparral Shrubland

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.B Temperate & Boreal Grassland & Shrubland
Formation: 2.B.2 Temperate Grassland & Shrubland
Division: 2.B.2.Nd - D061 Western North American Interior Chaparral
Macrogroup: 2.B.2.Nd.1 - M094 Cool Interior Chaparral
Group: 2.B.2.Nd.1.a - G282 Western North American Montane Sclerophyll Scrub
Alliance: A0788 Greenleaf Manzanita - Pinemat Manzanita Shrubland
Association: *Arctostaphylos patula* Sierran Chaparral Shrubland

USNVC Identifier: CEGL005820

LOCAL INFORMATION

Environmental Description: This vegetation association is scattered throughout much of the park at low to moderately high elevations. Slopes are moderately steep to very steep. Topographic positions are most often midslope and high slope but can also be fairly level on summits and low slopes. Soils are loamy sand and sand and are well-drained to rapidly drained. This association is often found on steep slopes that have experienced a high severity fire event in the relatively recent past and are slow to infill with trees due to shallow or skeletal soils. In some cases, these shrub fields have persisted through multiple high severity fires and may be maintained by these periodic high severity events. This association also occurs on steep slopes with shallow soils where fires have been less important in maintaining the shrubland as well as in larger openings among the ponderosa pine woodland in the northeast portion of the park.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1834.8	20.3	165.0	59.5
Range	1678-2144	0-40	0-263	15-89

Vegetation Description: This is a dense shrub vegetation association dominated by greenleaf manzanita (*Arctostaphylos patula*). Snowbrush ceanothus (*Ceanothus velutinus* var. *velutinus*) is often present and codominant and is occasionally the dominant shrub present. Bush chinquapin (*Chrysolepis sempervirens*) is sometimes present and is occasionally codominant. Pinemat manzanita (*Arctostaphylos nevadensis*) may be present but is subdominant. Total vegetation cover is often very high.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pinus ponderosa*	0-10	1.1	60
	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0-5	1.0	60
Shrub	Broad-leaved evergreen shrub	*Arctostaphylos patula*	10-95	36.1	100
	Broad-leaved evergreen shrub	*Ceanothus velutinus* var. *velutinus*	0-75	14.7	70
	Broad-leaved evergreen shrub	*Chrysolepis sempervirens*	0-50	4.8	40
	Broad-leaved evergreen shrub	*Arctostaphylos nevadensis*	0-10	2.2	60
	Broad -leaved deciduous shrub	*Holodiscus discolor*	0-5	0.7	50
Herb	Graminoid	*Carex inops* ssp. *inops*	0-5	0.6	50

Species Richness:
Plot Vascular Plant Species Richness Average: 12.4
Plot Vascular Plant Species Richness Range: 9-25

Diagnostic Species: None
Constant Species: *Arctostaphylos patula*
Other Noteworthy Species: *Ceanothus velutinus* var. *velutinus*
Local Range: This association is scattered throughout much of the park at low to moderately high elevations. It is most common on the slopes of Castle Point, Crater Peak, Grayback Ridge and in high severity burn patches on the central east boundary of the park.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 10. Relevés 40; 149; 183; 211; 247; 335; 340; 385; 432; 434
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This shrubland association is currently only known from Yosemite National Park in California, and the following description is based on occurrences there. Additional information will be added as it becomes available. It is likely that this association ranges throughout the Sierra Nevada and perhaps elsewhere in montane California. Stands are found at low to mid elevations (1495-2530 m [4900-8300 feet]) on mid to high portions of slopes with all aspects. The slopes tend to be linear and moderately steep to abrupt (10-70°). This association is found on

moderately deep to deep soils and occasionally on shallow soils. Soils are poorly drained to well-drained with textures ranging from stony and gravelly to loam from sedimentary and granitic parent materials. Although fires in this type can be small due to resistance to ignition, they can support catastrophic fires once they get started. The unvegetated surface is made up of litter, wood and bare soil. Disturbance in the form of invasion by exotics, logging, improper burning regime, and road and trail construction occur in low to high intensity. Most stands are the result of fire or other natural or unnatural processes. Many stands could support conifer woodland or forest with long intervals between fires or other disturbance processes.

Global Vegetation Description: This association forms open to moderately dense stands dominated by *Arctostaphylos patula*. Often found in this association are *Abies concolor, Calocedrus decurrens, Quercus kelloggii*, and *Chamaebatia foliolosa*. Occasionally, *Pinus jeffreyi, Quercus kelloggii*, and *Apocynum androsaemifolium* are present. A variety of other species present in this association may include *Carex multicaulis, Ceanothus parvifolius, Ceanothus cordulatus, Chamaesyce serpyllifolia, Lupinus breweri*, and *Prunus emarginata*. Stands of this association are variable in their disturbance regimes. Some are clearly seral to forest types, and others are edaphically controlled, probably persisting from 50 to more than 100 years at least without being invaded by conifers.

DISTRIBUTION

Range: This association is only known from Yosemite National Park in California. Information about its global characteristics is not available without additional inventory. It is likely that this association ranges throughout the Sierra Nevada and perhaps elsewhere in montane California.
States/Provinces: CA, OR.

Global Description Reference: T. Keeler-Wolf. 2010. *Arctostaphylos patula* Sierran Chaparral Shrubland [06May2010]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Greenleaf Manzanita Sierran Chaparral Shrubland at Crater Lake National Park.

32. PINEMAT MANZANITA / LACE LIPFERN SHRUBLAND

Arctostaphylos nevadensis / Cheilanthes gracillima Shrubland

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.B Temperate & Boreal Grassland & Shrubland
Formation: 2.B.2 Temperate Grassland & Shrubland
Division: 2.B.2.Nd - D061 Western North American Interior Chaparral
Macrogroup: 2.B.2.Nd.1 - M094 Cool Interior Chaparral
Group: 2.B.2.Nd.1.a - G282 Western North American Montane Sclerophyll Scrub
Alliance: A0788 Greenleaf Manzanita - Pinemat Manzanita Shrubland
Association: *Arctostaphylos nevadensis / Cheilanthes gracillima* Shrubland

USNVC Identifier: CEPP007205

LOCAL INFORMATION

Environmental Description: This vegetation association occurs throughout the park at all elevations, but is predominantly found in the western half and southern half of the park. It occurs on areas of exposed rock and areas of shallow bedrock where the substrate is stable enough to maintain its woody vegetation cover. This association can occur in extensive areas of cliff, rock, and scree, as well as in smaller forest openings. Topographic positions are mostly midslope but also include high slope, summit, and low level. Soils are loamy sands or sands. Slopes are fairly steep.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1904.7	19.0	180.0	28.8
Range	1765-2109	12-25	110-250	8-59

Vegetation Description: This low shrub vegetation association is dominated by pinemat manzanita (*Arctostaphylos nevadensis*) at moderate to high cover. Lace lipfern (*Cheilanthes gracillima*) is always present but often has low cover. The graminoids squirreltail (*Elymus elymoides* ssp. *elymoides*), western needlegrass (*Achnatherum occidentale*), long-stolon sedge (*Carex inops* ssp. *inops*), and Parry's rush (*Juncus parryi*) are often present at generally low cover. There are sometimes scattered small trees such as Sierra lodgepole pine (*Pinus contorta* var. *murrayana*), mountain hemlock (*Tsuga mertensiana*) and Shasta red fir (*Abies magnifica* var. *shastensis*). Though conspicuous, these small trees combine for little cover.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0-5	1.9	83
	Needle-leaved evergreen tree	*Tsuga mertensiana*	0-5	1.7	83
	Needle-leaved evergreen tree	*Pinus albicaulis*	0-5	0.6	17
Shrub	Broad-leaved evergreen shrub	*Arctostaphylos nevadensis*	2-50	20.2	100
	Broad-leaved deciduous shrub	*Holodiscus discolor*	0-2	0.4	50
Herb	Subshrub	*Penstemon davidsonii* var. *davidsonii*	0-5	0.8	50
	Graminoid	*Carex inops* ssp. *inops*	0-5	2.6	83
	Graminoid	*Achnatherum occidentale* ssp. *californicum*	0-2	0.8	83
	Graminoid	*Elymus elymoides* ssp. *elymoides*	0-1	0.3	83
	Fern or fern ally	*Cheilanthes gracillima*	0.01-1	0.2	100

Species Richness:
Plot Vascular Plant Species Richness Average: 16.2
Plot Vascular Plant Species Richness Range: 12-23

Diagnostic Species: *Cheilanthes gracillima*
Constant Species: *Arctostaphylos nevadensis*, *Cheilanthes gracillima*
Other Noteworthy Species: None
Local Range: This association is found throughout the western half and southern half of the park.

Classification Comments: This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 6. Relevés 243; 398; 399; 401; 408; 455



Above: Pinemat Manzanita / Lace Lipfern Shrubland at Crater Lake National Park.

33. BEARBRUSH / LOBB'S FIDDLELEAF SHRUBLAND

Garrya fremontii / Nama lobbii Shrubland

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.B Temperate & Boreal Grassland & Shrubland
Formation: 2.B.2 Temperate Grassland & Shrubland
Division: 2.B.2.Nd - D061 Western North American Interior Chaparral
Macrogroup: 2.B.2.Nd.1 - M094 Cool Interior Chaparral
Group: 2.B.2.Nd.1.a - G282 Western North American Montane Sclerophyll Scrub
Alliance: A0788 Greenleaf Manzanita - Pinemat Manzanita Shrubland
Association: *Garrya fremontii* / *Nama lobbii* Shrubland

USNVC Identifier: CEPP007263

LOCAL INFORMATION

Environmental Description: This vegetation association is only found on the south-facing slopes of Red Blanket Creek canyon in the far southwestern corner of the park. This area burned relatively recently in the 2008 Lonesome Fire. This association tends to occur in areas that were montane chaparral before the 2008 fire that have since recovered to chaparral shrubland. Elevations are relatively low for the park. The topographic positions are mostly high slope and midslope. Soils are loamy sands or gravels that are well-drained to rapidly drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1601.8	27.8	170.9	4.0
Range	1525-1659	24-33	19-190	3-5

Vegetation Description: This moderately open to dense shrub vegetation association is comprised of medium stature, evergreen sclerophyllous shrubs in recently burned areas, sometimes with scattered standing dead conifers. Bearbrush (*Garrya fremontii*) is the dominant shrub present, averaging about 10 percent cover. Greenleaf manzanita (*Arctostaphylos patula*) and prostrate ceanothus (*Ceanothus prostratus*) are subdominant shrubs. Snowbrush ceanothus (*Ceanothus velutinus* var. *velutinus*) is also frequently present but with low cover. In some areas the shrub form of Oregon white oak (*Quercus garryana*) is also a subdominant shrub. The perennial, fire following herb, Lobb's fiddleleaf (*Nama lobbii*), is abundant in the herb layer. Wavyleaf Indian paintbrush (*Castilleja applegatei* ssp. *pinetorum*) is also usually found in the herb layer at low cover. Bearbrush is a stump-sprouting shrub that quickly recovers its shrub form after its above ground parts are burned off in wildfires. This association tends to occur in areas that were montane chaparral before the 2008 fire that have since recovered to chaparral shrubland.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Shrub	Broad-leaved evergreen shrub	*Garrya fremontii*	5-50	18.1	100
	Broad-leaved evergreen shrub	*Arctostaphylos patula*	0.01-25	5.5	100
	Broad-leaved evergreen shrub	*Ceanothus prostratus*	0.1-2	1	100
	Broad-leaved evergreen shrub	*Ceanothus velutinus* var. *velutinus*	0.01-2	0.5	100
	Broad-leaved deciduous shrub	*Quercus garryana*	0-5	1.3	50
Herb	Perennial herb	*Nama lobbii*	5-95	25.9	100
	Perennial herb	*Castilleja applegatei* ssp. *pinetorum*	0.01-1	0.4	100
	Graminoid	*Carex inops* ssp. *inops*	0.01-5	1.0	100

Species Richness:
Plot Vascular Plant Species Richness Average: 15
Plot Vascular Plant Species Richness Range: 11-23

Diagnostic Species: *Garrya fremontii, Nama lobbii*
Constant Species: *Garrya fremontii, Nama lobbii, Arctostaphylos patula, Carex inops* ssp. *inops, Castilleja applegatei* ssp. *pinetorum, Ceanothus prostratus, Ceanothus velutinus* var. *velutinus*
Other Noteworthy Species: *Quercus garryana*
Local Range: This vegetation association is found on the south-facing slopes of Red Blanket Creek canyon in the far southwestern corner of the park.

Classification Comments: This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 4. Relevés 30; 31; 217; 218
Crater Lake National Park Notes: None



Above: Bearbrush / Lobb's Fiddleleaf Shrubland at Crater Lake National Park. In the foreground on the left is Lobb's fiddleleaf (*Nama lobbii*). On the far right in the foreground is bearbrush (*Garrya fremontii*).

34. BITTER CHERRY SIERRAN CHAPARRAL SHRUBLAND

Prunus emarginata Sierran Chaparral Shrubland

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.B Temperate & Boreal Grassland & Shrubland
Formation: 2.B.2 Temperate Grassland & Shrubland
Division: 2.B.2.Nd - D061 Western North American Interior Chaparral
Macrogroup: 2.B.2.Nd.1 - M094 Cool Interior Chaparral
Group: 2.B.2.Nd.1.a - G282 Western North American Montane Sclerophyll Scrub
Alliance: A3918 Californian Montane Bitter Cherry - Oceanspray Shrubland
Association: *Prunus emarginata* Sierran Chaparral Shrubland

USNVC Identifier: CEGL005822

LOCAL INFORMATION

Environmental Description: This vegetation association occurs on exposed rock and scree slopes at moderate to high elevations across the southern portion of the park. Topographic position at these locations are midslope and high slope. Slopes are steep. Soils are sandy loam or loamy sand and range from well-drained to rapidly drained. This association is most commonly found on cliffs, rock, and areas of stabilized scree. It is also found on areas of shallow or skeletal soils, some of which are in old burn patches, and it sometimes occurs with Greenleaf Manzanita Sierran Chaparral Shrubland (CEGL005820).

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1959.5	29	175	39
Range	1920-1999	25-33	170-80	7-71

Vegetation Description: This is an open to dense shrubland association dominated or codominated by the shrub bitter cherry (*Prunus emarginata*). Other shrubs often occur and can be equally as common as bitter cherry. These include greenleaf manzanita (*Arctostaphylos patula*), Cascara buckthorn (*Frangula purshiana*) and snowbrush ceanothus (*Ceanothus velutinus* var. *velutinus*). The trailing shrub, creeping snowberry (*Symphoricarpos mollis*), may be abundant in the understory. Other understory species are few and can include long-stolon sedge (*Carex inops* spp. *inops*), Pacific bleeding heart (*Dicentra formosa*), and spreading groundsmoke (*Gayophytum diffusum*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Shrub	Broad-leaved deciduous shrub	*Prunus emarginata*	10-25	18.0	100
	Broad-leaved deciduous shrub	*Ribes cereum* var. *cereum*	0-2	1.0	50
	Broad-leaved evergreen shrub	*Frangula purshiana*	0-25	7.5	50
	Broad-leaved evergreen shrub	*Ceanothus velutinus* var. *velutinus*	0-25	6.25	50
	Broad-leaved evergreen shrub	*Arctostaphylos patula*	0-25	5.5	50
	Broad-leaved evergreen shrub	*Chrysolepis sempervirens*	0-5	2.5	50
Herb	Graminoid	*Carex inops* ssp. *inops*	0-10	3.8	50

Species Richness:
Plot Vascular Plant Species Richness Average: 14
Plot Vascular Plant Species Richness Range: 13-15

Diagnostic Species: *Prunus emarginata, Ceanothus velutinus* var. *velutinus, Eriogonum nudum* var. *nudum, Frangula purshiana*
Constant Species: *Prunus emarginata, Dicentra formosa, Gayophytum diffusum*
Other Noteworthy Species: None
Local Range: This association is found on the cliffs and scree slopes around the Crater Lake caldera rim as well as scree slopes to the south of Crater Lake. It is common on Anderson Bluffs, Vidae Ridge, Grayback Ridge, Whitehorse Bluff, and around Maklaks Crater. It is also likely this association occurs on the caldera walls inside the caldera itself.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 2. Relevés 375; 460
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This shrubland association is currently only known from Yosemite National Park in California, and the following description is based on occurrences there. Additional information will be added as it becomes available. Stands are found at mid elevations (1800-2500 m [5900-8200 feet]) on gentle to somewhat steep slopes (5-24°). This association is

found on soils with textures ranging from sand to silt loam derived from granitic parent material. Litter cover at these sites can be high (40-70%).

Global Vegetation Description: Stands of this shrubland form a continuous shrub layer dominated by *Prunus emarginata*. *Populus tremuloides* is occasionally present in the overstory. *Prunus andersonii* can be common in the shrub layer. The shrub layer may also consist of low amounts of *Artemisia tridentata, Ribes roezlii, Purshia tridentata, Cercocarpus ledifolius*, and *Symphoricarpos rotundifolius* var. *rotundifolius*. The herbaceous layer may include *Lupinus latifolius, Apocynum androsaemifolium, Elymus elymoides, Gayophytum ramosissimum, Castilleja applegatei, Carex exserta, Carex hoodii*, and *Holodiscus discolor*.

DISTRIBUTION

Range: This association is only known from Yosemite National Park, California. Information about its global characteristics is not available without additional inventory.
States/Provinces: CA.

Global Description Reference: T. Keeler-Wolf. 2010. *Prunus emarginata* Sierran Chaparral Shrubland [06May2010]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Bitter Cherry Sierran Chaparral Shrubland at Crater Lake National Park. Bitter cherry (*Prunus emarginata*) is the tall shrub in the mid ground. Cascara buckthorn (*Frangula purshiana*) is the brighter green colored broadleave shrub in the foreground and is surrounded by pinemat manzanita (*Arctostaphylos nevadensis*).

35. OCEANSPRAY / MARUMLEAF BUCKWHEAT - LONG-STOLON SEDGE SHRUBLAND

Holodiscus discolor / Eriogonum marifolium - Carex inops ssp. inops Shrubland

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.B Temperate & Boreal Grassland & Shrubland
Formation: 2.B.2 Temperate Grassland & Shrubland
Division: 2.B.2.Nd - D061 Western North American Interior Chaparral
Macrogroup: 2.B.2.Nd.1 - M094 Cool Interior Chaparral
Group: 2.B.2.Nd.1.a - G282 Western North American Montane Sclerophyll Scrub
Alliance: A3918 Californian Montane Bitter Cherry - Oceanspray Shrubland
Association: *Holodiscus discolor* / *Eriogonum marifolium - Carex inops* ssp. *inops* Shrubland

USNVC Identifier: CEPP007264

LOCAL INFORMATION

Environmental Description: This vegetation association occurs on exposed rock and scree slopes at moderate to high elevations throughout the park. It is most common on the cliffs and scree slopes just south of the Crater Lake caldera rim as well as on the caldera walls inside the caldera itself. Topographic positions at these locations range from midslope to high slope and are occasionally lowslope. Slopes are steep. Soils are loamy sand range from well-drained to rapidly drained. This association is most commonly found on cliffs, rock, and areas of stabilized scree. Combined large rock and bedrock cover ranges from 30-70 percent.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	2115.5	29.8	168.8	23.2
Range	1888-2260	8-40	95-237	5-45

Vegetation Description: This is an open to somewhat dense shrubland association dominated by the deciduous shrub oceanspray (*Holodiscus discolor*). The low growing evergreen shrubs, pinemat manzanita (*Arctostaphylos nevadensis*) and/or prostrate ceanothus (*Ceanothus prostratus*) are often present and may be equally or slightly more abundant than oceanspray. A sparse cover of shubshrubs and perennial herbs are also present and may include marumleaf buckwheat (*Eriogonum marifolium*), cream stonecrop (*Sedum oregonense*), silverleaf phacelia (*Phacelia hastata* var. *hastata*), and Cascade aster (*Eucephalus ledophyllus*). The grasses California brome (*Bromus carinatus*) and squirreltail (*Elymus elymoides* ssp. *elymoides*) may also be somewhat common. Occasional small trees [e.g., Shasta red fir (*Abies magnifica* var. *shastensis*)] may occur.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Shrub	Broad-leaved evergreen shrub	*Ceanothus prostratus*	0-50	12.6	50
	Broad-leaved evergreen shrub	*Arctostaphylos nevadensis*	0-10	3.3	67
	Broad-leaved deciduous shrub	*Holodiscus discolor*	2-25	10.8	100
	Narrow-leaved evergreen shrub	*Ericameria greenei*	0-10	1.8	50
Herb	Subshrub	*Potentilla glandulosa*	0-10	3.8	33
	Subshrub	*Eriogonum marifolium*	0-5	1.2	67
	Perennial herb	*Chamerion angustifolium* ssp. *circumvagum*	0-5	0.7	67
	Graminoid	*Bromus carinatus*	0-5	0.8	83

Species Richness:
Plot Vascular Plant Species Richness Average: 19.7
Plot Vascular Plant Species Richness Range: 6-28

Diagnostic Species: *Holodiscus discolor*, *Arabis × divaricarpa*
Constant Species: *Holodiscus discolor*
Other Noteworthy Species: None
Local Range: This association is found on the cliffs and scree slopes around the Crater Lake caldera rim as well as on the caldera walls inside the caldera itself. It is common on Castle Crest, Appelgate Peak, Vidae Ridge, Grayback Ridge, and Anderson Bluffs. It is also found above the Red Blanket Creek canyon around Bald Top as well as on Wizard Island. It is likely this association occurs on cliffs and scree slopes elsewhere in the park.

Classification Comments: This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 6. Relevé 284; 288; 295; 316; 457; 458
Crater Lake National Park Notes: None



Above: Oceanspray / Marumleaf Buckwheat - Long-Stolon Sedge Shrubland at Crater Lake National Park.

36. RED ELDERBERRY / SPEARLEAF ARNICA SHRUBLAND

Sambucus racemosa / Arnica longifolia Shrubland

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.B Temperate & Boreal Grassland & Shrubland
Formation: 2.B.2 Temperate Grassland & Shrubland
Division: 2.B.2.Nd - D061 Western North American Interior Chaparral
Macrogroup: 2.B.2.Nd.1 - M094 Cool Interior Chaparral
Group: 2.B.2.Nd.1.a - G282 Western North American Montane Sclerophyll Scrub
Alliance: A3918 Californian Montane Bitter Cherry - Oceanspray Shrubland
Association: *Sambucus racemosa* / *Arnica longifolia* Shrubland

USNVC Identifier: CEPP007280

LOCAL INFORMATION

Environmental Description: This vegetation association occurs at moderately high elevations on scree slopes just south of the Crater Lake caldera rim as well as on Wizard Island. Topographic positions are high slope, midslope, lowslope and toeslope. Soils are loamy sand or loam and are moderately well-drained, well-drained or, in some cases, rapidly drained. Slopes are moderate to very steep. Sites are rock and scree that appear to receive subsurface soil moisture from snowmelt runoff.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1982.8	22.4	63.9	31.0
Range	1890-2017	6-31	284 - 95	10-80

Vegetation Description: This moderately dense, mesic shrub vegetation association is dominated by red elderberry (*Sambucus racemosa*). The lush herbaceous understory is often dominated by spearleaf arnica (*Arnica longifolia*) along with a variety of other perennial herbs.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Shrub	Broad-leaved deciduous shrub	*Sambucus racemosa*	5-25	12.6	100
	Broad-leaved deciduous shrub	*Ribes lacustre*	0-25	1.0	40
Herb	Perennial herb	*Arnica longifolia*	0-95	40.9	80
	Perennial herb	*Dicentra formosa*	0-10	2.8	60
	Perennial herb	*Polemonium californicum*	0-10	1.2	20
	Graminoid	*Elymus glaucus*	0-10	1.7	60
	Fern or fern ally	*Athyrium filix-femina*	0-10	1.5	20

Species Richness:
Plot Vascular Plant Species Richness Average: 16.2
Plot Vascular Plant Species Richness Range: 9-30

Diagnostic Species: *Sambucus racemosa*
Constant Species: *Sambucus racemosa*
Other Noteworthy Species: *Arnica longifolia*
Local Range: This association occurs just south of the Crater Lake caldera rim as well as on Wizard Island.

Classification Comments: This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 5. Relevés 293; 420; 459; 478; 502



Above: Red Elderberry / Spearleaf Arnica Shrubland at Crater Lake National Park.

37. RABBITBUSH SHRUB GRASSLAND [PROVISIONAL]

Ericameria bloomeri Shrub Grassland [Provisional]

USNVC CLASSIFICATION:
Class: 3 Desert & Semi-Desert
Subclass: 3.B Cool Semi-Desert Scrub & Grassland
Formation: 3.B.1 Cool Semi-Desert Scrub & Grassland
Division: 3.B.1.Ne - D040 Western North American Cool Semi-Desert Scrub & Grassland
Macrogroup: 3.B.1.Ne.3 - M169 Great Basin-Intermountain Tall Sagebrush Steppe & Shrubland
Group: 3.B.1.Ne.3.b - G302 Intermountain Mesic Tall Sagebrush Steppe & Shrubland
Alliance: A3179 Antelope Bitterbrush - Big Sagebrush Mesic Steppe & Shrubland

NPS Unique Identifier: NPSCRLA004

LOCAL INFORMATION

Environmental Description: This vegetation association occurs along the drier, east side of the park at relatively low elevations. Topographic positions at these locations range from low level to midslope. Slopes are nearly level to moderate. Soils are loamy sand and sand and are well-drained to rapidly drained. This association often occurs where a high severity fire event has burned off a former Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) forest (and potentially other montane forest on the east side of the park) in the relatively recent past.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1801.3	4.5	66.0	15.3
Range	1777-1835	2-7	10-109	12-20

Vegetation Description: This is a sparse, mixed shrub and herbaceous vegetation association. It is comprised of a sparse cover of rabbitbush (*Ericameria bloomeri*) often with scattered greenleaf manzanita (*Arctostaphylos patula*) and antelope bitterbrush (*Purshia tridentata*). Rabbitbush can be present with as low as 2% cover but is evenly distributed throughout. An herbaceous cover of long-stolon sedge (*Carex inops* ssp. *inops*), western needlegrass (*Achnatherum occidentale*), squirreltail (*Elymus elymoides* ssp. *elymoides*), and/or Anderson's lupine (*Lupinus andersonii*) is present and can make up the dominant vegetation cover. This association often occurs in fire-killed Sierra lodgepole pine forests. Therefore, an abundance of dead standing and downed snags, as well as Sierra lodgepole pine seedlings and saplings, may be present.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0-5	1.8	75
Shrub	Narrow-leaved deciduous shrub	*Ericameria bloomeri*	1-5	3.0	100
	Broad-leaved evergreen shrub	*Arctostaphylos patula*	0-2	0.6	50
	Broad-leaved deciduous shrub	*Purshia tridentata*	0-1	0.5	50
Herb	Perennial herb	*Lupinus andersonii*	0-5	1.1	75
	Graminoid	*Carex inops* ssp. *inops*	0.01-25	8.1	100
	Graminoid	*Elymus elymoides* ssp. *elymoides*	0.01-25	4.6	100
	Graminoid	*Achnatherum occidentale* ssp. *pubescens*	1-5	2.5	100

Species Richness:
Plot Vascular Plant Species Richness Average: 9.25
Plot Vascular Plant Species Richness Range: 7-11

Diagnostic Species: *Ericameria bloomeri*
Constant Species: *Ericameria bloomeri*, *Carex inops* ssp. *inops*, *Elymus elymoides* ssp. *elymoides*, *Achnatherum occidentale* ssp. *pubescens*
Other Noteworthy Species: None
Local Range: This vegetation association occurs at relatively low elevations on the far eastern side of the park, on or fairly close to the eastern boundary.

Classification Comments: We classified our association 37. Rabbitbush Shrub Grassland [Provisional] under the USNVC's Antelope Bitterbrush - Big Sagebrush Mesic Steppe & Shrubland Alliance (A3179). Rabbitbush (*Ericameria bloomeri*), common in our relevés that grouped into this provisional association, is described as present in disturbed areas in a USNVC association that occurs under A3179: the *Purshia tridentata* / *Carex pensylvanica - Achnatherum occidentale* Shrub Grassland (CEGL001492).

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 4**.** Relevés 152; 153; 383; 384



Above**:** Rabbitbush Shrub Grassland [Provisional] at Crater Lake National Park.

38. ANTELOPE BITTERBRUSH / LONG-STOLON SEDGE - WESTERN NEEDLEGRASS SHRUB GRASSLAND

Purshia tridentata / Carex inops ssp. inops - Achnatherum occidentale Shrub Grassland

USNVC CLASSIFICATION:
Class: 3 Desert & Semi-Desert
Subclass: 3.B Cool Semi-Desert Scrub & Grassland
Formation: 3.B.1 Cool Semi-Desert Scrub & Grassland
Division: 3.B.1.Ne - D040 Western North American Cool Semi-Desert Scrub & Grassland
Macrogroup: 3.B.1.Ne.3 - M169 Great Basin-Intermountain Tall Sagebrush Steppe & Shrubland
Group: 3.B.1.Ne.3.b - G302 Intermountain Mesic Tall Sagebrush Steppe & Shrubland
Alliance: A3179 Antelope Bitterbrush - Big Sagebrush Mesic Steppe & Shrubland
Association: *Purshia tridentata* / *Carex inops* ssp. *inops* - *Achnatherum occidentale* Shrub Grassland

USNVC Identifier: CEGL001492

LOCAL INFORMATION

Environmental Description: This vegetation association occurs along the east side of the park at relatively low elevations. Topographic positions at these locations range from low level to high slope. Slopes range from nearly level to steep. Soils are rapidly drained or well-drained and are sand or loamy sand.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1615.2	13.8	172.1	14.0
Range	1592-1639	4-38	135-207	2-30

Vegetation Description: This is an open shrubland association dominated by antelope bitterbrush (*Purshia tridentata*). The herb layer is sparse and dominated by western needlegrass (*Achnatherum occidentale*), long-stolon sedge (*Carex inops* ssp. *inops*), and squirreltail (*Elymus elymoides* ssp. *elymoides*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Shrub	Broad-leaved deciduous shrub	*Purshia tridentata*	10-75	40.2	100
	Broad-leaved deciduous shrub	*Ribes cereum* var. *cereum*	0-2	0.4	33
	Narrow-leaved evergreen shrub	*Ericameria bloomeri*	0-5	0.8	33
Herb	Graminoid	*Carex inops* ssp. *inops*	0-10	2.7	67
	Graminoid	*Achnatherum occidentale* ssp. *pubescens*	0.1-10	2.5	100
	Graminoid	*Elymus elymoides* ssp. *elymoides*	0.01-2	0.8	100
	Annual herb	*Gayophytum diffusum*	0.01-1	0.2	100

Species Richness:
Plot Vascular Plant Species Richness Average: 10.7
Plot Vascular Plant Species Richness Range: 7-13

Diagnostic Species: *Purshia tridentata*
Constant Species: *Purshia tridentata, Achnatherum occidentale* ssp. *pubescens, Gayophytum diffusum, Elymus elymoides* ssp. *elymoides*
Other Noteworthy Species: *Carex inops* ssp. *inops*
Local Range: This vegetation association occurs at relatively low elevations on the far eastern side of the park, on or fairly close to the eastern boundary.

Classification Comments: The USNVC's *Purshia tridentata / Carex inops* ssp. *inops - Achnatherum occidentale* Shrub Grassland association was described from plots in Crater Lake National Park.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 6. Relevés 44; 48; 184; 190; 332; 345
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This rare shrubland was described from 5 good condition plots on flat, stream terraces, floodplains and dry drainages along the eastern side of the Cascades in southern Oregon. Elevations are between 1340 and 1650 m. All known sites are from the Winema National Forest, and much of the habitat has been damaged by overuse by cattle. The soils are deep, alluvial sands deposited over Mazama ash and pumice.

Global Vegetation Description: *Purshia tridentata* is the dominant shrub, always present between 5 and 20% cover. In poor condition stands *Ericameria bloomeri* (= *Haplopappus bloomeri*) or *Ericameria nauseosa* (= *Chrysothamnus nauseosus*) are more important. *Achnatherum occidentale* (= *Stipa occidentalis)* and *Carex pensylvanica* are codominant on good condition stands, although with grazing *Elymus elymoides* increases. Other forbs include *Packera cana* (= *Senecio canus*), *Eriogonum umbellatum, Phacelia hastata,* and *Cistanthe umbellata* (= *Spraguea umbellata*). This type is easily distinguished by the dominants, and its occurrence on alluvial sands on pumice.

DISTRIBUTION

Range: Only known from the sandy openings along stream terraces and floodplains in the pumice zone east of Crater Lake, on the Winema National Forest and in Crater Lake National Park in south-central Oregon.

States/Provinces: OR.

Global Description References: J.S. Kagan. 1997. *Purshia tridentata / Carex pensylvanica - Achnatherum occidentale* Shrub Grassland [26Nov1997]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Antelope Bitterbrush / Long-stolon Sedge - Western Needlegrass Shrub Grassland at Crater Lake National Park.

39. UNDERGREEN WILLOW / MOUNTAIN SEDGE WET SHRUBLAND

Salix commutata / Carex scopulorum Wet Shrubland

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland
Division: 2.C.4.Nb - D031 Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
Macrogroup: 2.C.4.Nb.2 - M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland
Group: 2.C.4.Nb.2.d - G527 Western Montane-Subalpine Riparian & Seep Shrubland
Alliance: A1003 Cascadian Undergreen Willow Wet Shrubland
Association: *Salix commutata* / *Carex scopulorum* Wet Shrubland

USNVC Identifier: CEGL001189

LOCAL INFORMATION

Environmental Description: This vegetation association occurs in wetlands and along creeks on the slopes south of Crater Lake from the caldera rim to the Panhandle, as well as along Castle Creek. Elevations range from low to high. Topographic positions are basin floor, toeslope and midslope. Soils range from somewhat poorly drained to very poorly drained. Soil texture was only estimated in one plot and it was silty clay.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1885.3	4.2	147.5	56.2
Range	1645-2014	2-8	35-223	25-80

Vegetation Description: This wet shrubland association has a dense cover of 1-2 m tall undergreen willow (*Salix commutata*) with an herbaceous understory dominated by alpine nerve sedge (*Carex neurophora*), lakeshore sedge (*Carex lenticularis*), Gray's licorice-root (*Ligusticum grayi*), arrowleaf ragwort (*Senecio triangularis*), and a variety of other wetland and mesic site herbs and graminoids.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Shrub	Broad-leaved deciduous shrub	*Salix commutata*	25-95	65.0	100
	Broad-leaved deciduous shrub	*Salix lucida* ssp. *lasiandra*	0-50	4.7	17
Herb	Perennial herb	*Senecio triangularis*	0-25	7.8	67
	Perennial herb	*Mimulus primuloides* var. *primuloides*	0-25	2.5	33
	Perennial herb	*Ligusticum grayi*	0-5	1.5	67
	Graminoid	*Carex aquatilis* var. *dives*	0-95	24.7	33
	Graminoid	*Glyceria striata*	0-75	11.7	17
	Graminoid	*Carex lenticularis*	0-25	6.9	33
	Graminoid	*Carex neurophora*	0.1-25	5.1	100
	Graminoid	*Carex scopulorum* var. *bracteosa*	0-25	3.1	33

Species Richness:
Plot Vascular Plant Species Richness Average: 24.5
Plot Vascular Plant Species Richness Range: 12-36

Diagnostic Species: *Salix commutata*
Constant Species: *Salix commutata, Carex neurophora*
Other Noteworthy Species: None
Local Range: This association occurs primarily in wetlands in and around Munson Valley, along Annie Creek, and along the upper reaches of Castle Creek and Sun Creek.

Classification Comments: Mountain sedge (*Carex scopulorum*) is not the dominant sedge, nor is it constant in the relevés collected from the park that comprised our Undergreen Willow / Mountain Sedge Wet Shrubland association.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 6. Relevés 484; 510; 542; 562; 570; 595
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: Elevations range from about 1524 to 2377 m (5000-7800 feet) in the upper reaches of small streams or near lakeshores. Sites supporting this association vary from narrow to broad valleys with low to moderate gradients. Soils are poorly to very poorly drained (saturated for most of the growing season) and cold, with the water table at or near the surface all year. This association often forms small patches of shrub-carr in sloped, flow-through peatlands affiliated with seeps and springs emanating from lateral moraines or mountain slopes. Such sites are

often at the margins of small intermediate to rich fens characterized by hummocks, undulations, and numerous rivulets. Soils at these sites are organic loam or peat (over 35 cm thick) with poorly decomposed large woody debris incorporated. Occasionally, stands form on floodplains or streambanks with fine-textured mineral loamy soils.

Global Vegetation Description: *Salix commutata* is the dominant shrub, forming an open stand of scattered individuals to a dense overstory (15-95% cover) only 0.20 m to 1.1 m tall on average. *Salix planifolia* ssp. *planifolia* (= var. *monica*) and *Lonicera caerulea* are occasionally abundant shrubs, but their constancy is not high. *Carex scopulorum* is typically the most abundant and highly constant understory species, often with high cover. *Calamagrostis canadensis* has high constancy in this association, with cover averaging about 10%. Other mesic graminoids are often present, and occasionally locally abundant, such as *Carex cusickii*, *Carex nigricans*, *Carex spectabilis* (in Washington stands), *Carex utriculata*, and *Eleocharis quinqueflora*. Numerous forbs are also usually present and occasionally locally abundant. The most characteristic include *Caltha leptosepala* ssp. *howellii* (= *Caltha biflora*), *Dodecatheon jeffreyi*, *Equisetum arvense*, *Pedicularis groenlandica*, *Polemonium occidentale*, *Potentilla flabellifolia*, *Saxifraga* spp., *Packera buekii* (= *Senecio cymbalarioides*), and *Viola* spp. Moss cover can be very high, with mats sometimes covering nearly all of the soil surface. *Sphagnum* spp. are occasional.

DISTRIBUTION

Range: This association is restricted to high elevations along the crest of the Cascades in Oregon and Washington (mainly on the east side), the Blue Mountains of northeastern Oregon, and headwaters of tributary streams to the Middle Fork Salmon River in west-central Idaho. It possibly also occurs in California and at Steens Mountain in southeastern Oregon. Both *Salix commutata* and *Carex scopulorum* are widespread in western Montana, but stands dominated by *Salix commutata* are not documented from there.

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

Global Description Reference: Western Ecology Group, mod. C. Murphy and G. Kittel. 2010. *Salix commutata* / *Carex scopulorum* Wet Shrubland [28Sept2004]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Undergreen Willow / Mountain Sedge Wet Shrubland at Crater Lake National Park.

40. BOOTH'S WILLOW / BLUEJOINT WET SHRUBLAND

Salix boothii / Calamagrostis canadensis Wet Shrubland

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland
Division: 2.C.4.Nb - D031 Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
Macrogroup: 2.C.4.Nb.2 - M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland
Group: 2.C.4.Nb.2.d - G527 Western Montane-Subalpine Riparian & Seep Shrubland
Alliance: A3769 Western Montane Tall Willow Wet Shrubland
Association: *Salix boothii* / *Calamagrostis canadensis* Wet Shrubland

USNVC Identifier: CEGL001175

LOCAL INFORMATION

Environmental Description: This vegetation association occurs throughout the southern and western portions of the park in seasonally and permanently saturated soils in riparian areas and seeps along creeks, along the margins of meadows or throughout some wetlands. Elevations range from low to moderate. Slopes range from nearly level to moderately steep. Soils are somewhat poorly drained to poorly drained. This vegetation is found in low lying topographic positions, such as low level and toeslopes, as well as on slopes along creek canyons.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1752	3	260	77.5
Range	1626-1878	1-5	170-350	70-85

Vegetation Description: This wet shrubland association dominated is by dense stands of Booth's willow (*Salix boothii*) with interlocking crowns. Booth's willow can be short or relatively tall (1-2m). Herbs from wet meadow environments occur in the shrub understory or in openings. These include Columbian monkshood (*Aconitum columbianum*), arrowleaf ragwort (*Senecio triangularis*), broad-leaved lupine (*Lupinus latifolius*) and bluejoint (*Calamagrostis canadensis*). Where Booth's willow is shorter, it can occur intermixed with dense swards of cyperaceous species such as panicled bulrush (*Scirpus microcarpus*). Conifers such as subalpine fir (*Abies lasiocarpa* var. *lasiocarpa*) and Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) occasionally occur, generally as isolated individuals.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Shrub	Broad-leaved deciduous shrub	*Salix boothii*	10-95	47.5	100
Herb	Perennial herb	*Senecio triangularis*	1-5	3.0	100
	Perennial herb	*Parnassia fimbriata*	0-25	10.0	50
	Perennial herb	*Mimulus moschatus*	0.1-10	5.2	100
	Perennial herb	*Aconitum columbianum* var. *viviparum*	0.1-5	3.0	100
	Fern or fern ally	*Equisetum arvense*	0-10	3.5	50
	Graminoid	*Scirpus microcarpus*	0-75	30.0	50
	Graminoid	*Calamagrostis canadensis*	2-75	29.0	100
	Graminoid	*Carex neurophora*	2-5	4.5	100
	Graminoid	*Carex lenticularis*	2-5	3.0	100

Species Richness:
Plot Vascular Plant Species Richness Average: 28.5
Plot Vascular Plant Species Richness Range: 25-32

Diagnostic Species: *Salix boothii, Mimulus tilingii, Agrostis exarata*
Constant Species: *Salix boothii, Calamagrostis canadensis, Senecio triangularis, Carex neurophora, Carex lenticularis, Aconitum columbianum* var. *viviparum, Agrostis exarata, Glyceria striata, Mimulus moschatus*
Other Noteworthy Species: None
Local Range: This association occurs in riparian areas, seeps, and wetlands throughout the southern and western portions of the park.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 2. Relevés 529; 591
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This riparian shrub association is found in the U.S. Rocky Mountains from western Montana south through western Wyoming, central and eastern Idaho, and northeastern Utah, into northern Colorado, and west as far as eastern Oregon and possibly eastern Washington. Stands occur on medium- or fine-textured mineral soils (sometimes with an appreciable volume of rock fragments) with a seasonally high water table, on terraces and gentle slopes. Elevations vary with geographic area from 1469 to 2234 m (4820-7330 feet) in Montana, 1890 to 2290 m (6100-7500 feet) in western Wyoming and eastern Idaho, over 2745 m (9000 feet) in the

Uinta Mountains of northeastern Utah, 2370 to 2700 m (7900-8900 feet) in northern Colorado, and about 2164 m (7100 feet) in eastern Oregon.

Global Vegetation Description: The vegetation consists of a tall-shrub layer dominated by *Salix boothii* and often containing *Salix geyeriana, Salix drummondiana, Salix eastwoodiae*, or *Salix commutata*; often, a low-shrub layer of *Lonicera involucrata, Ribes* spp., and *Salix wolfii*; and a thick herbaceous layer in which *Calamagrostis canadensis* (or, in Montana, *Calamagrostis stricta*) contributes as much cover as does any other native species. The dominance of *Salix boothii* in the tall-shrub layer and *Calamagrostis canadensis* in the herbaceous layer set this association apart from other willow associations.

DISTRIBUTION

Range: This riparian shrub association is found in the U.S. Rocky Mountains from western Montana south through western Wyoming, central and eastern Idaho, and northeastern Utah, into northern Colorado, and west as far as eastern Oregon and possibly eastern Washington.
States/Provinces: CO, ID, MT?, NV, OR, UT, WA?, WY.

Global Description References: G.P. Jones. 2004. *Salix boothii* / *Calamagrostis canadensis* Wet Shrubland [27Sep2004]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Booth's Willow / Bluejoint Wet Shrubland at Crater Lake National Park**.**

41. GRAY ALDER / FOWL MANNAGRASS WET SHRUBLAND

Alnus incana / Glyceria striata Wet Shrubland

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland
Division: 2.C.4.Nb - D031 Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
Macrogroup: 2.C.4.Nb.2 - M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland
Group: 2.C.4.Nb.2.d - G527 Western Montane-Subalpine Riparian & Seep Shrubland
Alliance: A3771 Western Alder Wet Shrubland
Association: *Alnus incana* / *Glyceria striata* Wet Shrubland

USNVC Identifier: CEGL000228

LOCAL INFORMATION

Environmental Description: This association occurs on the west and south portions of the park at low to middle elevations. It occurs primarily in floodplains and other streamside environments, but it can also be found around springs or in seeps and wetland basins. Topographic positions are mostly low level and toeslope but are occasionally midslope and high slope. Slopes are level to moderately steep and occasionally are very steep. This association occurs on rich organic soils that are completely saturated during the growing season. Soils are somewhat poorly drained to poorly drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1609.6	7.9	266.9	50.7
Range	1394-1872	1-34	195-75	11-87

Vegetation Description: This is a wet shrubland association comprised of a dense shrub layer of tall (1-3 m) gray alder (*Alnus incana* ssp. *tenuifolia*) with interlocking branches. Gaps in the shrub cover occur and are typically dominated by fowl mannagrass (*Glyceria striata*) along with a wide variety of graminoids and forbs. These include arrowleaf ragwort (*Senecio triangularis*), small enchanter's nightshade (*Circaea alpina* ssp. *pacifica*), pioneer violet (*Viola glabella*), Columbian monkshood (*Aconitum columbianum* ssp. *viviparum*), common ladyfern (*Athyrium filix-femina*), bluejoint (*Calamagrostis canadensis*), and a number of different sedge species (*Carex* spp.).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Shrub	Broad-leaved deciduous shrub	*Alnus incana* ssp. *tenuifolia*	25-100	84.1	100
Herb	Perennial herb	*Senecio triangularis*	0-25	3.6	89
	Perennial herb	*Circaea alpina* ssp. *pacifica*	0-50	7.6	56
	Perennial herb	*Aconitum columbianum ssp. viviparum*	0-25	4.2	67
	Perennial herb	*Asarum caudatum* var. *caudatum*	0-25	2.2	22
	Graminoid	*Glyceria striata*	0-50	21.5	89
	Graminoid	*Calamagrostis canadensis*	0-50	4.8	56
	Graminoid	*Carex aquatilis* var. *dives*	0-50	4.4	22
	Graminoid	*Carex laeviculmis*	0-25	4.1	56
	Fern or fern ally	*Athyrium filix-femina*	0-10	2.6	56

Species Richness:
Plot Vascular Plant Species Richness Average: 31.2
Plot Vascular Plant Species Richness Range: 22-57

Diagnostic Species: *Alnus incana* ssp. *tenuifolia*
Constant Species: *Alnus incana* ssp. *tenuifolia*
Other Noteworthy Species: *Glyceria striata*
Local Range: This association occurs in floodplains and other wetlands on the west and south portions of the park at low to middle elevations.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 9. Relevés 499; 506; 537; 546; 560; 566; 583; 592; 594
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This shrubland association is a widespread community known from around the rim of the northwestern end of the Columbia Plateau in Washington, in the Blue Mountains of Oregon, and in northern Idaho but of limited extent in the Pacific Northwest. Stands occur in narrow to moderately wide floodplains on streambanks and around springs. Sites are usually very low-gradient and can be characterized as "stagnant"; soils can include silts and mucks to sandy loams to organic fibric. It occurs at elevations between 533 and 2229 m (1750-7314 feet). Slopes are flat to 45%, and valleys are narrow, averaging 24.4-30.5 m (80-100 feet), to very wide (91.5 m [300 feet]). Stands occur on streambanks, floodplains, overflow swales, and springs.

Global Vegetation Description: These shrublands are characterized by stands of medium-tall and tall deciduous shrubs and herbaceous undergrowth of wetland-indicator grasses and forbs. They have little to no overstory tree canopy, although individual *Picea engelmannii, Abies grandis, Abies lasiocarpa,* or *Thuja plicata* trees may be present. Total shrub cover usually exceeds 50% and is dominated by *Alnus incana* ssp. *tenuifolia*, the diagnostic shrub. Other shrubs include *Cornus sericea, Symphoricarpos albus,* and *Ribes* spp. The understory of undisturbed stands has an herbaceous layer with abundant cover of *Glyceria striata* (= *Glyceria elata*) and/or *Cinna latifolia*. These grasses are often accompanied by *Calamagrostis canadensis* or *Elymus glaucus*. Other common herbs include *Nemophila breviflora, Geum macrophyllum, Galium triflorum, Senecio triangularis, Heracleum maximum, Galium triflorum, Valeriana* sp., and *Equisetum* spp. Heavily disturbed stands have abundant non-native grasses.

DISTRIBUTION

Range: This shrubland association is a widespread community in the Pacific Northwest, known from around the rim of the northwestern end of the Columbia Plateau in Washington, in the Blue Mountains of Oregon, and in northern Idaho.
States/Provinces: ID, OR, WA, WY.

Global Description References: R.C. Crawford, mod. G. Kittel. 2005. *Alnus incana* / *Glyceria striata* Wet Shrubland [11Aug2005]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Gray Alder / Fowl Mannagrass Wet Shrubland at Crater Lake National Park.

42. SITKA ALDER / MESIC FORBS WET SHRUBLAND

Alnus viridis ssp. *sinuata* / Mesic Forbs Wet Shrubland

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland
Division: 2.C.4.Nb - D031Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
Macrogroup: 2.C.4.Nb.2 - M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland
Group: 2.C.4.Nb.2.d - G527 Western Montane-Subalpine Riparian & Seep Shrubland
Alliance: A3771 Western Alder Wet Shrubland
Association: *Alnus viridis* ssp. *sinuata* / Mesic Forbs Wet Shrubland

USNVC Identifier: CEGL002633

LOCAL INFORMATION

Environmental Description: This association occurs on or near the base of mesic scree slopes south of the Crater Lake caldera rim. It is also very common on scree slopes on the caldera walls inside the caldera. Elevations are moderate to high. Topographic position is midslope. Soils are moderately well-drained to rapidly drained and are mostly loamy sand. Slopes are moderately steep to very steep. Sites are rock and scree that appear to receive subsurface soil moisture from snowmelt runoff. Sites are often in areas with a late snowpack and are sometimes associated with seeps and springs.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1985.3	30.9	113.9	49
Range	1905-2031	20-45	74-260	20-82

Vegetation Description: This is a very dense, deciduous shrubland association strongly dominated by Sitka alder (*Alnus viridis* ssp. *sinuata*) and sometimes interspersed with red elderberry (*Sambucus racemosa*). These shrubs typically range from 1-3 m. Cover is usually greater than 75% and often close to 100%. The most abundant herbs are Pacific bleeding heart (*Dicentra formosa*), red baneberry (*Actaea rubra*), and small enchanter's nightshade (*Circaea alpina* ssp. *pacifica*). Each of these can reach 10% cover, but are often rare or absent.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Shrub	Broad-leaved deciduous shrub	*Alnus viridis* ssp. *sinuata*	10-100	69.0	100
	Broad-leaved deciduous shrub	*Sambucus racemosa*	0-10	4.9	88
Herb	Perennial herb	*Senecio triangularis*	0-10	5.5	25
	Perennial herb	*Heracleum maximum*	0-25	2.9	13
	Perennial herb	*Mimulus lewisii*	0-10	1.0	13
	Perennial herb	*Circaea alpina* ssp. *pacifica*	0-10	2.5	50
	Perennial herb	*Dicentra formosa*	0.01-10	2.5	100
	Fern or fern ally	*Athyrium filix-femina*	0-10	1.4	25
	Graminoid	*Cinna latifolia*	0-10	1.3	25
	Graminoid	*Carex bolanderi*	0-5	0.5	14

Species Richness:
Plot Vascular Plant Species Richness Average: 18
Plot Vascular Plant Species Richness Range: 7-46

Diagnostic Species: *Alnus viridis* ssp. *sinuata*
Constant Species: *Alnus viridis* ssp. *sinuata, Dicentra formosa*
Other Noteworthy Species: *Sambucus racemosa*
Local Range: This association is found on scree slopes south of the Crater Lake caldera rim. It is also very common on scree slopes on the caldera walls inside the caldera. It is likely this association occurs on cliffs and scree slopes elsewhere in the park.

Classification Comments: Our association 42. Sitka Alder / Mesic Forbs Wet Shrubland is equivalent to the *Alnus viridis* ssp. *sinuata* / Mesic Forbs Wet Shrubland (CEGL002633) classified under the Western Alder Wet Shrubland Alliance (A3771) in the USNVC. Several relevés in our association 42. Sitka Alder / Mesic Forbs Wet Shrubland (477; 479; 461; 503) with a high cover of both Sitka alder (*Alnus viridis* ssp. *sinuata*) and red elderberry (*Sambucus racemosa*) comprised their own sub-group. These were merged with relevés with a high cover of Sitka alder and low or no cover of red elderberry because no other significant differences existed.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 8. Relevés 461; 477; 479; 503; 516; 524; 554; 599
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This deciduous shrubland is located in moderate to high-elevation (1200-3000 m) riparian habitats of the northern Rocky Mountains and Cascade Range where deep snow accumulations are common. They usually occur in low-gradient creek drainages, on midslope avalanche chutes, in cirque basins, and in relatively steep drainages, all of which flood from spring snowmelt or summer rainstorms. The wet soils and frequent fluvial disturbance act to discourage colonization by coniferous trees and allow full sunlight to reach the ground at these sites. Soils are often well-drained colluvial or glacial-fluvial deposits, generally sandy loam to clay loam over sorted gravels and sands.

This association usually occurs at sites that are too wet or frequently disturbed for coniferous forest to establish. *Alnus viridis* ssp. *Sinuata* is highly shade-intolerant and persists largely in forest openings with abundant light. It colonizes quickly, has rapid growth, and resprouts following fire or flood, making it an important species on wet, disturbed sites.

Global Vegetation Description: A dense tall-shrub cover of *Alnus viridis* ssp. *sinuata* characterizes this vegetation. *Acer circinatum, Alnus incana, Sambucus racemosa,* or *Salix drummondiana* may be codominant in the tall-shrub layer. *Acer glabrum, Ribes lacustre, Sorbus scopulina,* and *Menziesia ferruginea* may also be present. In the northern Rocky Mountains, *Abies lasiocarpa* colonizes these communities, and scattered seedlings or saplings may be present. Low cold-deciduous or ericaceous shrubs may be abundant, including *Rubus spectabilis, Rubus parviflorus, Sambucus racemosa, Paxistima myrsinites*, and *Vaccinium* spp. A lush herbaceous layer is usually present, characterized by a high diversity of low-abundance tall mesic forbs, including *Aconitum columbianum, Achillea millefolium, Heracleum maximum* (= *Heracleum lanatum*), *Veratrum viride, Senecio triangularis, Prosartes* spp. (= *Disporum* spp.), *Urtica dioica*, and *Osmorhiza berteroi* (= *Osmorhiza chilensis*). Graminoids are generally uncommon.

DISTRIBUTION

Range: This deciduous shrubland is located in moderate to high-elevation (1200-3000 m) riparian and avalanche chute habitats of the northern Rocky Mountains of Montana and Alberta, as well as the Cascade Range of Washington.
States/Provinces: AB, ID?, MT, OR, WA.

Global Description References: G. Kittel 2004. *Alnus viridis* ssp. *sinuata* / Mesic Forbs Wet Shrubland [15Jan20014]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Sitka Alder / Mesic Forbs Wet Shrubland at Crater Lake National Park. Shown at center left, right, and background is Sitka alder (*Alnus viridis* ssp. *sinuata*). In the immediate foreground is red elderberry (*Sambucus racemosa*).

43. BOG BLUEBERRY / SITKA SEDGE WET SHRUBLAND

Vaccinium uliginosum / Carex aquatilis var. dives Wet Shrubland

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland
Division: 2.C.4.Nb - D031 Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
Macrogroup: 2.C.4.Nb.4 - M073 Vancouverian Lowland Marsh, Wet Meadow & Shrubland
Group: 2.C.4.Nb.4.c - G322 Vancouverian Wet Shrubland
Alliance: A1123 Pacific Northwest Blueberry Wet Shrubland
Association: *Vaccinium uliginosum* / *Carex aquatilis* var. *dives* Wet Shrubland

USNVC Identifier: CEGL001249

LOCAL INFORMATION

Environmental Description: This association occurs in wetlands on the far west side of the park at low elevations. It occurs on rich organic soils that are completely saturated during the growing season. Soils are muck and somewhat poorly drained to very poorly drained. There may be standing water in some locations. It occurs primarily in wetland basins but also occurs in wetlands on floodplains, in seeps, and around springs. Slopes are level to slight. Topographic positions are mostly low level and toeslope.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1594.7	2.7	180.4	51.3
Range	1484-1602	1-5	160-4	16-95

Vegetation Description: This is a wet shrubland association dominated by the low, deciduous shrub, bog blueberry (*Vaccinium uliginosium*), which is generally 1 m in height or less. Sitka sedge (*Carex aquatilis* var. *dives*) is often abundant in the openings and intermixed with the shrubs. Conifers such as subalpine fir (*Abies lasiocarpa* var. *lasiocarpa*) and Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) occasionally occur, generally as isolated individuals.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0-10	2.2	67
Shrub	Broad-leaved deciduous shrub	*Vaccinium uliginosum*	10-95	62.8	100
	Broad-leaved deciduous shrub	*Salix boothii*	0-50	6.0	17
	Broad-leaved deciduous shrub	*Gaultheria ovatifolia*	0-50	5.7	17
Herb	Perennial herb	*Caltha leptosepala* ssp. *howellii*	0-75	10.3	33
	Graminoid	*Carex aquatilis* var. *dives*	0-75	20.6	83
	Graminoid	*Carex utriculata*	0-95	13.3	17
	Graminoid	*Deschampsia cespitosa*	0-25	2.8	33
	Graminoid	*Agrostis thurberiana*	0-25	2.6	33
	Graminoid	*Scirpus microcarpus*	0-25	2.2	17

Species Richness:
Plot Vascular Plant Species Richness Average: 14.2
Plot Vascular Plant Species Richness Range: 2-24

Diagnostic Species: None
Constant Species: *Vaccinium uliginosium*
Other Noteworthy Species: *Carex aquatilis* var. *dives*
Local Range: This association occurs in wetlands on the far west side of the park in Sphagnum Bog, Thousand Springs, near Oasis Springs, near Boundary Springs, and in wetlands near Bybee Creek.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 6. Relevés 480; 531; 538; 575; 585; 589
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION
Global Environmental Description: N/A

Global Vegetation Description: N/A

DISTRIBUTION
Range: N/A
States/Provinces: CA?, OR.

Global Description References: *Vaccinium uliginosum* / *Carex aquatilis* var. *dives* Wet Shrubland. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Bog Blueberry / Sitka Sedge Wet Shrubland at Crater Lake National Park.

44. ROSE SPIREA WET SHRUBLAND

Spiraea douglasii Wet Shrubland

USNVC CLASSIFICATION:
Class: 2 Shrub & Herb Vegetation
Subclass: 2.C Shrub & Herb Wetland
Formation: 2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland
Division: 2.C.4.Nb - D031Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland
Macrogroup: 2.C.4.Nb.4 - M073 Vancouverian Lowland Marsh, Wet Meadow & Shrubland
Group: 2.C.4.Nb.4.c - G322 Vancouverian Wet Shrubland
Alliance: A3835 Pacific Willow - Rose Spirea Wet Shrubland
Association: *Spiraea douglasii* Wet Shrubland

USNVC Identifier: CEGL001129

LOCAL INFORMATION

Environmental Description: This association is characterized from only one relevé plot. It is found on the far west side of the park. It occurs on rich organic soils that are completely saturated during the growing season. Soils are somewhat poorly drained. Elevations are low. It occurs on a midslope topographic position.

Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
1629	2	300	65

Vegetation Description: This wet shrubland association is comprised of a moderately dense cover of 1 meter tall rose spirea (*Spiraea douglasii* var. *douglasii*) with a dense understory of Sitka sedge (*Carex aquatilis* var. *dives*). Several other species of sedge (*Carex* ssp.) are also common but are much less abundant than Sitka sedge.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Shrub	Broad-leaved deciduous shrub	*Spiraea douglasii* var. *douglasii*	–	16.0	100
Herb	Perennial herb	*Viola adunca*	–	0.3	100
	Graminoid	*Carex aquatilis* var. *dives*	–	78.0	100
	Graminoid	*Carex exsiccata*	–	14.0	100
	Graminoid	*Carex leporinella*	–	0.3	100
	Graminoid	*Carex leptopoda*	–	8.0	100

Species Richness:
Plot Vascular Plant Species Richness Average: 7
Plot Vascular Plant Species Richness Range: N/A

Diagnostic Species: *Spiraea douglasii* var. *douglasii*, *Viola adunca*, *Carex leptopoda*, *Carex leporinella*, *Carex exsiccata*
Constant Species: N/A
Other Noteworthy Species: *Carex aquatilis* var. *dives*
Local Range: This association is known from only one relevé in a wetland near Poison Meadows on the far west side of the park. It also likely occurs in Sphagnum Bog.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 1. Relevé 577
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: According to Christy (2004), this association is a shrub swamp found in riparian zones, prairies, and fens from northern California to southeastern Alaska. Stands may be extensive along floodplains, and some have no doubt developed on abandoned pasture land and old prairie. Plots are highly variable and indicate that numerous phases are present that need further study.

Global Vegetation Description: The association in northwestern Oregon more-or-less monotypic and common at lower elevations. Trees are absent or peripheral. The shrub layer is dominated by *Spiraea douglasii* with an average cover of 95% and is so dense that the herb layer is nearly nonexistent. Changes in hydrology may enhance dense stands. More northerly examples may contain *Myrica gale* and *Ledum glandulosum*.

DISTRIBUTION

Range: According to Christy (2004), this association is a shrub swamp found in riparian zones, prairies, and fens from northern California to southeastern Alaska.
States/Provinces: AK?, BC, ID, MT, OR, WA, WY.

Global Description References: J.A. Christy. 2004. *Spiraea douglasii* Wet Shrubland [10Jun2006]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).

FOREST AND WOODLAND VEGETATION

45. PONDEROSA PINE / GREENLEAF MANZANITA - ANTELOPE BITTERBRUSH WOODLAND

Pinus ponderosa / Arctostaphylos patula - Purshia tridentata Woodland

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nb - D194 Rocky Mountain Forest & Woodland
Macrogroup: 1.B.2.Nb.2 - M501 Central Rocky Mountain Dry Lower Montane-Foothill Forest
Group: 1.B.2.Nb.2.a - G213 Central Rocky Mountain Ponderosa Pine Open Woodland
Alliance: A3446 Central Rocky Mountain Ponderosa Pine / Shrub Woodland
Association: *Pinus ponderosa* / *Arctostaphylos patula - Purshia tridentata* Woodland

USNVC Identifier: CEGL000063

LOCAL INFORMATION

Environmental Description: This vegetation association occurs along the northern half of the eastern park boundary. Topographic positions are mostly low level but include lowslope, midslope and toeslope. Slopes are low to moderate. Soils are loamy sand, sandy loam, and sand. Soils are well-drained and occasionally moderately well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1682.6	6.6	64.5	85.6
Range	1582-1765	1-12	290-122	48-94

Vegetation Description: This is a woodland vegetation association with an open to semi-open canopy dominated be large and medium sized ponderosa pines (*Pinus ponderosa*). Sierra lodgepole pines (*Pinus contorta* var. *murrayana*) may be present, but are not abundant. The shrubs greenleaf manzanita (*Arctostaphylos patula*) and snowbrush (*Ceanothus velutinus* var. *velutinus*) are common in the understory. Antelope bitterbrush (*Purshia tridentata*) is also common in the understory but is usually less abundant than greenleaf manzanita. Common herbaceous species present include long-stolon sedge (*Carex inops* ssp. *inops*) and western needlegrass (*Achnatherum occidentale*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pinus ponderosa*	2-50	22.1	100
	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0-10	1.5	76
Shrub	Broad-leaved evergreen shrub	*Arctostaphylos patula*	0.1-50	12.6	100
	Broad-leaved evergreen shrub	*Ceanothus velutinus* var. *velutinus*	0-50	6.3	53
	Broad-leaved evergreen shrub	*Arctostaphylos nevadensis*	0-25	2.6	35
	Broad-leaved deciduous shrub	*Purshia tridentata*	0-10	2.3	94
Herb	Graminoid	*Carex inops* ssp. *inops*	0.01-5	1.1	100
	Graminoid	*Achnatherum occidentale* ssp. *pubescens*	0-5	0.9	94

Species Richness:
Plot Vascular Plant Species Richness Average: 10
Plot Vascular Plant Species Richness Range: 8-15

Diagnostic Species: None
Constant Species: *Pinus ponderosa*, *Arctostaphylos patula*, *Carex inops* ssp. *inops*
Other Noteworthy Species: *Purshia tridentata*
Local Range: This vegetation association occurs in extensive stands along the northern half of the eastern park boundary and is common east of the park boundary. Smaller stands are occasional near the park boundary through the southeast corner of the park.

Classification Comments: Our association 45. Ponderosa Pine / Greenleaf Manzanita - Antelope Bitterbrush Woodland association is equivalent to the USNVC's *Pinus ponderosa* / *Arctostaphylos patula* - *Purshia tridentata* Woodland (CEGL000063) described under the Central Rocky Mountain Ponderosa Pine / Shrub Woodland Alliance (A3446). However, a very similar USNVC association, the *Pinus ponderosa* / *Purshia tridentata* / *Achnatherum occidentale* Woodland (CEGL000198), is reported by the USNVC as present in Crater Lake National Park. Our association was not considered equivalent to this USNVC association because CEGL000198 lists antelope bitterbrush (*Purshia tridentata*) as the dominant shrub and greenleaf manzanita (*Arctostaphylos patula*) as only a minor component. The 17 relevés grouped under our association 45 all had high cover of *Arctostaphylos patula*. Therefore, we selected CEGL000063 as the equivalent USNVC association to our association.

Other Comments: None
Local Description Author: D. A. DiPaolo

Number of Plots: 17. **Relevés** 39; 41; 42; 46; 47; 171; 172; 173; 174; 176; 178; 326; 327; 328; 329; 337; 341
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This forest association is common in the eastern Cascades of Oregon and California. It is found at elevations between 915 and 1980 m (3000-6500 feet) on all aspects of variable steepness. Soils are derived from basalt, ash, and cinders but vary in water-holding capacity.

Global Vegetation Description: The overstory is typically a semi-open canopy (5-48% cover) of *Pinus ponderosa*. Other trees may occur but are always subdominant and include *Abies concolor* and *Pinus contorta*. The shrub layer is codominated by *Arctostaphylos patula, Purshia tridentata,* and *Ceanothus velutinus* with occasional *Ericameria bloomeri*. The herb layer usually supports at least one grass species, such as *Festuca idahoensis, Achnatherum occidentale* ssp. *occidentale* (= *Stipa occidentalis*), and *Elymus elymoides* ssp. *elymoides* (= *Sitanion hystrix*). Many different forbs can be found, although none has high cover. In natural condition, this community is associated with periodic non-stand-replacing fire.

DISTRIBUTION

Range: This association is common in the eastern Cascades from central Oregon to northern California.
States/Provinces: CA, OR.

Global Description References: M.P. Murray. 1997. *Pinus ponderosa* / *Arctostaphylos patula* - *Purshia tridentata* Woodland [26Nov1997]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Ponderosa Pine / Greenleaf Manzanita – Antelope Bitterbrush Woodland at Crater Lake National Park.

46. PONDEROSA PINE / ANTELOPE BITTERBRUSH / LONG-STOLON SEDGE FOREST

Pinus ponderosa / Purshia tridentata / Carex inops ssp. inops Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nb - D194 Rocky Mountain Forest & Woodland
Macrogroup: 1.B.2.Nb.2 - M501 Central Rocky Mountain Dry Lower Montane-Foothill Forest
Group: 1.B.2.Nb.2.a - G213 Central Rocky Mountain Ponderosa Pine Open Woodland
Alliance: A3446 Central Rocky Mountain Ponderosa Pine / Shrub Woodland
Association: *Pinus ponderosa* / *Purshia tridentata* / *Carex inops* ssp. *inops* Forest

USNVC Identifier: CEGL000193

LOCAL INFORMATION

Environmental Description: This vegetation association occurs at scattered locations along and near the eastern park boundary at generally low park elevations. Topographic positions are low level and low slope. Slopes are level or nearly so. Soil are loamy sand and sand. Soils are well-drained, or occasionally moderately well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1623.5	3.3	66.9	82.4
Range	1606-1686	1-5	38-108	76-88

Vegetation Description: This is a forest association comprised of large ponderosa pine trees (*Pinus ponderosa*) that dominate the overstory with Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) forming an abundant midstory. Antelope bitterbrush (*Purshia tridentata*) is common in the understory, as are long-stolon sedge (*Carex inops* ssp. *inops*) and western needlegrass (*Achnatherum occidentale*). Greenleaf manzanita (*Arctostaphylos patula*) and snowbrush ceanothus (*Ceanothus velutinus* var. *velutinus*) may be present but are typically not abundant.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	5-50	22.6	100
	Needle-leaved evergreen tree	*Pinus ponderosa*	2-25	9.3	100
Shrub	Broad-leaved deciduous shrub	*Purshia tridentata*	2-50	6.5	100
	Broad-leaved evergreen shrub	*Ceanothus velutinus* var. *velutinus*	0-25	2.5	57
	Broad-leaved evergreen shrub	*Arctostaphylos patula*	0.1-2	0.7	100
Herb	Graminoid	*Carex inops* ssp. *inops*	0.1-10	4.2	100
	Graminoid	*Achnatherum occidentale* ssp. *pubescens*	0.01-2	1.0	100

Species Richness:
Plot Vascular Plant Species Richness Average: 12.3
Plot Vascular Plant Species Richness Range: 9-18

Diagnostic Species: None
Constant Species: *Pinus contorta*, *Pinus ponderosa*, *Purshia tridentata*, *Carex inops* ssp. *inops*, *Achnatherum occidentale*, *Arctostaphylos patula*
Other Noteworthy Species: None
Local Range: This vegetation association occurs at scattered locations along and near the eastern park boundary at generally low park elevations. It occurs among and around the association 45. Ponderosa Pine / Greenleaf Manzanita - Antelope Bitterbrush Woodland where Sierra lodgepole pine becomes common. It is particularly common in the far northeast corner of the park, to the south of the Desert Creek Research Natural Area, and towards the upper slope limit of ponderosa pine woodland as it transitions to Sierra lodgepole pine forests. Stands of this association are also occasional near the park boundary through the southeast corner of the park, particularly along Sand Creek. It was observed extending well to the east of the eastern park boundary.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 7. Relevés 50; 51; 58; 60; 170; 175; 333
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This forest is endemic to the eastern Cascades of central Oregon. It is found on a narrow elevational belt between 1500-1800 m (4900-5900 feet) on level slopes (1-10%) of all aspects. Soils are loamy coarse sand to sandy loams which are well-drained. It is possible that it occurs in deep, recent pumice outcrops in northern California, but it has not been documented there.

Global Vegetation Description: *Pinus ponderosa* (10-40% cover) and *Pinus contorta* (1-20% cover) partially shade an understory of *Purshia tridentata* (7-40% cover), *Achnatherum occidentale* ssp. *occidentale* (= *Stipa occidentalis*) (trace-10% cover), and the diagnostic species, *Carex inops* ssp. *inops*. Other plants which may be present include *Arctostaphylos patula*, *Ceanothus velutinus*, *Carex rossii*, *Elymus elymoides* ssp. *elymoides* (= *Sitanion hystrix*), *Achillea millefolium*, *Eriogonum umbellatum*, and *Machaeranthera canescens* (= *Aster canescens*). This association is well-adapted to periodic fires.

DISTRIBUTION

Range: This is endemic to the eastern Cascades of Oregon. It is possible that it occurs in deep, recent pumice outcrops in northern California, but it has not yet been documented there.
States/Provinces: CA?. OR.

Global Description Reference: M.P. Murray. 1997. *Pinus ponderosa* / *Purshia tridentata* / *Carex inops* ssp. *inops* Forest [26Nov1997]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Ponderosa Pine / Antelope Bitterbrush / Long-stolon Sedge Forest at Crater Lake National Park.

47. SUBALPINE FIR - ENGELMANN SPRUCE / GROUSE WHORTLEBERRY FOREST

Abies lasiocarpa - Picea engelmannii / Vaccinium scoparium Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nb - D194 Rocky Mountain Forest & Woodland
Macrogroup: 1.B.2.Nb.5 - M020 Rocky Mountain Subalpine-High Montane Conifer Forest
Group: 1.B.2.Nb.5.b - G219 Rocky Mountain Subalpine Dry-Mesic Spruce - Fir Forest & Woodland
Alliance: A3643 Rocky Mountain Dry-Mesic Subalpine Fir - Engelmann Spruce Forest
Association: *Abies lasiocarpa - Picea engelmannii* / *Vaccinium scoparium* Forest

USNVC Identifier: CEGL000344

LOCAL INFORMATION

Environmental Description: This forest association is found at scattered locations on the central west side of the park as well as along lower Sand Creek on the east side of the park. Elevations are low to moderate within the park. Topographic positions are low level and lowslope. Slopes are nearly level to moderate. Soils are loams to sandy loams and moderately well-drained to well-drained. This association occurs in low lying areas, often near drainages or on the drier slopes above forested wetlands.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1647.7	4.0	304.7	83.3
Range	1553-1748	2-8	176-351	79-87

Vegetation Description: This is a dense, multilayered conifer forest association. Engelmann spruce (*Picea engelmannii*) is dominant in the overstory with subalpine fir (*Abies lasiocarpa* var. *lasiocarpa*) as a subdominant overstory species or Engelmann spruce and subalpine fir are codominant on the overstory. Mountain hemlock (*Tsuga mertensiana*) is also codominant in the overstory and is often abundant in the understory. Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) can also be present in the overstory. Grouse whortleberry (*Vaccinium scoparium*) is common in the understory along with a variety of mesic site herbs, including pipsissewa (*Chimaphila umbellata*), bride's bonnet (*Clintonia uniflora*), Gray's licorice-root (*Ligusticum grayi*), northwestern twayblade (*Listera caurina*), sidebells wintergreen (*Orthilia secunda*), and roughfruit berry (*Rubus lasiococcus*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Picea engelmannii*	10-50	30.2	100
	Needle-leaved evergreen tree	*Tsuga mertensiana*	5-50	18.7	100
	Needle-leaved evergreen tree	*Abies lasiocarpa* var. *lasiocarpa*	1-50	11.2	100
	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0-10	3.2	67
	Needle-leaved evergreen tree	*Abies magnifica* var. *shastensis*	0-5	1.7	67
	Needle-leaved evergreen tree	*Abies lowiana*	0-5	1.3	33
Shrub	Broad-leaved deciduous shrub	*Vaccinium scoparium*	0.1-75	22.2	100
Herb	Subshrub	*Chimaphila umbellata*	0.05-5	1.4	100
	Perennial herb	*Clintonia uniflora*	0.1-2	1.2	100

Species Richness:
Plot Vascular Plant Species Richness Average: 32.7
Plot Vascular Plant Species Richness Range: 27-38

Diagnostic Species: *Picea engelmannii, Campanula scouleri, Pyrola minor, Viola orbiculata*
Constant Species: *Abies lasiocarpa* var. *lasiocarpa, Picea engelmannii, Vaccinium scoparium, Chimaphila umbellata, Clintonia uniflora, Ligusticum grayi, Listera caurina, Orthilia secunda, Pinus monticola, Rubus lasiococcus, Tsuga mertensiana, Viola orbiculata*
Other Noteworthy Species: None
Local Range: This forest association is found at scattered locations on the central west side of the park, from near the western boundary eastward to just below the slopes surrounding the Crater Lake caldera rim. It occurs along lower Sand Creek on the east side of the park as well.

Classification Comments: Our association 47. Subalpine Fir - Engelmann Spruce / Grouse Whortleberry Forest is equivalent to the *Abies lasiocarpa - Picea engelmannii* / *Vaccinium scoparium* Forest (CEGL000344) described in the USNVC under the Rocky Mountain Dry-Mesic Subalpine Fir - Engelmann Spruce Forest Alliance (A3643).

Our association 47. was considered equivalent to CEGL000344 because the vegetation description from this USNVC association matches our association well and includes forests from the eastern Cascades. However our park association 47. is very similar to our *Abies lasiocarpa – Pinus contorta* var. *murrayana* Forest [Provisional] association and our *Abies lasiocarpa – Tsuga mertensiana / Rubus lasiococcus* Forest [Provisional] association classified under the Cascadian Subalpine Fir -

Engelmann Spruce Forest Alliance (A3729) the Cascadian Pacific Silver Fir - Mountain Hemlock - Subalpine Fir Forest & Woodland Alliance (A3726) respectively.

It is possible this park association 47. should be described as a provisional association classified under the Cascadian Pacific Silver Fir - Mountain Hemlock - Subalpine Fir Forest & Woodland Alliance (A3726). Further inquiry should reveal the best USNVC placement for our association 47. Subalpine Fir - Engelmann Spruce / Grouse Whortleberry Forest.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 3. Relevés 108; 118; 221
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This widespread subalpine forest association occurs throughout the Rocky Mountains extending to the mountains in the eastern Cascades. Elevations range between 2590 and 3800 m (7760-12,500 feet) in Colorado to 1525-2590 m (5000-8500 feet) in Montana and 1005-1900 m (3300-6230 feet) in central Washington. This type is characterized by deep snowpack and brief, cool summers. Sites are relatively xeric and cold. Stands are common in the middle to upper subalpine zone. Soils are variable but are often shallow, rocky, well-drained, sandy loam (to sandy clay) soils derived from andesite, conglomerate, granite, quartzite, sandstone, shale, and various other rocks. Litter and duff and downed wood cover a significant portion of the ground surface.

Global Vegetation Description: The vegetation is characterized by a moderately dense to dense conifer tree canopy codominated by *Picea engelmannii* and *Abies lasiocarpa*, with an understory characterized by a dwarf-shrub layer strongly dominated by *Vaccinium scoparium*. *Pinus albicaulis* or *Pinus flexilis* may be present in the canopy of some stands. *Pinus contorta, Populus tremuloides*, and *Larix occidentalis* (northern stands) are the most common seral species, though *Pseudotsuga menziesii* may occur in lower elevation stands. In the understory, *Vaccinium myrtillus* may be present but is usually trace to less than half the cover of *Vaccinium scoparium*. Other shrubs may be present at low cover such as *Lonicera involucrata, Lonicera utahensis, Mahonia repens, Paxistima myrsinites, Spiraea betulifolia*, and *Vaccinium membranaceum*. Herbaceous species such as *Arnica* spp., *Calamagrostis rubescens, Carex geyeri, Carex rossii, Chamerion angustifolium, Erigeron peregrinus, Erythronium grandiflorum, Eucephalus engelmannii, Hieracium gracile, Lupinus argenteus, Luzula parviflora, Orthilia secunda, Poa nervosa, Pedicularis racemosa, Polemonium pulcherrimum, Orthilia secunda* (= *Pyrola secunda*), *Thalictrum occidentale*, and *Trisetum spicatum* are commonly present with low cover values.

DISTRIBUTION

Range: This subalpine forest association occurs throughout the Rocky Mountains and extends into the mountains in the eastern Cascades.
States/Provinces: AZ?, CO, ID, MT, NM?, OR, UT, WA, WY.

Global Description Reference: K. A. Schulz. 2005. *Abies lasiocarpa - Picea engelmannii* / *Vaccinium scoparium* Forest [18Jul2005]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Subalpine Fir – Engelmann Spruce / Grouse Whortleberry Forest at Crater Lake National Park.

48. QUAKING ASPEN – PONDEROSA PINE FOREST [PROVISIONAL]

Populus tremuloides - Pinus ponderosa Forest [Provisional]

USNVC CLASSIFICATION:
Class: 1 - Forest & Woodland
Subclass: 1.B - Temperate & Boreal Forest & Woodland
Formation: 1.B.2 - Cool Temperate Forest & Woodland
Division: 1.B.2.Nb - D194 Rocky Mountain Forest & Woodland
Macrogroup: 1.B.2.Nb.5 - M020 Rocky Mountain Subalpine-High Montane Conifer Forest
Group: 1.B.2.Nb.5.d - G222 Rocky Mountain Subalpine-Montane Aspen Forest & Woodland
Alliance: A2036 Rocky Mountain Aspen Forest & Woodland

NPS Unique Identifier: NPSCRLA005

LOCAL INFORMATION

Environmental Description: This vegetation association occurs near the eastern boundary of the park on slopes directly above lower Sand Creek. In addition, it occurs in small patches in the Panhandle and elsewhere towards the southernmost boundary, and may occur inside the Crater Lake caldera on the caldera wall on the east side of the lake. Elevations are relatively low for inside the park. Topographic positions are low level and high slope. Soils are loamy sand and sandy loam and are well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1483.3	11.7	231.9	81
Range	1368-1594	0-34	183-0	73-91

Vegetation Description: This dense forest association is dominated by quaking aspen (*Populus tremuloides*) in the overstory with ponderosa pine (*Pinus ponderosa*) as a subdominant overstory species, or it is codominated by quaking aspen, ponderosa pine and Sierra white fir (*Abies lowiana*) in the overstory. The shrubs antelope bitterbrush (*Purshia tridentata*), creeping snowberry (*Symphoricarpos mollis*) and wax currant (*Ribes cereum* var. *cereum*) may be present and somewhat common. A number of graminoids may also be present and somewhat common. These include long-stolon sedge (*Carex inops* ssp. *inops*) and blue wildrye (*Elymus glaucus*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Broad-leaved deciduous tree	*Populus tremuloides*	5-50	20.3	100
	Needle-leaved evergreen tree	*Abies lowiana*	10-50	14.3	67
	Needle-leaved evergreen tree	*Pinus ponderosa*	1-25	8.0	100
Shrub	Broad-leaved evergreen shrub	*Ceanothus velutinus* var. *velutinus*	0-10	2.4	67
	Broad-leaved deciduous shrub	*Symphoricarpos mollis*	0-5	1.3	67
	Broad-leaved deciduous shrub	*Purshia tridentata*	0-5	1.4	67
Herb	Perennial herb	*Hieracium albiflorum*	0-5	1.2	33
	Graminoid	*Carex inops* ssp. *inops*	0-5	2.3	67
	Graminoid	*Elymus glaucus*	0-5	1.7	67
	Graminoid	*Melica aristata*	0-5	1.2	67

Species Richness:
Plot Vascular Plant Species Richness Average: 24.7
Plot Vascular Plant Species Richness Range:,19-33

Diagnostic Species: *Populus tremuloides*
Constant Species: *Populus tremuloides, Pinus ponderosa*, *Stephanomeria lactucina*, *Ribes cereum* var. *cereum*, *Ericameria bloomeri*
Other Noteworthy Species: None
Local Range: This association occurs predominantly near the eastern boundary of the park on slopes directly above lower Sand Creek. In addition, it occurs in small patches in the Panhandle and elsewhere towards the southernmost boundary and may occur inside the Crater Lake caldera on the caldera wall on the east side of the lake.

Classification Comments: We classified our association 48. Quaking Aspen – Ponderosa Pine Forest [Provisional] under the Rocky Mountain Aspen Forest & Woodland Alliance (A2036). Our provisional association is similar in its vegetation description to the USNVC's *Populus tremuloides* / *Symphoricarpos albus* / *Elymus glaucus* Woodland (CEGL000946) classified under A2036, However, our provisional association was not selected as equivalent to CEGL000946 because *Symphoricarpos albus* helps define this USNVC association, but is not present in the relevés grouped under our provisional association.

The USNVC's *Pinus ponderosa - Populus tremuloides / Carex* spp. - (*Poa* spp.) Riparian Forest (CEGL000191) classified under the Quaking Aspen Riparian Forest Alliance (A3760) is very similar in its vegetation description to ours; however, our provisional association describes vegetation of

mostly upland environments, not riparian ones. The USNVC's *Abies concolor - Pinus ponderosa* / *Carex inops* ssp. *inops* Forest (CEGL000257) classified under Eastern Sierran White Fir - Ponderosa Pine Forest & Woodland Alliance (A3677), has a vegetation description that is very similar to our provisional association. However, this USNVC association lists *Populus tremuloides* as subdominant or absent. Further inquiry should confirm the best USNVC placement for this park provisional association.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 3. Relevés 15; 185; 350
Crater Lake National Park Notes: None



Above: Quaking Aspen – Ponderosa Pine Forest [Provisional] at Crater Lake National Park. The trees with the whitish trunks are quaking aspens (*Populus tremuloides*).

49. QUAKING ASPEN / CALIFORNIA BROME FOREST

Populus tremuloides / Bromus carinatus Forest

USNVC CLASSIFICATION:
Class: 1 - Forest & Woodland
Subclass: 1.B - Temperate & Boreal Forest & Woodland
Formation: 1.B.2 - Cool Temperate Forest & Woodland
Division: 1.B.2.Nb - D194 Rocky Mountain Forest & Woodland
Macrogroup: 1.B.2.Nb.5 - M020 Rocky Mountain Subalpine-High Montane Conifer Forest
Group: 1.B.2.Nb.5.d - G222 Rocky Mountain Subalpine-Montane Aspen Forest & Woodland
Alliance: A2036 Rocky Mountain Aspen Forest & Woodland
Association: *Populus tremuloides* / *Bromus carinatus* Forest

USNVC Identifier: CEGL000573

LOCAL INFORMATION

Environmental Description: This vegetation association occurs near drainages on the western slope of the park and along Annie Creek at relatively low to moderate elevations. Topographic position is low level, and slopes are moderate. Soils range from somewhat poorly drained to well-drained and are sandy loam or loamy sand. Sites where this association occurs are often rather mesic.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1593	12	207.5	93.5
Range	1547-1639	6-18	190-225	92-95

Vegetation Description: This is an open forest or woodland association dominated by the deciduous tree quaking aspen (*Populus tremuloides*). Small conifers such as Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) and subalpine fir (*Abies lasiocarpa* var. *lasiocarpa*) are present but with very low cover. The dense herbaceous understory is diverse and many species are quite common, including the graminoids California brome (*Bromus carinatus*) and long-stolon sedge (*Carex inops* ssp. *inops*), as well as the forb Rydberg's penstemon (*Penstemon rydbergii* var. *oreocharis*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Broad-leaved deciduous tree	*Populus tremuloides*	10-25	20.5	100
	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0.1-5	3.0	100
	Needle-leaved evergreen tree	*Abies lasiocarpa* var. *lasiocarpa*	0.1-2	1.3	100
Herb	Perennial herb	*Penstemon rydbergii* var. *oreocharis*	1-10	4.5	100
	Graminoid	*Bromus carinatus*	1-50	19.5	100
	Graminoid	*Carex inops* ssp. *inops*	0.01-25	8.8	100
	Graminoid	*Elymus glaucus*	0-25	8.8	50
	Graminoid	*Elymus elymoides* ssp. *elymoides*	0.01-10	3.8	100
	Graminoid	*Achnatherum occidentale* ssp. *californicum*	0.01-2	0.8	100

Species Richness:
Plot Vascular Plant Species Richness Average: 36
Plot Vascular Plant Species Richness Range: 22-54

Diagnostic Species: *Populus tremuloides, Penstemon rydbergii* var. *oreocharis, Hackelia micrantha, Agoseris aurantiaca, Castilleja miniata* ssp. *miniata, Rumex acetosella, Agoseris grandiflora, Amelanchier alnifolia* var. *semiintegrifolia*
Constant Species: *Populus tremuloides, Abies lasiocarpa* var. *lasiocarpa, Abies magnifica* var. *shastensis, Penstemon rydbergii* var. *oreocharis, Bromus carinatus, Achnatherum occidentale* ssp. *californicum, Agoseris aurantiaca, Amelanchier alnifolia var. semiintegrifolia, Carex inops* ssp. *inops, Castilleja miniata* ssp. *miniata, Elymus elymoides* ssp. *elymoides, Hackelia micrantha, Ligusticum grayi, Lupinus andersonii, Melica aristata, Melica subulata, Pinus contorta* var. *murrayana, Viola glabella*
Other Noteworthy Species: None
Local Range: This vegetation association occurs near Bybee Creek and a northern tributary of Castle Creek on the western slope of the park, as well as along Annie Creek in the southern portion of the park, at relatively low to moderate elevations.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 2. Relevés 397; 411
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION
Global Environmental Description: N/A.

Global Vegetation Description: N/A.

DISTRIBUTION
Range: N/A.
States/Provinces: CA?, MT, NV, UT, WY.

Global Description Reference: Western Ecology Group. *Populus tremuloides* / *Bromus carinatus* Forest. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Quaking Aspen / California Brome Forest at Crater Lake National Park.

50. SIERRA WHITE FIR - SUGAR PINE - PONDEROSA PINE / GREENLEAF MANZANITA FOREST

Abies lowiana - Pinus lambertiana - Pinus ponderosa / Arctostaphylos patula Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.2 - M023 Southern Vancouverian Montane-Foothill Forest
Group: 1.B.2.Nd.2.a - G344 Californian Montane Conifer Forest & Woodland
Alliance: A3672 White Fir - Sugar Pine Forest
Association: *Abies lowiana - Pinus lambertiana - Pinus ponderosa* / *Arctostaphylos patula* Forest

USNVC Identifier: CEGL000016

LOCAL INFORMATION

Environmental Description: This vegetation association occurs primarily in the Panhandle at the southernmost portion of the park. It also occurs at scattered locations in the southeast and northeast corners of the park. Elevations of these locations are low to moderate. Topographic positions are predominantly low level, lowslope, and midslope but occasionally are high slope. Slopes are nearly level to fairly steep. Soils are moderately well-drained to well-drained and are sandy loam, loamy sand, and loam.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1510.5	11.3	177.5	80.8
Range	1381-1774	2-30	82-330	64-90

Vegetation Description: This is a tall, fairly dense forest association dominated more or less equally by sugar pine (*Pinus lambertiana*), ponderosa pine (*Pinus ponderosa*) and Sierra white fir (*Abies lowiana*). Shasta red fir (*Abies magnifica* var. *shastensis*) is occasionally abundant in the overstory at the higher elevations where this association occurs and may replace Sierra white fir in importance in the overstory. Pinemat manzanita (*Arctostaphylos nevadensis*) is often very common in the understory. Greenleaf manzanita (*Arctostaphylos patula*), snowbrush ceanothus (*Ceanothus velutinus* var. *velutinus*), and/or bush chinquapin (*Chrysolepis sempervirens*) are sometimes present. Herbaceous cover is frequently sparse and often includes pipsissewa (*Chimaphila umbellata*), whiteveined wintergreen (*Pyrola picta*), and spreading dogbane (*Apocynum androsaemifolium*) at low cover.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved tree	*Abies lowiana*	0-50	21.1	82
	Needle-leaved tree	*Pinus monticola*	0-10	0.8	27
	Needle-leaved tree	*Pinus lambertiana*	2-25	11.5	100
	Needle-leaved tree	*Pinus ponderosa*	2-25	9.4	100
	Needle-leaved tree	*Abies magnifica* var. *shastensis*	0-50	7.2	45
	Needle-leaved tree	*Pinus contorta* var. *murrayana*	0-25	4.0	82
Shrub	Broad-leaved evergreen shrub	*Arctostaphylos nevadensis*	0-50	6.6	91
	Broad-leaved evergreen shrub	*Chrysolepis sempervirens*	0-5	1.1	73
	Broad-leaved evergreen shrub	*Arctostaphylos patula*	0-5	0.8	36
Herb	Subshrub	*Chimaphila umbellata*	0-5	1.5	91

Species Richness:
Plot Vascular Plant Species Richness Average: 15.9
Plot Vascular Plant Species Richness Range: 9-29

Diagnostic Species: *Pinus lambertiana*
Constant Species: *Pinus ponderosa, Pinus lambertiana*
Other Noteworthy Species: *Abies lowiana*
Local Range: This vegetation association occurs primarily in the Panhandle at the southernmost portion of the park. It also occurs at scattered locations in the southeast and northeast corners of the park, particularly on Bear Butte and Sharp Peak.

Classification comments: Our association 50. Sierra White Fir - Sugar Pine - Ponderosa Pine / Greenleaf Manzanita Forest is equivalent to the *Abies lowiana - Pinus lambertiana - Pinus ponderosa* / *Arctostaphylos patula* Forest (CEGL000016) described in the USNVC under the White Fir - Sugar Pine Forest Alliance (A3672). Our association 50. and the USNVC association CEGL000016 matches very well in principal tree species, but not *Arctostaphylos patula* occurrence. This shrub is not present in over half of the relevés from our park association 50., but is considered ubiquitous in the USNVC type. These relevés that lack *Arctostaphylos patula* may better fit the USNVC *Abies concolor - Pinus lambertiana* Forest (CEGL008679) association.

Three relevés (180, 334, 336) with high cover of *Abies magnifica* var. *shastensis* were originally classified in their own association but were eventually merged with this association. Additional data collection and inquiry may determine that another association dominated by *Abies magnifica* var. *shastensis* and *Pinus lambertiana*, equivalent to the *Abies magnifica - Abies concolor - Pinus lambertiana* / Sparse Understory Forest (CEGL008683), is present within the park.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 11. Relevés 1; 2; 3; 5; 9; 10; 13; 18; 180; 334; 336
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: N/A.

Global Vegetation Description: N/A.

DISTRIBUTION

Range: N/A.
States/Provinces: CA, OR.

Global Description References: *Abies concolor - Pinus lambertiana - Pinus ponderosa* / *Arctostaphylos patula* Forest. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Sierra White Fir - Sugar Pine - Ponderosa Pine / Greenleaf Manzanita Forest at Crater Lake National Park. The large tree to the right of the yellow tape is a sugar pine (*Pinus lambertiana*).

51. DOUGLAS-FIR – SIERRA WHITE FIR - INCENSE-CEDAR FOREST

Pseudotsuga menziesii - Abies lowiana - Calocedrus decurrens Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.2 - M023 Southern Vancouverian Montane-Foothill Forest
Group: 1.B.2.Nd.2.a - G344 Californian Montane Conifer Forest & Woodland
Alliance: A3673 Ponderosa Pine - Incense-cedar - Douglas-fir Forest
Association: *Pseudotsuga menziesii - Abies lowiana - Calocedrus decurrens* Forest

USNVC Identifier: CEGL005813

LOCAL INFORMATION

Environmental Description: This forest association is found in the central-west portion of the park predominantly near its far western margin. Elevations are relatively low to moderate for inside the park. Topographic positions include lowslope, midslope, high slope, high level, and summit. Slopes in these forest environments range from gentle to fairly steep. Soils are mostly loams but also include sandy loams and organic. Soils are moderately well-drained to well-drained, and in cases with organic soils, are somewhat poorly drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1597.3	10.8	11.3	82.9
Range	1533-1624	2-22	330-178	74-91

Vegetation Description: This is a dense to moderately dense, tall forest association codominated in the overstory by incense cedar (*Calocedrus decurrens*), Sierra white fir (*Abies lowiana*), and often, but not always, Douglas fir (*Pseudotsuga menziesii* var. *menziesii*). The understory can be somewhat sparse as well as have a high cover of mesic forest species, including sweet after death (*Achlys triphylla*), white insideout flower (*Vancouveria hexandra*), star flower (*Trientalis borealis*), Sierra pea (*Lathyrus nevadensis*), small enchanter's nightshade (*Circea alpina* ssp. *pacifica*), Columbian windflower (*Anemone deltoidea*), western rattlesnake plantain (*Goodyera oblongifolia*), and largeleaf sandwort (*Moehringia macrophylla*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pseudotsuga menziesii* var. *menziesii*	0-75	22.6	67
	Needle-leaved evergreen tree	*Abies lowiana*	2-50	19.6	100
	Needle-leaved evergreen tree	*Abies magnifica* var. *shastensis*	0-25	6.1	67
	Needle-leaved evergreen tree	*Tsuga mertensiana*	0-10	2.5	33
	Scale-leaved evergreen tree	*Calocedrus decurrens*	5-25	14.6	100
Herb	Subshrub	*Chimaphila umbellata*	0-5	0.9	89
	Perennial herb	*Achlys triphylla*	0-25	2.8	78
	Perennial herb	*Vancouveria hexandra*	0-10	1.3	67

Species Richness:
Plot Vascular Plant Species Richness Average: 40.9
Plot Vascular Plant Species Richness Range: 21-69

Diagnostic Species: *Calocedrus decurrens, Goodyera oblongifolia, Moehringia macrophylla*
Constant Species: *Abies lowiana, Calocedrus decurrens, Anemone deltoidea, Goodyera oblongifolia*
Other Noteworthy Species: *Pseudotsuga menziesii* var. *menziesii*
Local Range: This forest association is uncommon and occurs predominantly among Sierra white fir dominated forests in the central-west portion of the park predominantly near the park's far western margin.

Classification Comments: Our association 51. Douglas-fir - Sierra White Fir - Incense-Cedar Forest is equivalent to the USNVC's *Pseudotsuga menziesii - Abies concolor - Calocedrus decurrens* Forest (CEGL005813) described in the USNVC under the Ponderosa Pine - Incense-cedar - Douglas-fir Forest Alliance (A3673). However, Douglas-fir (*Pseudotsuga menziesii*), while abundant, is not constant in our association 51. Our association 51. also lacks the lower elevation, warmer site-associated species California black oak (*Quercus kelloggii*), sugar pine (*Pinus lambertiana*), and Pacific dogwood (*Cornus nuttallii*) that are described in the USNVC association. Our association matches the description of USNVC association CEGL005813 fairly well except our park relevés appear to be from colder and wetter environments on average than those described under CEGL005813, and sometimes our association 51. has high cover of *Abies magnifica* var. *shastensis.* USNVC association CEGL005813 and the alliance it is classified under is described from forests of the Sierra Nevada, which may account for the minor differences in species composition in the description with our association 51.

Both Kagan et al. (2004) and Atzet and McCrimmon (1990) describe an *Abies concolor - Calocedrus decurrens* /*Mahonia nervosa* Forest that may be equivalent to our association 51. The *Abies concolor - Abies* x *shastensis* / *Ribes* spp. Forest (CEGL00031) in the USNVC is also similar to our association except *Calocedrus decurrens* is not a principal species. Further inquiry should reveal the best USNVC placement for our park association 51.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 9. Relevés 38; 52; 54; 55; 204; 209; 210; 220; 368
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This association occurs throughout the northern Sierra Nevada and southern Cascades of California at least as far south as Yosemite Valley. Stands of this forest are found at low elevations (640-1460 m [2100-4800 feet]) at cool, moist sites with humid air. These sites tend to occur on north- or northeast-facing, gentle to moderately steep (12-80%), lower or midslopes. Sites are often adjacent to perennial streams generally occupying small areas. Soils are moderately deep to deep in metamorphic or volcanic substrates. Coarse fragments tend to be higher in this association. Fire is infrequent, with low to medium intensities and variable spread (Fites 1994).

Global Vegetation Description: Stands of this forest form a dense, multi-layered overstory of *Pseudotsuga menziesii, Abies concolor,* and *Calocedrus decurrens*. *Corylus cornuta* is in the shrub layer, and dense patches of both or either *Adenocaulon bicolor* or *Trichostema lanceolatum* are in the herb layer. *Pseudotsuga menziesii* dominates and occasionally codominates with *Abies concolor*. *Calocedrus decurrens, Pinus lambertiana,* and occasionally *Pinus ponderosa* are minor associates. Infrequently, *Taxus brevifolia* and *Torreya californica* are present. *Pseudotsuga menziesii* dominate the regeneration, but *Abies concolor* and *Calocedrus decurrens* can also be high or dominant. *Quercus kelloggii, Pinus lambertiana,* and *Cornus nuttallii* are common in low amounts. *Quercus chrysolepis* occurs in the overstory and midstory on sites with limiting soil conditions, either shallow and stony sites with limited rootability or very high coarse fragments. *Corylus cornuta* forms a tall-shrub layer of variable cover. The herb layer is well-developed with dense patches dominated by *Adenocaulon bicolor* and *Trichostema lanceolatum*.

DISTRIBUTION

Range: This association occurs throughout the northern Sierra Nevada and southern Cascades (Fites 1994) at least as far south as Yosemite Valley. Don Potter (pers. comm. 2002) has sampled this association near Carlon. The southern range limit is probably Big Creek near Huntington Lake, Fresno County.
States/Provinces: CA, OR.

Global Description Reference: T. Keeler-Wolf. 2010. *Pseudotsuga menziesii - Abies concolor - Calocedrus decurrens* Forest [06May2010]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Douglas-fir – Sierra White Fir - Incense-Cedar Forest at Crater Lake National Park.

52. SIERRA WHITE FIR / PIPSISSEWA FOREST

Abies lowiana / Chimaphila umbellata Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.2 - M023 Southern Vancouverian Montane-Foothill Forest
Group: 1.B.2.Nd.2.a - G344 Californian Montane Conifer Forest & Woodland
Alliance: A3674 Coastal, Cascadian & Sierran White Fir - Douglas-fir Forest
Association: *Abies lowiana* / *Chimaphila umbellata* Forest

USNVC Identifier: CEGL000015

LOCAL INFORMATION

Environmental Description: This forest association is common in the southeast, the central west, and northeast portions of the park at low to moderate elevations. Topographic positions are low level, lowslope, and midslope. Slopes are gentle to moderate. Soils are sandy loam, loamy sand, and loam and are well-drained and moderately well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1483.9	3.4	125.7	88.1
Range	1451-1591	1-7	65-249	80-94

Vegetation Description: This is a tall, dense forest association where Sierra white fir (*Abies lowiana*) is the sole dominant tree in the overstory. Ponderosa pine (*Pinus ponderosa*) is sometimes present in the overstory but much less so than Sierra white fir, usually with less than 5% cover. The understory is sparse; however, pipsissewa (*Chimaphila umbellata*), creeping snowberry (*Symphoricarpos mollis*), and long-stolon sedge (*Carex inops* ssp. *inops*) are usually present in the understory.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Abies lowiana*	10-75	42.7	100
	Needle-leaved evergreen tree	*Pinus ponderosa*	0-5	2.2	92
Shrub	Broad leaved evergreen shrub	*Arctostaphylos nevadensis*	0-10	0.7	25
Herb	Subshrub	*Chimaphila umbellata*	0-5	1.5	83
	Graminoid	*Carex inops* ssp. *inops*	0-1	0.4	92

Species Richness:
Plot Vascular Plant Species Richness Average: 16.6
Plot Vascular Plant Species Richness Range: 5-33

Diagnostic Species: None
Constant Species: *Abies lowiana*, *Chimaphila umbellata*, *Carex inops* ssp. *inops*
Other Noteworthy Species: None
Local Range: This forest association is common in Sierra white fir dominated forests in the southeast corner of the park, in the central west portion of the park, and on the eastern slopes of Timber Crater in the northeast portion of the park. It may be found elsewhere in the park where Sierra white fir forests are common.

Classification Comments: Our association 52. Sierra White Fir / Pipsissewa Forest is equivalent to the USNVC's *Abies concolor / Chimaphila umbellata* Forest (CEGL000015) described in the USNVC under the Coastal, Cascadian & Sierran White Fir - Douglas-fir Forest Alliance (A3674). Our association and the USNVC association CEGL000015 closely resemble each other in principal species: Sierra white fir (*Abies lowiana*) in the overstory and pipsissewa (*Chimaphila umbellata*) in the understory, however, CEGL000015, describes stands in the Klamath-Siskiyou mountains and understory vegetation common in forests west of the Cascade crest. Nonetheless, a study of the ponderosa pine - Sierra white fir forests in Crater Lake National Park was referenced by USNVC in the development of USNVC association CEGL000015. All relevés of our association are from east of the Cascade crest and occur at elevations just above the *Abies concolor - Pinus ponderosa* / *Carex inops* ssp. *inops* Forest (CEGL000257) and just below the *Abies concolor - Abies* x *shastensis* / *Chimaphila umbellata* Forest (CEGL000030). However, stands of our association 52. were observed on the west side of the Cascade crest. It is possible that Sierra white fir dominated stands from the east and west of the Cascade crest represent two different associations. Further inquiry should reveal whether this split is warranted. If so, relevés from west of the crest would be retained here in association 52., and those east of the Cascade crest may best be classified with associations under the Eastern Sierran White Fir - Ponderosa Pine Forest & Woodland Alliance (A3677) or the White Fir - California Red Fir - Shasta Red Fir Forest Alliance (A3678).

Other Comments: None

Local Description Author: D. A. DiPaolo
Number of Plots: 12**.** Relevés 61; 169; 193; 194; 196; 198; 200; 347; 349; 351; 352; 355

Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This association is native to Oregon's Klamath-Siskiyou region and may occur in northwestern California. Stands are found at elevations of 1160-1500 m (3800-4900 feet) on southerly aspects with moderate to gentle slopes. Soils are not well-documented except that parent material is andesite or pumice.

Global Vegetation Description: The dominant overstory species are *Pseudotsuga menziesii* and *Abies concolor* with cover averaging 33% and 42%, respectively. The most common understory plants are *Chimaphila umbellata* (28%), *Mahonia nervosa* (= var. *nervosa)* (6%), *Rubus ursinus* (5%), and *Anemone deltoidea* (1%).

DISTRIBUTION

Range: This association occurs in the Klamath-Siskiyou region in southwestern Oregon, and may occur in northwestern California.
States/Provinces: CA?, OR.

Global Description References: M.P. Murray. 1997. *Abies concolor* / *Chimaphila umbellata* Forest [26Nov1997]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Sierra White Fir / Pipsissewa Forest at Crater Lake National Park.

53. SIERRA WHITE FIR - DOUGLAS-FIR / CASCADE BARBERRY FOREST

Abies lowiana - Pseudotsuga menziesii / Mahonia nervosa Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.2 - M023 Southern Vancouverian Montane-Foothill Forest
Group: 1.B.2.Nd.2.a - G344 Californian Montane Conifer Forest & Woodland
Alliance: A3674 Coastal, Cascadian & Sierran White Fir - Douglas-fir Forest
Association: *Abies lowiana - Pseudotsuga menziesii* / *Mahonia nervosa* Forest

USNVC Identifier: CEGL000019

LOCAL INFORMATION

Environmental Description: This forest association is found along the western margin of the park at low to moderate park elevations. Topographic positions are lowslope, midslope, and high slope. Slopes in these forest environments are variable but are mostly moderate to steep. Soils are loams and sandy loams. Soils are moderately well-drained to well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1504.5	21.6	202.8	77.9
Range	1301-1670	2-40	156-311	55-91

Vegetation Description: This is a tall, dense forest association where Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*) and Sierra white fir (*Abies lowiana*) are codominant in the overstory. Sierra white fir is sometimes subdominant to Douglas-fir in the overstory. Cascade barberry (*Mahonia nervosa*) is almost always present in the understory. Herbs in the understory are sparse to dense and can be diverse. These include pipsissewa (*Chimaphila umbellata*), sweet after death (*Achlys triphylla*), American trailplant (*Adenocaulon bicolor*), California blackberry (*Rubus ursinus*), and white insideout flower (*Vancouveria hexandra*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pseudotsuga menziesii* var. *menziesii*	1-75	51.5	100
	Needle-leaved evergreen tree	*Abies lowiana*	0-50	20.1	93
	Needle-leaved evergreen tree	*Abies magnifica* var. *shastensis*	0-10	1.3	45
Shrub	Broad-leaved evergreen shrub	*Mahonia nervosa*	0-25	2.0	93
Herb	Subshrub	*Chimaphila umbellata*	0.01-10	1.9	100
	Perennial herb	*Achlys triphylla*	0-50	4.9	80
	Perennial vine	*Rubus ursinus*	0-25	1.8	87

Species Richness:
Plot Vascular Plant Species Richness Average: 34.7
Plot Vascular Plant Species Richness Range: 17-50

Diagnostic Species: *Mahonia nervosa, Rubus ursinus*
Constant Species: *Pseudotsuga menziesii* var. *menziesii, Chimaphila umbellata*
Other Noteworthy Species: *Abies lowiana*
Local Range: This forest association is common along the western margin of the park at low to moderate park elevations.

Classification Comments: Our association 53. Sierra White Fir - Douglas-fir / Cascade Barberry Forest is equivalent to the USNVC's *Abies concolor - Pseudotsuga menziesii* / *Mahonia nervosa* Forest (CEGL000019) described in the USNVC under the Coastal, Cascadian & Sierran White Fir - Douglas-fir Forest Alliance (A3674). Our park association was considered to be equivalent to this USNVC association because both share the same principal species; however, CEGL000019 lacks a written description. Several other USNVC associations describe very similar vegetation in terms of species composition and geographical location to our park association 53. The *Abies concolor* / *Mahonia nervosa* Forest (CEGL000012) and the *Abies concolor* / *Chimaphila umbellata* Forest (CEGL000015) are very similar. The *Abies concolor* / *Amelanchier alnifolia* / *Anemone deltoidea* Forest (CEGL000010) is also similar to our park association 53., however, Saskatoon serviceberry (*Amelanchier alnifolia*) is not constant in all relevés of our association 53. Atzet et al. (1996) describe an *Abies concolor* / *Berberis nervosa* / *Achlys triphylla* association and a *Pseudotsuga menziesii - Abies concolor* association that are also very similar to our park association 53. Further inquiry should confirm the best USNVC association that is equivalent to our park association 53.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 15. Relevés 27; 28; 29; 33; 34; 35; 36; 37; 53; 103; 119; 120; 121; 186; 342

Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: N/A.

Global Vegetation Description: N/A.

DISTRIBUTION

Range: N/A.
States/Provinces: CA?, OR.

Global Description Reference: *Abies concolor - Pseudotsuga menziesii* / *Mahonia nervosa* Forest. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Sierra White Fir - Douglas-fir / Cascade Barberry Forest at Crater Lake National Park.

54. SIERRA WHITE FIR - DOUGLAS-FIR / BUSH CHINQUAPIN FOREST

Abies lowiana - Pseudotsuga menziesii / Chrysolepis sempervirens Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.2 - M023 Southern Vancouverian Montane-Foothill Forest
Group: 1.B.2.Nd.2.a - G344 Californian Montane Conifer Forest & Woodland
Alliance: A3674 Coastal, Cascadian & Sierran White Fir - Douglas-fir Forest
Association: *Abies lowiana - Pseudotsuga menziesii* / *Chrysolepis sempervirens* Forest

USNVC Identifier: CEPP007202

LOCAL INFORMATION

Environmental Description: This forest association is found at relatively low to moderate elevations in the southeastern portion of the park, particularly in the Panhandle along lower Annie Creek and in the surrounding area towards Sun Creek. Topographic positions are lowslope, midslope and low level. Slopes are generally steep but are occasionally gentle. Soils are sandy loam and well-drained to moderately well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1411.5	32.7	63.0	79
Range	1328-1603	1-45	43-150	74-90

Vegetation Description: This is a tall, dense coniferous forest association with Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*) and Sierra white fir (*Abies lowiana*) codominant in the overstory. Ponderosa pine (*Pinus ponderosa*) is sometimes present. Bush chinquapin (*Chrysolepis sempervirens*) is often found in the understory at low to moderate cover. A variety of other shrubs, including Saskatoon serviceberry (*Amelanchier alnifolia* var. *semiintegrifolia*), creeping snowberry (*Symphoricarpos mollis*), dwarf rose (*Rosa gymnocarpa*), sticky currant (*Ribes viscosissimum*), thimbleberry (*Rubus parviflorus*) are often present with low to moderate cover. Commonly occurring perennial herbs in the understory include pipsissewa (*Chimaphila umbellata*), American trailplant (*Adenocaulon bicolor*), bride's bonnet (*Clintonia uniflora*), starry false lily of the valley (*Maianthemum stellatum*), feathery false lily of the valley (*Maianthemum racemosum*), and white hawkweed (*Hieracium albiflorum*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pseudotsuga menziesii* var. *menziesii*	10-75	38.2	100
	Needle-leaved evergreen tree	*Abies lowiana*	5-75	32.9	100
	Needle-leaved evergreen tree	*Pinus ponderosa*	0-25	4.2	86
Shrub	Broad-leaved evergreen shrub	*Chrysolepis sempervirens*	0-10	3.4	86
	Broad-leaved deciduous shrub	*Rosa gymnocarpa*	0-5	2.3	71
	Broad-leaved deciduous shrub	*Symphoricarpos mollis*	0-5	1.4	86
	Broad-leaved deciduous shrub	*Ribes viscosissimum*	0-2	1.1	86
Herb	Subshrub	*Chimaphila umbellata*	0.1-5	1.1	100
	Perennial herb	*Maianthemum stellatum*	0-10	1.4	71

Species Richness:
Plot Vascular Plant Species Richness Average: 33
Plot Vascular Plant Species Richness Range: 13-41

Diagnostic Species: *Sorbus scopulina, Rubus parviflorus, Arnica cordifolia, Maianthemum racemosum*
Constant Species: *Pseudotsuga menziesii* var. *menziesii*, *Abies lowiana*, *Chimaphila umbellata*, *Chimaphila menziesii*, *Orthilia secunda, Pyrola picta*
Other Noteworthy Species: *Chrysolepis sempervirens*, *Adenocaulon bicolor*
Local Range: This forest association is found in the southeastern portion of the park, particularly in the Panhandle and just to the north along lower Annie Creek and in the surrounding area towards Sun Creek. It is most common inside the creek canyons of lower Annie Creek and lower Sun Creek.
Local Description Author: D. A. DiPaolo
Number of Plots: 7. Relevés 20; 21; 22; 23; 24; 25; 354
Crater Lake National Park Notes: None

Classification Comments: This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Our association 54. Sierra White Fir - Douglas-fir / Bush Chinquapin Forest is very similar in some of the principal species present to the USNVC's *Abies concolor* / *Symphoricarpos mollis* Forest

association (CEGL000027) described in the USNVC under the Coastal, Cascadian & Sierran White Fir - Douglas-fir Forest Alliance (A3674). A study of the ponderosa pine - Sierra white fir forests in Crater Lake National Park was referenced by USNVC in the development of CEGL000027. However, this USNVC association was not selected as equivalent to our park association described here because it describes vegetation from the Klamath-Siskiyou mountains and lists creeping snowberry (*Symphoricarpos mollis*) as always the dominant shrub species. In our association, other shrub species may be more abundant. The *Abies concolor - Pinus ponderosa / Symphoricarpos* spp. Forest (CEGL000018) is also similar to our park provisional association except that Douglas-fir (*Pseudotsuga menziesii*) is listed as only a subdominant. Atzet et al. (1996) describe a *Pseudotsuga menziesii - Abies concolor* association that is very similar to our association 54.



Above: Sierra White Fir - Douglas-fir / Bush Chinquapin Forest at Crater Lake National Park.

55. PONDEROSA PINE – INCENSE-CEDAR / PROSTRATE CEANOTHUS WOODLAND [PROVISIONAL]

Pinus ponderosa – Calocedrus decurrens / Ceanothus prostratus Woodland [Provisional]

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.2 - M023 Southern Vancouverian Montane-Foothill Forest
Group: 1.B.2.Nd.2.a - G344 Californian Montane Conifer Forest & Woodland
Alliance: A3677 Eastern Sierran White Fir - Ponderosa Pine Forest & Woodland

NPS Unique Identifier: NPSCRLA006

LOCAL INFORMATION

Environmental Description: This vegetation association occurs primarily on a steep slope and ridgeline just north of the Annie Creek canyon and the Panhandle. Elevations are relatively low for inside the park. Topographic positions are midslope to high slope. Slopes are fairly steep. Soils are well-drained and loamy sand to sandy loam.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1546.5	26.5	197.5	68.5
Range	1504-1589	23-30	180-215	47-90

Vegetation Description: This is a sparse to somewhat open forest association dominated more or less equally by incense cedar (*Calocedrus decurrens*) and ponderosa pine (*Pinus ponderosa*). Sierra white fir (*Abies lowiana*) is often present but is subdominant. The shrubs greenleaf manzanita (*Arctostaphylos patula*) and snowbrush ceanothus (*Ceanothus velutinus* var. *velutinus*) are often present with low cover. Prostrate ceanothus (*Ceanothus prostratus*) is always present in the understory. Long-stolon sedge (*Carex inops* ssp. *inops*) is common in the understory along with a number of herbs found in lower elevation east-side forests and woodlands.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Scale-leaved evergreen tree	*Calocedrus decurrens*	2-10	6.0	100
	Needle-leaved evergreen tree	*Pinus ponderosa*	1-10	5.5	100
	Needle-leaved evergreen tree	*Pseudotsuga menziesii* var. *menziesii*	0-5	1.8	50
	Needle-leaved evergreen tree	*Abies lowiana*	0.1-2	1.3	100
Shrub	Broad-leaved evergreen shrub	*Arctostaphylos patula*	0.1-2	1.3	100
	Broad-leaved evergreen shrub	*Ceanothus prostratus*	0.01-1	0.3	100
	Broad-leaved evergreen shrub	*Ceanothus velutinus* var. *velutinus*	0.01-1	0.3	100
Herb	Annual herb	*Collomia tinctoria*	0.01-1	0.3	100
	Graminoid	*Carex inops* ssp. *inops*	1-5	2.5	100
	Graminoid	*Elymus elymoides* ssp. *elymoides*	0.01-1	0.3	100

Species Richness:
Plot Vascular Plant Species Richness Average: 20
Plot Vascular Plant Species Richness Range: 19-21

Diagnostic Species: *Calocedrus decurrens*, *Collomia tinctoria*, *Senecio integerrimus* var. *exaltatus*, *Agoseris retrorsa*, *Fritillaria atropurpurea*
Constant Species: *Calocedrus decurrens*, *Pinus ponderosa*, *Abies lowiana*, *Ceanothus prostratus*, *Achnatherum occidentale*, *Arctostaphylos patula*, *Carex inops* ssp. *inops*, *Ceanothus velutinus* var. *velutinus*, *Collomia tinctoria*, *Elymus elymoides* ssp. *elymoides*, *Gayophytum diffusum*, *Senecio integerrimus* var. *exaltatus*, *Stephanomeria lactucina*
Other Noteworthy Species: None
Local Range: This association is found just to the north of the Annie Creek canyon on a steep slope and ridgeline that runs from just north of Annie Creek Falls southeast to just north of the Panhandle.

Classification Comments: We classified our association Ponderosa Pine – Incense-Cedar / Prostrate Ceanothus Woodland [Provisional] under the USNVC's Eastern Sierran White Fir - Ponderosa Pine Forest & Woodland Alliance (A3677) because the species composition of our association is similar to that of the vegetation description of the *Abies concolor - Pinus ponderosa* / *Amelanchier alnifolia* Forest (CEGL000014) and it occurs among *Abies concolor - Pinus ponderosa* / *Carex inops* ssp. *inops* Forest (CEGL000257). Both of these USNVC associations are classified under alliance A3677. This park provisional association may be similar to the *Pinus ponderosa – Calocedrus decurrens* / *Ceanothus prostratus* association described by Simpson (2007).

It is also possible that our provisional association should be classified in the Ponderosa Pine - Incense-cedar - Douglas-fir Forest Alliance (A3673) because of the similar codominance of all three of these principal tree species in our association, however, A3673 describes vegetation from the west side of the Cascade mountains. Further inquiry should reveal the best USNVC placement for our park provisional association.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 2. Relevés 231; 348
Crater Lake National Park Notes: None

Local Description Reference: Simpson, M. 2007. Forested Plant Associations of the Oregon East Cascades. Pacific Northwest Region Technical Paper R6-NR-ECOL-TP-03-2007. United States Department of Agriculture.



Above: Ponderosa Pine – Incense-cedar / Prostrate Ceanothus Woodland [Provisional] at Crater Lake National Park.

56. SIERRA WHITE FIR - PONDEROSA PINE / LONG-STOLON SEDGE FOREST

Abies lowiana - Pinus ponderosa / Carex inops ssp. *inops* Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.2 - M023 Southern Vancouverian Montane-Foothill Forest
Group: 1.B.2.Nd.2.a - G344 Californian Montane Conifer Forest & Woodland
Alliance: A3677 Eastern Sierran White Fir - Ponderosa Pine Forest & Woodland
Association: *Abies lowiana - Pinus ponderosa* / *Carex inops* ssp. *inops* Forest

USNVC Identifier: CEGL000257

LOCAL INFORMATION

Environmental Description: This vegetation association is common in the Panhandle area, the southeast corner of the park, along the eastern edge of the park and on the eastern slope of Timber Crater in the northeast corner of the park. Elevations are relatively low for inside the park. Topographic positions are low level and lowslope. Slopes are fairly level to moderate. Soils are loam, loamy sand, sandy loam and are moderately well-drained to well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1403.2	5.9	175.9	82.1
Range	1355-1648	0-17	0-270	70-91

Vegetation Description: This is a moderately dense, tall forest association dominated more or less equally by Sierra white fir (*Abies lowiana*) and ponderosa pine (*Pinus ponderosa*). The shrub snowbrush ceanothus (*Ceanothus velutinus* var. *velutinus*) is almost always present and is sometimes dense. The herb long-stolon sedge (*Carex inops* ssp. *inops*) is always present in the understory and is sometimes abundant.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Abies lowiana*	5-50	23.1	100
	Needle-leaved evergreen tree	*Pinus ponderosa*	5-50	17.5	100
	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0-5	1.0	44
Shrub	Broad-leaved evergreen shrub	*Ceanothus velutinus* var. *velutinus*	0.01-50	7.7	100
	Broad-leaved evergreen shrub	*Arctostaphylos patula*	0-10	1.0	44
	Broad-leaved deciduous shrub	*Symphoricarpos mollis*	0-10	1.5	56
	Narrow-leaved evergreen shrub	*Ericameria bloomeri*	0-5	0.6	67
Herb	Perennial herb	*Hieracium albiflorum*	0-2	0.6	89
	Graminoid	*Carex inops* ssp. *inops*	0.1-25	5.3	100

Species Richness:
Plot Vascular Plant Species Richness Average: 23.2
Plot Vascular Plant Species Richness Range: 14-33

Diagnostic Species: None
Constant Species: *Abies lowiana, Pinus ponderosa, Ceanothus velutinus* var. *velutinus, Carex inops* ssp. *inops*
Other Noteworthy Species: None
Local Range: This vegetation association is common in the Panhandle area, the southeast corner of the park, along the eastern edge of the park just north of Sand Creek and around Bear Butte and Sharp Peak and on the lower eastern slope of Timber Crater in the northeast corner of the park.

Classification Comments: Our association 56. Sierra White Fir - Ponderosa Pine / Long-Stolon Sedge Forest is equivalent to the USNVC's *Abies concolor - Pinus ponderosa* / *Carex inops* ssp. *inops* Forest (CEGL000257) described in the USNVC under the Eastern Sierran White Fir - Ponderosa Pine Forest & Woodland Alliance A3677. However, the description for CEGL000257 characterizes ponderosa pine (*Pinus ponderosa*) as more abundant than Sierra white fir (*Abies lowiana*), which is only present at 5-10% cover. Our park association 56. includes relevés that are codominated by these two species in nearly equal amounts, or where Sierra white fir is more abundant as well as stands where ponderosa pine is more abundant than Sierra white fir. The similar USNVC association *Abies concolor - Pinus ponderosa* / *Ceanothus velutinus* Forest (CEGL000258) may be equivalent to our park association 56. due to the high cover of *Ceanothus velutinus* in both;

however CEGL000258 lacks a description needed to make a determination. Further inquiry should confirm the equivalent USNVC association to this park association.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 9. Relevés 4; 6; 7; 11; 16; 17; 19; 43; 325
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This relatively open forest community resides in the southern Cascades of Oregon at elevations of 1770-2135 m (5800-7000 feet). Slopes vary between 6-26% and occur on all aspects. Soils are silty-clay loams over ash and basalt.

Global Vegetation Description: *Pinus ponderosa* dominates the tree canopy with cover of 30-50%. Cover of *Abies concolor* and *Populus tremuloides* is 5-10% and 0-30%, respectively. Important herbaceous species are *Poa nervosa* (5-40%), *Achillea millefolium* (1-30%), and *Carex inops* ssp. *inops* (1-30%).

DISTRIBUTION

Range: This association is only known from the eastern Cascades of Oregon's Fremont National Forest. It is possibly also found in the adjacent Warner Mountains of northeastern California.
States/Provinces: CA?, OR.

Global Description References: M.P. Murray. 1997. *Abies concolor - Pinus ponderosa* / *Carex inops* ssp. *inops* Forest [26Nov1997]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Sierra White Fir - Ponderosa Pine / Long-Stolon Sedge Forest at Crater Lake National Park.

57. SIERRA WHITE FIR - SHASTA RED FIR / PIPSISSEWA FOREST

Abies lowiana - Abies magnifica var. shastensis / Chimaphila umbellata Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.2 - M023 Southern Vancouverian Montane-Foothill Forest
Group: 1.B.2.Nd.2.a - G344 Californian Montane Conifer Forest & Woodland
Alliance: A3678 Sierra White Fir - California Red Fir - Shasta Red Fir Forest
Association: *Abies lowiana - Abies magnifica* var. *shastensis* / *Chimaphila umbellata* Forest

USNVC Identifier: CEGL000030

LOCAL INFORMATION

Environmental Description: This forest association is found in the southeast portion of the park as well as along the eastern and western margins of the park. It occurs at the upper elevational limit of Sierra white fir (*Abies lowiana*) where forests dominated by Sierra white fir transition into Shasta red fir (*Abies magnifica* var. *shastensis*) dominated forests. Elevations are somewhat low to moderate. Topographic positions include low level, lowslope, midslope, high slope, and summit. Slopes range from nearly level to steep. Soils are sandy loams and loamy sands and well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1695.9	11.7	125.7	84.6
Range	1509-1854	2-38	30-240	73-90

Vegetation Description: This is a dense, multilayered forest association more or less evenly dominated by Sierra white fir (*Abies lowiana*) and Shasta red fir (*Abies magnifica* var. *shastensis*). The understory is sparse with a lot of down wood present on the forest floor. Pipsissewa (*Chimaphila umbellata*) is constant in the understory with low to relatively moderate cover.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Abies lowiana*	1-50	27.8	100
	Needle-leaved evergreen tree	*Abies magnifica* var. *shastensis*	5-50	23.6	100
	Needle-leaved evergreen tree	*Pinus ponderosa*	0-5	1.1	55
	Needle-leaved evergreen tree	*Pinus monticola*	0-5	0.8	55
Herb	Subshrub	*Chimaphila umbellata*	0.01-5	1.0	100

Species Richness:
Plot Vascular Plant Species Richness Average: 13.4
Plot Vascular Plant Species Richness Range: 6-22

Diagnostic Species: None
Constant Species: *Abies lowiana, Abies magnifica* var. *shastensis, Chimaphila umbellata*
Other Noteworthy Species: None
Local Range: This forest association is found in the southeast portion of the park as well as along the eastern and western margins of the park. It occurs at the upper elevational limit of Sierra white fir (*Abies lowiana*) where forest dominated by Sierra white fir transition into Shasta red fir (*Abies magnifica* var. *shastensis*) dominated forests.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 11. Relevés 79; 197; 199; 222; 223; 225; 235; 353; 373; 376; 377
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: These forests are common in the southern Cascades and less extensive in the Klamath-Siskiyou region. The association is typically a closed-canopy forest with gaps at boulders. Elevations average 1650 m (5420 feet). Slopes range between 3 and 50% and are usually west or northwest-facing. Soils are loamy sands with parent material varying from andesite and basalt to diorite and granite.

Global Vegetation Description: The tree canopy is codominated by *Abies concolor* and *Abies* x *shastensis* which average about 29% and 19% cover, respectively. The understory is extremely sparse, and includes *Rosa gymnocarpa,* about 2% cover at most sites, and *Chimaphila umbellata* with about 8% cover.

DISTRIBUTION

Range: This type is restricted to the extreme southern Cascades and the Klamath-Siskiyou region of Oregon and California.

States/Provinces: CA, OR.

Global Description References: M.P. Murray. 1997. *Abies concolor - Abies* x *shastensis* / *Chimaphila umbellata* Forest [26Nov1997]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Sierra White Fir - Shasta Red Fir / Pipsissewa Forest at Crater Lake National Park. The large tree to the left is Sierra white fir (*Abies lowiana*) and the large tree to the right is Shasta red fir (*Abies magnifica* var. *shastensis*).

58. SHASTA RED FIR – WESTERN WHITE PINE / DAVIDSON'S PENSTEMON FOREST [PROVISIONAL]

Abies magnifica var. *shastensis - Pinus monticola / Penstemon davidsonii* Forest [Provisional]

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest
Group: 1.B.2.Nd.4.a - G749 Sierra-Cascade Red Fir - Mountain Hemlock Forest
Alliance: A3619 Sierra-Cascade Red Fir Forest

NPS Unique Identifier: NPSCRLA007

LOCAL INFORMATION

Environmental Description: This forest association was only observed on Wizard Island, where it is found on rocky or pumice substrates. It is likely present on similar substrates elsewhere in the park. Elevations are moderate. Topographic positions are low slope and midslope. It is usually found on steep slopes. Soils are mostly loamy sands to rock. They are well-drained to rapidly well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1936	25.3	192.5	31.8
Range	1895-1991	7-35	150-240	10-61

Vegetation Description: This is a sparse to moderately dense forest association where western white pine (*Pinus monticola*) is the dominant overstory tree or it is codominant with Shasta red fir (*Abies magnifica* var. *shastensis*) and occasionally mountain hemlock (*Tsuga mertensiana*). Davidson's penstemon (*Penstemon davidsonii* var. *davidsonii*) is always present. The low-growing shrub, pinemat manzanita (*Arctostaphylos nevadensis*), is often present and abundant.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Abies magnifica* var. *shastensis*	5-50	20.5	100
	Needle-leaved evergreen tree	*Pinus monticola*	2-25	8.9	100
	Needle-leaved evergreen tree	*Tsuga mertensiana*	0-10	3.4	50
Shrub	Broad-leaved evergreen shrub	*Arctostaphylos nevadensis*	0-25	7.1	75
Herb	Subshrub	*Penstemon davidsonii* var. *davidsonii*	0.01-2	0.9	100

Species Richness:
Plot Vascular Plant Species Richness Average: 9.8
Plot Vascular Plant Species Richness Range: 4-13

Diagnostic Species: None
Constant Species: *Pinus monticola*, *Abies magnifica* var. *shastensis*, *Penstemon davidsonii* var. *davidsonii*
Other Noteworthy Species: None
Local Range: This forest association was observed on Wizard Island, where it is found on rocky or pumice substrates. It may be found on rocky or pumice substrates elsewhere in the park, particularly inside the Crater Lake caldera rim and on cliffs where relevé sampling was restricted.

Classification Comments: We classified our association 58. Shasta Red Fir – Western White Pine / Davidson's Penstemon Forest [Provisional] under the USNVC's Sierra-Cascade Red Fir Forest Alliance (A3619) in the Sierra-Cascade Red Fir - Mountain Hemlock Forest Group (G749). Our provisional association is also very similar to the *Abies magnifica - Pinus monticola* / *Arctostaphylos nevadensis* Forest (CEGL008615) association. In our classification, we distinguished our provisional association 58. from a very similar park association that was equivalent to the *Abies magnifica - Pinus monticola* / *Arctostaphylos nevadensis* Forest association (CEGL008615) due to the presence of Davidson's penstemon (*Penstemon davidsonii* var. *davidsonii*) and absence of Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) in our provisional association 58. Therefore, our association was not considered equivalent to the *Abies magnifica - Pinus monticola* / *Arctostaphylos nevadensis* Forest association.

It is also possible that very sparsely vegetated stands of our provisional association could be described as a separate provisional association and classified in the Southern Vancouverian Cliff, Scree & Rock Vegetation Group (G573). Further inquiry should reveal the best USNVC placement for our park provisional association.

Other Comments: None
Local Description Author: D. A. DiPaolo

Number of Plots: 4. Relevés 290; 292; 452; 456
Crater Lake National Park Notes: None



Above: Shasta Red Fir – Western White Pine / Davidson's Penstemon Forest [Provisional] at Crater Lake National Park.

59. SHASTA RED FIR - MOUNTAIN HEMLOCK / PINEMAT MANZANITA FOREST

Abies magnifica var. *shastensis - Tsuga mertensiana / Arctostaphylos nevadensis* Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest
Group: 1.B.2.Nd.4.a - G749 Sierra-Cascade Red Fir - Mountain Hemlock Forest
Alliance: A3619 Sierra-Cascade Red Fir Forest
Association: *Abies magnifica* var. *shastensis - Tsuga mertensiana* / *Arctostaphylos nevadensis* Forest

USNVC Identifier: CEGL000035

LOCAL INFORMATION

Environmental Description: This forest association is common on lower, middle and some upper slopes across the entire park. Elevations range from low to moderately high. It occupies a wide a variety of topographic positions. Slopes are low to moderate. Soils are sandy loam, loamy sand, and loam. Soils are well-drained and moderately well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1750	6.6	312.5	84.4
Range	1540-2102	2-28	15-340	70-91

Vegetation Description: This is a dense, tall and multilayered forest association of the upper montane and subalpine zones of the park. Shasta red fir (*Abies magnifica* var. *shastensis*) is codominant with mountain hemlock (*Tsuga mertensiana*) in the overstory, although Shasta red fir is sometimes dominant in the overstory and mountain hemlock subdominant. Western white pine (*Pinus monticola*), and to a lesser extent, Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) are often present in the overstory, sometimes with moderate cover. The low shrubs grouse whortleberry (*Vaccinium scoparium*) and/or pinemat manzanita (*Arctostaphylos nevadensis*) are common in the understory. The herbs pipsissewa (*Chimaphila umbellata*) and long-stolon sedge (*Carex inops* ssp. *inops*) are nearly always present in the understory but low in cover.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Abies magnifica* var. *shastensis*	2-75	25.4	100
	Needle-leaved evergreen tree	*Tsuga mertensiana*	2-95	21.6	100
	Needle-leaved evergreen tree	*Pinus monticola*	0-25	3.7	96
	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0-25	1.8	54
Shrub	Broad-leaved deciduous shrub	*Vaccinium scoparium*	0-25	1.2	54
	Broad-leaved evergreen shrub	*Arctostaphylos nevadensis*	0-25	2.3	50
Herb	Subshrub	*Chimaphila umbellata*	0-5	0.6	85

Species Richness:
Plot Vascular Plant Species Richness Average: 12.2
Plot Vascular Plant Species Richness Range: 6-24

Diagnostic Species: None
Constant Species: *Tsuga mertensiana, Abies magnifica* var. *shastensis*
Other Noteworthy Species: *Arctostaphylos nevadensis, Chimaphila umbellata, Vaccinium scoparium*
Local Range: This forest association is common on lower, middle and some upper slopes across much of the park. It is found from low to moderately high elevations wherever Shasta red fir dominated forests are common. It is likely the most common Shasta red fir dominated forest association found in the park.

Classification Comments: Our association 59. Shasta Red Fir - Mountain Hemlock / Pinemat Manzanita Forest is equivalent to the USNVC's *Abies* x *shastensis* - *Tsuga mertensiana* / *Arctostaphylos nevadensis* Forest (CEGL000035). However, CEGL000035 lacks a description necessary to make a confident determination. In addition, pinemat manzanita (*Arctostaphylos nevadensis*), while abundant and common in our association 59. is not constant. In our association, pipsissewa (*Chimaphila umbellata*) is nearly constant and grouse whortleberry (*Vaccinium scoparium*) is common but not constant. It is possible that our association 59. encompasses two separate associations, an *Abies* x *shastensis* - *Tsuga mertensiana* / *Arctostaphylos nevadensis* Forest association (CEGL000035) and a park provisional *Abies magnifica* var. *shastensis* - *Tsuga mertensiana* / *Chimaphila umbellata* Forest. Further inquiry should determine whether an additional *Abies magnifica* var. *shastensis* - *Tsuga mertensiana* / *Chimaphila umbellata* Forest should be split from our association 59.

Other Comments: None

Local Description Author: D. A. DiPaolo
Plots: 26. Relevés 81; 82; 106; 107; 109; 110; 111; 112; 203; 213; 215; 216; 246; 248; 263; 273; 362; 365; 369; 370; 371; 372; 389**;** 423; 426; 466
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: N/A.

Global Vegetation Description: N/A.

DISTRIBUTION

Range: N/A.
States/Provinces: CA, OR.

Global Description References: *Abies* x *shastensis* - *Tsuga mertensiana* / *Arctostaphylos nevadensis* Forest. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Shasta Red Fir - Mountain Hemlock / Pinemat Manzanita Forest at Crater Lake National Park.

60. SHASTA RED FIR / THINLEAF HUCKLEBERRY / PIPSISSEWA FOREST

Abies magnifica var. *shastensis / Vaccinium membranaceum / Chimaphila umbellata* Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest
Group: 1.B.2.Nd.4.a - G749 Sierra-Cascade Red Fir - Mountain Hemlock Forest
Alliance: A3619 Sierra-Cascade Red Fir Forest
Association: *Abies magnifica* var. *shastensis* / *Vaccinium membranaceum* / *Chimaphila umbellata* Forest

USNVC Identifier: CEGL000037

LOCAL INFORMATION

Environmental Description: This forest association is found along the central-west margin of the park. It generally occurs at low park elevations but can also occur at moderate elevations. Topographic positions include low level, lowslope, midslope, high slope, and summit. Slopes are low to moderate and occasionally steep. Soils are sandy loam, loamy sand and loam and are moderately well-drained to well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1555.4	8.0	304.7	86.2
Range	1444-1803	1-25	150-22	74-93

Vegetation Description: This is a tall, dense multilayered forest association dominated by Shasta red fir (*Abies magnifica* var. *shastensis*) and Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*) in the overstory. Sierra white fir (*Abies lowiana*) is often codominant with Shasta red fir and Douglas-fir in the overstory but can be subordinate or absent. Mountain hemlock (*Tsuga mertensiana*) and western white pine (*Pinus monticola*) are often present in the overstory as well and can be codominant with the other conifer species present. A sometimes lush and species diverse understory cover may be present and can include Cascade barberry (*Mahonia nervosa*), grouse whortleberry (*Vaccinium scoparium*), roughfruit berry (*Rubus lasiococcus*), sweet after death (*Achlys triphylla*), and Columbian windflower (*Anemone deltoidea*). Pipsessewa (*Chimaphila umbellata*) is always present in the understory.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pseudotsuga menziesii* var. *menziesii*	5-75	21.1	100
	Needle-leaved evergreen tree	*Abies magnifica* var. *shastensis*	5-50	18.5	100
	Needle-leaved evergreen tree	*Abies lowiana*	0-50	15.6	94
	Needle-leaved evergreen tree	*Tsuga mertensiana*	0-50	15.0	94
	Needle-leaved evergreen tree	*Pinus monticola*	0.01-10	3.1	100
	Needle-leaved evergreen tree	*Picea engelmannii*	0-25	2.2	33
	Needle-leaved evergreen tree	*Tsuga heterophylla*	0-5	0.6	28
Shrub	Broad-leaved evergreen shrub	*Mahonia nervosa*	0-5	0.8	56
Herb	Subshrub	*Chimaphila umbellata*	0.01-5	2.1	100
	Perennial herb	*Achlys triphylla*	0-25	1.3	39

Species Richness:
Plot Vascular Plant Species Richness Average: 23.8
Plot Vascular Plant Species Richness Range: 11-44

Diagnostic Species: None
Constant Species: *Pseudotsuga menziesii* var. *menziesii*, *Abies magnifica* var. *shastensis*, *Chimaphila umbellata*, *Orthilia secunda*, *Pinus monticola*
Other Noteworthy Species: *Abies lowiana*, *Listera caurina*
Local Range: This forest association is found along the central-west margin of the park at low to moderate elevations.

Classification Comments: Our association 60. is very similar to the USNVC's *Abies* x *shastensis* / *Vaccinium membranaceum* / *Chimaphila umbellata* Forest association (CEGL000037) described in the USNVC under the Sierra-Cascade Red Fir Forest Alliance (A3619). However, thinleaf huckleberry (*Vaccinium membranaceum*) is not constant in our association 60. while Sierra white fir (*Abies lowiana*) is not listed as present in USNVC association CEGL000037, but is codominant in our association 60. Our association is also similar to the *Abies magnifica* / *Ribes viscosissimum* Forest (CEGL000347) under the Sierra-Cascade Red Fir Forest Alliance (A3619) as well as the *Abies concolor* - *Abies* x *shastensis* / *Ribes* spp. Forest (CEGL000031) under the White Fir - California Red Fir - Shasta Red Fir Forest Alliance (A3678), although there are notable differences. Further inquiry should reveal the proper equivalent USNVC association to our association 60. as well as its proper placement in the USNVC.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 18. Relevés 105; 123; 126; 127; 132; 133; 134; 135; 187; 188; 202; 206; 207; 208; 212; 236; 237; 393
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This association occurs in Oregon and California. The forests have a multi-storied tree canopy with high cover of shrubs. It averages 1630 m (5342 feet) elevation with slopes ranging 5-30% on predominantly northwestern aspects. Soil tends to be ash or basalt with the former being less productive.

Global Vegetation Description: *Abies* x *shastensis* dominates the tree canopy with an average 29-39% cover. Usually present are *Pinus contorta, Tsuga mertensiana, Pseudotsuga menziesii,* and *Pinus monticola*. The shrub layer averages 53% cover and is characterized by *Vaccinium membranaceum* and *Chimaphila umbellata*. Herb cover is generally low (8%) with *Orthilia secunda* (= *Pyrola secunda*) and *Anemone deltoidea* often present. Grasses are usually absent. This association resembles *~Abies concolor / Vaccinium membranaceum* Forest (CEGL000264), but is taller and has significant *Abies* x *shastensis* cover. It also resembles *~Abies concolor - Abies* x *shastensis / Chimaphila umbellata* Forest (CEGL000030), but has a better developed understory. *~Abies* x *shastensis / Carex inops* ssp. *inops* Forest (CEGL000348) is also similar except for the presence of *Carex inops* ssp. *heliophila*.

DISTRIBUTION

Range: This association is native to the Klamath-Siskiyou and Southern Cascades region in Oregon and California. It could also be present in the northern Sierra Nevada and in the Modoc Plateau.
States/Provinces: CA, OR.

Global Description Reference: M. P. Murray. 1997. *Abies* x *shastensis* / *Vaccinium membranaceum* / *Chimaphila umbellata* Forest [26Nov1997]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Shasta Red Fir / Thinleaf Huckleberry / Pipissewa Forest at Crater Lake National Park.

61. SHASTA RED FIR / LONG-STOLON SEDGE FOREST

Abies magnifica var. *shastensis / Carex inops* ssp. *inops* Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest
Group: 1.B.2.Nd.4.a - G749 Sierra-Cascade Red Fir - Mountain Hemlock Forest
Alliance: A3619 Sierra-Cascade Red Fir Forest
Association: *Abies magnifica* var. *shastensis* / *Carex inops* ssp. *inops* Forest

USNVC Identifier: CEGL000348

LOCAL INFORMATION

Environmental Description: This forest association is found throughout the park wherever Shasta red fir dominated forests are common. Elevations are generally moderate. Topographic positions are lowslope, midslope, and high level. Slopes are gentle to steep. Soils are sandy loams, loamy sands, and loam. Soils are mostly well-drained, and occasionally moderately well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1893.7	15.0	160.9	80.2
Range	1868-1948	2-33	90-230	50-92

Vegetation Description: This is a dense, uneven-aged forest association comprised of Shasta red fir (*Abies magnifica* var. *shastensis*), which is the sole dominant tree. Some specimens are quite old and large in some stands. The understory is often sparse; however, long-stolon sedge (*Carex inops* ssp. *inops*) is always present.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Abies magnifica* var. *shastensis*	10-95	65.8	100
	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0-2	0.6	67
	Needle-leaved evergreen tree	*Pinus monticola*	0-2	0.6	67
Shrub	Broad –leaved evergreen shrub	*Arctostaphylos nevadensis*	0-10	1.3	33
Herb	Graminoid	*Carex inops* ssp. *inops*	0.01-5	1.6	100

Species Richness:
Plot Vascular Plant Species Richness Average: 10.7
Plot Vascular Plant Species Richness Range: 6-17

Diagnostic Species: None
Constant Species: *Abies magnifica* var. *shastensis*, *Carex inops* ssp. *inops*
Other Noteworthy Species: None
Local Range: This forest association is found throughout the park wherever Shasta red fir dominated forests are common.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 6. Relevés 74; 75; 93; 101; 276; 374
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This is a productive, mostly closed-canopy subalpine or montane forest. It is documented in the Southern Cascades of Oregon and exists on all aspects and slopes 5-30% at elevations of 1740-2040 m (5700-6700 feet). Parent materials are andesite and basalt under loamy soils with many rocks.

Global Vegetation Description: The tree canopy is dominated by *Abies* x *shastensis* with 10-70% cover. There may be trace amounts of *Pinus monticola* and *Tsuga mertensiana*. A sparse understory is typified by *Carex inops* ssp. *inops* (0-10%) and *Chimaphila umbellata* (1-10%) except in open stands where a shrub-form of *Chrysolepis chrysophylla* (= *Castanopsis chrysophylla*) may dominate, especially at disturbed sites. This association is similar to ~*Abies* x *shastensis / Vaccinium membranaceum / Chimaphila umbellate* Forest (CEGL000037) except for the absence of *Vaccinium* spp.

DISTRIBUTION

Range: In Oregon, this type is restricted to extreme southern Cascades. It could possibly occur in the southeastern portion of Oregon's Klamath-Siskiyou region or the northern Modoc Plateau in California.

States/Provinces: CA?, OR.

Global Description Reference: M.P. Murray. 1997. *Abies* x *shastensis* / *Carex inops* ssp. *inops* Forest [26Nov1997]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Shasta Red Fir / Long-stolon Sedge Forest at Crater Lake National Park.

62. SHASTA RED FIR – DOUGLAS-FIR / PINEMAT MANZANITA FOREST

Abies magnifica var. *shastensis - Pseudotsuga menziesii / Arctostaphylos nevadensis* Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest
Group: 1.B.2.Nd.4.a - G749 Sierra-Cascade Red Fir - Mountain Hemlock Forest
Alliance: A3619 Sierra-Cascade Red Fir Forest
Association: *Abies magnifica* var. *shastensis - Pseudotsuga menziesii* / *Arctostaphylos nevadensis* Forest

USNVC Identifier: CEPP007203

LOCAL INFORMATION

Environmental Description: This forest association occurs along the western margin of the park at relatively low elevations. Topographic positions are low level and lowslope. Slopes are low to moderate. Soils are mostly sandy loams, but may also be loamy sands, or gravelly. Soils are mostly well-drained, and occasionally moderately well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1516.4	4.6	261.0	79.8
Range	1489-1565	2-9	156-358	67-89

Vegetation Description: This is a moderately dense to dense, multilayered forest association dominated by Shasta red fir (*Abies magnifica* var. *shastensis*) and Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*) in the overstory. Western white pine (*Pinus monticola*), and Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) are often present in the overstory and are sometimes codominant with Douglas-fir and Shasta red fir. Pinemat manzanita (*Arctostaphylos nevadensis*) and grouse whortleberry (*Vaccinium scoparium*) are common in the understory. Pipsissewa (*Chimaphila umbellata*) is also present in the understory with low cover.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Abies magnifica* var. *shastensis*	10-75	23.1	100
	Needle-leaved evergreen tree	*Pseudotsuga menziesii* var. *menziesii*	2-50	14.0	100
	Needle-leaved evergreen tree	*Tsuga mertensiana*	0.01-25	6.6	100
	Needle-leaved evergreen tree	*Pinus monticola*	0.01-25	6.1	100
	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	1-25	5.1	100
	Needle-leaved evergreen tree	*Abies lowiana*	0-10	2.4	50
Shrub	Broad-leaved evergreen shrub	*Arctostaphylos nevadensis*	0.1-50	7.6	100
	Broad-leaved deciduous shrub	*Vaccinium scoparium*	0.01-10	2.4	100
Herb	Subshrub	*Chimaphila umbellata*	0.01-2	0.8	100

Species Richness:
Plot Vascular Plant Species Richness Average: 13.5
Plot Vascular Plant Species Richness Range: 9-20

Diagnostic Species: None
Constant Species: *Abies magnifica* var. *shastensis*, *Pseudotsuga menziesii* var. *menziesii*, *Arctostaphylos nevadensis*, *Chimaphila umbellata*, *Pinus contorta* var. *murrayana*, *Pinus monticola*, *Tsuga mertensiana*, *Vaccinium scoparium*
Other Noteworthy Species: None
Local Range: This forest association occurs along the western margin of the park at relatively low elevations.

Classification Comments: This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 8. Relevés 26; 32; 136; 189; 219; 358; 359; 360
Crater Lake National Park Notes: None



Above: Shasta Red Fir – Douglas-fir / Pinemat Manzanita Forest at Crater Lake National Park. The large tree in the center of the photo is a Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*).

63. CALIFORNIA RED FIR – WESTERN WHITE PINE / PINEMAT MANZANITA FOREST

Abies magnifica - Pinus monticola / Arctostaphylos nevadensis Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest
Group: 1.B.2.Nd.4.a - G749 Sierra-Cascade Red Fir - Mountain Hemlock Forest
Alliance: A3619 Sierra-Cascade Red Fir Forest
Association: *Abies magnifica - Pinus monticola* / *Arctostaphylos nevadensis* Forest

USNVC Identifier: CEGL008615

LOCAL INFORMATION

Environmental Description: This forest association is found throughout the park wherever Shasta red fir dominated forests are common; however, it is most common on the east side of the park. Elevations are relatively low to moderate. Topographic positions include low level, lowslope, midslope, and high slope. Slopes are generally low, but are occasionally moderate to steep. Soils are loamy sands, sandy loams, and sand and are exclusively well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1745.2	5.9	59.6	84.3
Range	1596-1772	2-20	357-210	77-92

Vegetation Description: This is a moderately open to moderately dense, relatively dry forest association dominated in the overstory by Shasta red fir (*Abies magnifica* var. *shastensis*) and, to a lesser extent, western white pine (*Pinus monticola*). Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) is also often present in the overstory and may be codominant, however it may also be absent. Occasionally Sierra white fir (*Abies lowiana*) and ponderosa pine (*Pinus ponderosa*) are present in the overstory. The low-growing shrub pinemat manzanita (*Arctostaphylos nevadensis*) is often present in the understory, sometimes in abundance. Pipsessewa (*Chimaphila umbellata*) and long-stolon sedge (*Carex inops* ssp. *inops*) are often present in the understory as well.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Abies magnifica* var. *shastensis*	5-50	24.4	100
	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0-50	9.7	91
	Needle-leaved evergreen tree	*Pinus monticola*	0.1-25	7.3	100
	Needle-leaved evergreen tree	*Abies lowiana*	0-25	3.2	45
Shrub	Broad-leaved evergreen shrub	*Arctostaphylos nevadensis*	0-25	5.5	73

Species Richness:
Plot Vascular Plant Species Richness Average: 11.6
Plot Vascular Plant Species Richness Range: 6-14

Diagnostic Species: *Allotropa virgata*
Constant Species: *Abies magnifica* var. *shastensis*, *Pinus monticola*
Other Noteworthy Species: *Arctostaphylos nevadensis*
Local Range: This forest association is found throughout the park wherever Shasta red fir dominated forests are common, however, it is most common on the east side of the park. It also occurs on Wizard Island and potentially occurs on the caldera walls inside the Crater Lake caldera rim. Some notable stands with large specimens of western white pine occur in the Pinnacle Valley north of Sand Creek.

Classification Comments: Our association 63. California Red Fir – Western White Pine / Pinemat Manzanita Forest is nearly equivalent to the USNVC's *Abies magnifica - Pinus monticola* / *Arctostaphylos nevadensis* Forest (CEGL008615) association classified in the Sierra-Cascade Red Fir Forest Alliance (A3619). Our association very closely resembles CEGL008615 in species composition and structure as well as in its environmental description, however, Shasta red fir (*Abies magnifica* var. *shastensis*) is the taxon present in the park, as opposed to California red fir (*Abies magnifica*). Therefore *Abies magnifica* var. *shastensis* and *Abies magnifica* are considered equivalent here for the purpose of classifying our association 63.

Our association 63. could also be equivalent to the USNVC's *Abies magnifica - Pinus monticola* Forest (CEGL008613) classified under the Sierra-Cascade Red Fir Forest Alliance (A3619), however the USNVC's CEGL008613 appears to describe vegetation of the central and southern Sierra Nevada, California where there is not a high cover of pinemat manzanita (*Arctostaphylos nevadensis*).

Stands of our association 63. that lack pinemat manzanita and occur on excessively drained pumice/sand soils may possibly be described as a separate association equivalent to the USNVC's

Abies magnifica - Pinus monticola - Pinus contorta var. *murrayana* Forest (CEGL008616) under the Sierra-Cascade Red Fir Forest Alliance (A3619).

Stands of our association 63. with low *Abies magnifica* var. *shastensis* cover could possibly be described as a separate association equivalent to the USNVC's *Pinus monticola - Pinus contorta* var. *murrayana* / Sparse Understory Woodland (CEGL003157), classified under the Sierra Western Juniper - Whitebark Pine Woodland Alliance (A3622) or the *Pinus monticola* / *Achnatherum occidentale* Woodland (CEGL008622) association classified under the Sierra-Cascade Mountain Hemlock - Lodgepole Pine Forest Alliance (A3620).

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 11. Relevés 59, 62, 63, 64, 80, 83; 84, 85; 151; 224; 424
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This forest association is located on both the east and west sides of the central and southern Sierra Nevada, California, at elevations above 2440 m (8000 feet). Aspects are varied but predominantly southeastern and southwestern. Sites are mostly on ridges and moderate or somewhat steep upper and middle slopes on sites with broken and varied microrelief. Soils are predominantly derived from granite and may form on bedrock or alluvium or glacial till. Soils are typically shallow, well-drained or excessively drained sands or sandy loams. The available water-holding capacity in these stands is significantly lower than on other sites, although rootable fractures in the bedrock supply additional sources of moisture. Bare ground and surface rock are both significantly higher than most other sites, while litter depths are significantly less.

Global Vegetation Description: Stands are open with an understory of *Arctostaphylos nevadensis*. Total vegetation cover is higher than other plant associations due to the high cover of this shrub; however, tree cover is lower than most types. Overstory composition is characterized by *Pinus monticola* mixed with *Abies magnifica*, for a tree cover averaging 43%. Shrub cover averages 31%, *Arctostaphylos nevadensis* is the dominant shrub species, with *Chrysolepis sempervirens* as an occasional component of the shrub layer. The sparse herb layer averages 5% cover and includes *Arabis platysperma*, *Pedicularis semibarbata*, and *Achnatherum occidentale*.

DISTRIBUTION

Range: These forests are located on both the east and west sides of the central and southern Sierra Nevada, California.
States/Provinces: CA.

Global Description Reference: T. Keeler-Wolf. 2002. *Abies magnifica - Pinus monticola* / *Arctostaphylos nevadensis* Forest [03May2002]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: California Red Fir – Western White Pine / Pinemat Manzanita Forest at Crater Lake National Park.

64. MOUNTAIN HEMLOCK / SPARSE UNDERSTORY FOREST

Tsuga mertensiana / Sparse Understory Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest
Group: 1.B.2.Nd.4.a - G749 Sierra-Cascade Red Fir - Mountain Hemlock Forest
Alliance: A3620 Sierra-Cascade Mountain Hemlock - Lodgepole Pine Forest
Association: *Tsuga mertensiana* / Sparse Understory Forest

USNVC Identifier: CEGL008685

LOCAL INFORMATION

Environmental Description: This forest association is found throughout the park at predominantly middle to high elevations, but occasionally occurs at low elevations near the western park boundary. It may occur in all topographic positions. Slopes are typically quite low, but occasionally are fairly high. Soils are mostly loam, sandy loam, loamy sand, and occasionally silt loam. Soils range from moderately well-drained to well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1899.1	5.4	335.0	83.0
Range	1694-2194	1-32	270-170	32-93

Vegetation Description: This is a dense forest association comprised predominantly of mountain hemlock (*Tsuga mertensiana*). Shasta red fir (*Abies magnifica* var. *shastensis*) may be present and codominant, but can be absent. Lodgepole pine (*Pinus contorta* var. *murrayana*) may also occur. The herb layer is typically very sparse with species common across drier upland forests, such as the ubiquitous long-stolon sedge (*Carex inops* ssp. *inops*). Grouse whortleberry (*Vaccinium scoparium*) is sometimes present and may be abundant.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Tsuga mertensiana*	5-75	45.4	100
	Needle-leaved evergreen tree	*Abies magnifica* var. *shastensis*	0-50	8.3	81
	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0-25	3.1	71
	Needle-leaved evergreen tree	*Abies lasiocarpa* var. *lasiocarpa*	0-5	0.7	33
Shrub	Broad-leaved deciduous shrub	*Vaccinium scoparium*	0-50	2.8	38
Herb	Graminoid	*Carex inops* ssp. *inops*	0-5	0.4	81

Species Richness:
Plot Vascular Plant Species Richness Average: 8.6
Plot Vascular Plant Species Richness Range: 4-19

Diagnostic Species: None
Constant Species: *Tsuga mertensiana*
Other Noteworthy Species: None
Local Range: This forest association is found abundantly throughout the mountain hemlock dominated forests that encircle the Crater Lake caldera and extend north along the Cascade crest to the northern boundary, south to the southern boundary and the slope surrounding Union Peak, and east to the slopes surrounding Mount Scott. It may also be found at low elevations near the western park boundary. Hence, this association occurs across a wide range of elevations.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots 21**.** Relevés 94; 98; 99; 100; 113; 114; 115; 125; 205; 382; 402; 403; 404; 422; 425; 427; 428; 435; 438; 439; 462
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: Stands of this forest are found throughout the Sierra Nevada, however, predominantly north of the Kings River. This association is found at mid to high elevations (2255-2990 m [7400-9800 feet]) on gentle to somewhat steep (2-29%) slopes. Aspect varies but is often on northeast-facing slopes. Microrelief is usually broken and hummocky. Sites are found at lower to upper portions of slopes and rarely, are on ridgetops. Soils are typically from granitic parent material, however, some stands to the north are derived from volcanic or mixed lithology. These soils

are typically greater than 63.5 cm (25 inches) and occasionally greater than 89 cm (35 inches). Very little bare soil is usually exposed. Soil depths range from 35-100 cm (14-40 inches). Soil textures range from sand to loam and are excessively drained to well-drained.

Global Vegetation Description: Stands form a dense forest with an open understory. The tree layer is dominated by *Tsuga mertensiana* mixed with *Abies magnifica*. *Pinus contorta* var. *murrayana* and *Pinus monticola* are also important overstory tree species. The understory layers are typically open. Occasional shrub species may include *Ribes roezlii* (= *Grossularia roezlii*) and *Ribes montigenum*. Herb species may include *Eucephalus breweri* (= *Chrysopsis breweri*), *Hieracium albiflorum*, *Poa bolanderi*, and *Carex rossii*. Conifer regeneration is high at this association and is dominated by *Abies magnifica* with significantly lower amounts of *Tsuga mertensiana*.

DISTRIBUTION

Range: Stands of this forest are found throughout the Sierra Nevada, however, predominantly north of the Kings River (Potter 1994, 1998).
States/Provinces: CA, OR.

Global Description Reference: T. Keeler-Wolf, mod. M.J. Russo. 2010. *Tsuga mertensiana* / Sparse Understory Forest [06May2010]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Mountain Hemlock / Sparse Understory Forest at Crater Lake National Park.

65. MOUNTAIN HEMLOCK - SIERRA LODGEPOLE PINE - WHITEBARK PINE FOREST

Tsuga mertensiana – Pinus contorta var. *murrayana – Pinus albicaulis* Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest
Group: 1.B.2.Nd.4.a - G749 Sierra-Cascade Red Fir - Mountain Hemlock Forest
Alliance: A3620 Sierra-Cascade Mountain Hemlock - Lodgepole Pine Forest
Association: *Tsuga mertensiana - Pinus contorta* var. *murrayana - Pinus albicaulis* Forest

USNVC Identifier: CEGL008692

LOCAL INFORMATION

Environmental Description: This vegetation association occurs at moderate to high elevations on the slopes surrounding the outside of the Crater Lake caldera, particularly on the drier eastern and northern portions of the caldera rim and around Mount Scott. It also occurs on and near summits elsewhere in the park. The topographic positions are summit, high slope, midslope, lowslope, and high level. Slopes are gentle to moderate, but can occasionally be steep. Soils are loamy sand, sandy loam and sand and are well-drained to rapidly drained. This association occurs on soils that are exceedingly well-drained and have low organic content or on areas of rock and scree, and therefore support only sparse tree cover.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	2236.3	8.1	94.6	61.2
Range	1897-2434	1-26	265-201	20-90

Vegetation Description: This open woodland or forest association is dominated by whitebark pine (*Pinus albicaulis*) with mountain hemlock (*Tsuga mertensiana*) and/or Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) common in the overstory or it is codominated by whitebark pine, mountain hemlock, and Sierra lodgepole pine. Whitebark pine is always present with at least 5% cover and may be less abundant than either mountain hemlock or Sierra lodgepole pine. Either mountain hemlock or Sierra lodgepole pine may be absent or present with low cover, however at least one of these species is present with whitebark pine in the overstory. Trees occur in clumps or are sparse and evenly distributed. The understory is fairly sparse. The graminoids western needlegrass (*Achnatherum occidentale*), squirreltail (*Elymus elymoides* ssp. *elymoides*), Hitchcock's smooth woodrush (*Luzula glabrata* var. *hitchcockii*) and Ross' sedge (*Carex rossii*) are common.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Tsuga mertensiana*	0-75	12.7	93
	Needle-leaved evergreen tree	*Pinus albicaulis*	2-50	12.6	100
	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0-50	7.1	93
Herb	Graminoid	*Luzula glabrata* var. *hitchcockii*	0-50	3.6	80
	Graminoid	*Carex inops* ssp. *inops*	0-50	2.8	47
	Graminoid	*Elymus elymoides* ssp. *elymoides*	0-10	0.8	60

Species Richness:
Plot Vascular Plant Species Richness Average: 16.3
Plot Vascular Plant Species Richness Range: 9-27

Diagnostic Species: *Pinus albicaulis*
Constant Species: *Pinus albicaulis*
Other Noteworthy Species: *Tsuga mertensiana*, *Pinus contorta* var. *murrayana*
Local Range: This vegetation association occurs at moderate to high elevations on the slopes surrounding the outside of the Crater Lake caldera, particularly on the drier eastern and northern portions of the caldera rim and around Mount Scott, as well as on and near summits elsewhere in the park, including Timber Crater, Union Peak, Desert Ridge, and Red Cone.

Classification Comments: Our association 65. Mountain Hemlock - Sierra Lodgepole Pine - Whitebark Pine Forest is equivalent to the USNVC's *Tsuga mertensiana - Pinus contorta* var. *murrayana - Pinus albicaulis* Forest (CEGL008692) classified under the Sierra-Cascade Mountain Hemlock - Lodgepole Pine Forest Alliance (A3620). It is possible that our association is instead equivalent to the USNVC's *Pinus contorta* var. *murrayana - Pinus albicaulis* / *Carex rossii* Forest (CEGL008670). However, CEGL008670 does not list *Tsuga mertensiana* as present and therefore it was not selected as equivalent to our association.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 15. Relevés 150; 154; 161; 164; 166; 167; 168; 260; 261; 262; 301; 443; 463; 465; 474
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This forest association is currently only known from Yosemite National Park in California, and the following description is based on occurrences there. Additional information will be added as it becomes available. Stands are found at high elevations (2710-3110 m [8900-10,200 feet]) on gentle to steep slopes (3-27°). Slopes are concave in shape. Aspect ranges from west to northeast; however, it is often northwest. These sites can be rocky. Soils are poorly developed to well-developed with textures that range from rocky gravel to rock, gravelly, sandy loam. Soils are well-drained with soil depths ranging from shallow to deep. Parent material is granite. Fire is uncommon and restricted in size. Disturbance levels are usually low.

Global Vegetation Description: Stands are characterized by *Tsuga mertensiana, Pinus contorta,* and *Pinus albicaulis* in the overstory. *Juncus parryi* and/or *Juncus* species are often present in this association. Other species that are occasionally found contributing to low cover include *Arctostaphylos nevadensis, Phyllodoce breweri, Selaginella watsonii, Sedum obtusatum, Carex rossii, Phlox diffusa, Penstemon newberryi, Cryptogramma acrostichoides, Antennaria rosea,* and *Elymus elymoides* ssp. *californicus*.

DISTRIBUTION

Range: This association is only known from Yosemite National Park. Information about its global characteristics is not available without additional inventory.
States/Provinces: CA.

Global Description References: T. Keeler-Wolf, mod. M.J. Russo. 2010. *Tsuga mertensiana - Pinus contorta* var. *murrayana - Pinus albicaulis* Forest [06May2010]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Mountain Hemlock - Sierra Lodgepole Pine - Whitebark Pine Forest at Crater Lake National Park.

66. (TALL LODGEPOLE PINE, SIERRA LODGEPOLE PINE) / PINEMAT MANZANITA FOREST

Pinus contorta (var. latifolia, var. *murrayana) / Arctostaphylos nevadensis* Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest
Group: 1.B.2.Nd.4.b - G243 Sierra-Cascade Cold-Dry Subalpine Woodland
Alliance: A3621 Subalpine Sierra Lodgepole Pine Forest & Woodland
Association: *Pinus contorta* (var. *latifolia*, var. *murrayana*) / *Arctostaphylos nevadensis* Forest

USNVC Identifier: CEGL000133

LOCAL INFORMATION

Environmental Description: This vegetation association occurs throughout the park at low to moderate park elevations. Topographic positions are mostly low level but can also be low slope and midslope. Soils are loamy sand or sandy loam that are well-drained and occasionally moderately well-drained. This association is often, but not exclusively, found in disturbed forests (stand-replacing fire or beetle kill) formerly supporting mixed-conifer and upper montane forest.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1681.6	2.9	331.9	81.0
Range	1478-1868	1-7	172-73	74-94

Vegetation Description: This forest vegetation association is dominated by Sierra lodgepole pine (*Pinus contorta* var. *murrayana*). Other conifers such as Shasta red fir (*Abies magnifica* var. *shastensis*) and western white pine (*Pinus monticola*) may be present as well but are usually low in cover and clearly subordinate in the overstory. The understory has a dense and often patchy cover of pinemat manzanita (*Arctostaphylos nevadensis*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	5-50	20.6	100
	Needle-leaved evergreen tree	*Tsuga mertensiana*	0-25	2.5	50
	Needle-leaved evergreen tree	*Abies magnifica* var. *shastensis*	0.1-10	4.1	100
	Needle-leaved evergreen tree	*Pinus monticola*	0-10	3.0	88
Shrub	Broad-leaved evergreen shrub	*Arctostaphylos nevadensis*	0.1-25	6.0	100
	Broad-leaved deciduous shrub	*Vaccinium scoparium*	0-5	2.0	50
Herb	Graminoid	*Carex inops* ssp. *inops*	0-10	1.1	50

Species Richness:
Plot Vascular Plant Species Richness Average: 11.4
Plot Vascular Plant Species Richness Range: 8-17

Diagnostic Species: None
Constant Species: *Pinus contorta* var. *murrayana*, *Arctostaphylos nevadensis*, *Abies magnifica* var. *shastensis*
Other Noteworthy Species: *Pinus monticola*
Local Range: This vegetation association occurs throughout the park at low to moderate elevations wherever Sierra lodgepole pine is the dominant overstory tree.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 8. Relevés 73; 87; 104; 116; 181; 361; 386; 392
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: N/A.

Global Vegetation Description: N/A.

DISTRIBUTION

Range: N/A.
States/Provinces: CA?, OR.

Global Description Reference: Western Ecology Group. *Pinus contorta* / *Arctostaphylos nevadensis* Forest. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: (Tall Lodgepole Pine, Sierra Lodgepole Pine) / Pinemat Manzanita Forest at Crater Lake National Park.

67. SIERRA LODGEPOLE PINE / LONG-STOLON SEDGE FOREST

Pinus contorta var. *murrayana* / *Carex inops* spp. *inops* Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest
Group: 1.B.2.Nd.4.b - G243 Sierra-Cascade Cold-Dry Subalpine Woodland
Alliance: A3621 Subalpine Sierra Lodgepole Pine Forest & Woodland
Association: *Pinus contorta* var. *murrayana* / *Carex inops* spp. *inops* Forest

USNVC Identifier: CEGL000143

LOCAL INFORMATION

Environmental Description: This vegetation association occurs extensively throughout the park at all but the highest elevations. Slopes are generally level to low, but are occasionally moderate. Topographic positions are low level, high level, lowslope and midslope. Soils are loamy sand, sandy loam and occasionally sand and are well-drained to rapidly drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1812.3	2.6	209.2	78.4
Range	1709-2176	1-11	82-350	55-89

Vegetation Description: This is a moderately dense forest association dominated by Sierra lodgepole pine (*Pinus contorta* var. *murrayana*). Mountain hemlock (*Tsuga mertensiana*) and Shasta red fir (*Abies magnifica* var. *shastensis*) may be present but with low cover and/or are clearly subordinate in the overstory. Anderson's lupine (*Lupinus andersonii*), western needlegrass (*Achnatherum occidentale*) and long-stolon sedge (*Carex inops* ssp. *inops*) are common in the herbaceous layer and combined can average about 10 percent cover in the understory.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	10-75	36.2	100
	Needle-leaved evergreen tree	*Tsuga mertensiana*	0-25	4.1	56
	Needle-leaved evergreen tree	*Abies magnifica* var. *shastensis*	0-50	2.3	63
Herb	Perennial herb	*Lupinus andersonii*	0.01-25	3.8	100
	Graminoid	*Carex inops* ssp. *inops*	0.01-50	7.6	100
	Graminoid	*Elymus elymoides* ssp. *elymoides*	0-5	0.8	75
	Graminoid	*Achnatherum occidentale*	0.01-2	1.2	100

Species Richness:
Plot Vascular Plant Species Richness Average: 10.9
Plot Vascular Plant Species Richness Range: 8-16

Diagnostic Species: None
Constant Species: *Pinus contorta* var. *murrayana*, *Lupinus andersonii*, *Carex inops* ssp. *inops*, *Achnatherum occidentale*
Other Noteworthy Species: None
Local Range: This vegetation association occurs extensively throughout the park wherever Sierra lodgepole pine is the dominant overstory tree, except for on rocky substrates.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 16. Relevés 71; 72; 77; 78; 86; 128; 129; 130; 131; 244; 245; 251; 418; 419; 421; 444
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION
Global Environmental Description: N/A.

Global Vegetation Description: N/A.

DISTRIBUTION
Range: N/A.
States/Provinces: CA?, OR.

Global Description Reference: Western Ecology Group. *Pinus contorta / Carex pensylvanica* Forest. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Sierra Lodgepole Pine / Long-Stolon Sedge Forest at Crater Lake National Park.

68. LODGEPOLE PINE / ANTELOPE BITTERBRUSH / LONG-STOLON SEDGE FOREST

Pinus contorta / Purshia tridentata / Carex inops ssp. *inops* Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest
Group: 1.B.2.Nd.4.b - G243 Sierra-Cascade Cold-Dry Subalpine Woodland
Alliance: A3621 Subalpine Sierra Lodgepole Pine Forest & Woodland
Association: *Pinus contorta* / *Purshia tridentata* / *Carex inops* ssp. *inops* Forest

USNVC Identifier: CEGL000159

LOCAL INFORMATION

Environmental Description: This vegetation association occurs along the eastern park boundary at low to moderate elevations. Topographic positions are mostly low level but occasionally are lowslope. Slopes are mostly fairly level but can be moderate. Soils are well-drained and are loamy sand to sand.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1689.0	4.2	63.6	45.2
Range	1601-1790	2-14	4-108	4-85

Vegetation Description: This is a low statured forest association dominated by Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) and the low shrub antelope bitterbrush (*Purshia tridentata*). Wax currant (*Ribes cereum* var. *cereum*) is also present in the shrub layer. The graminoids Ross' sedge (*Carex rossii*), long-stolon sedge (*Carex inops* ssp. *inops*), and western needlegrass (*Achnatherum occidentale*) occur at modest cover in virtually all stands. Though not exclusively, this association is sometimes associated with areas where high severity fires have occurred in Sierra lodgepole pine forests. Therefore, an abundance of dead and downed snags as well as Sierra lodgepole pine saplings may be present.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	5-50	13.0	100
Shrub	Broad-leaved deciduous shrub	*Purshia tridentata*	0.1-25	5.5	100
	Broad-leaved deciduous shrub	*Ribes cereum* var. *cereum*	0-10	1.8	83
Herb	Graminoid	*Carex rossii*	0.01-25	3.8	100
	Graminoid	*Achnatherum occidentale* ssp. *pubescens*	0.01-5	1.8	100
	Graminoid	*Carex inops* ssp. *inops*	0.01-5	1.8	100

Species Richness:
Plot Vascular Plant Species Richness Average: 12
Plot Vascular Plant Species Richness Range: 8-17

Diagnostic Species: None
Constant Species: *Pinus contorta* var. *murrayana*, *Purshia tridentata*, *Carex inops* ssp. *inops*, *Achnatherum occidentale*, *Carex rossii*
Other Noteworthy Species: None
Local Range: This vegetation association is scattered along the eastern margin of the park at low to moderate elevations.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 6. Relevés 56; 177; 179; 182; 191; 388
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION
Global Environmental Description: N/A.

Global Vegetation Description: N/A.

DISTRIBUTION
Range: N/A.
States/Provinces: OR.

Global Description Reference: *Pinus contorta* / *Purshia tridentata* / *Carex pensylvanica* Forest. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Lodgepole Pine / Antelope Bitterbrush / Long-stolon Sedge Forest at Crater Lake National Park.

69. SIERRA LODGEPOLE PINE / SPARSE UNDERSTORY FOREST

Pinus contorta var. *murrayana* / Sparse Understory Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest
Group: 1.B.2.Nd.4.b - G243 Sierra-Cascade Cold-Dry Subalpine Woodland
Alliance: A3621 Subalpine Sierra Lodgepole Pine Forest & Woodland
Association: *Pinus contorta* var. *murrayana* / Sparse Understory Forest

USNVC Identifier: CEGL003069

LOCAL INFORMATION

Environmental Description: This vegetation association is common around the Pumice Desert towards the north end of the park, in Pumice Flat towards the southwest portion of the park, and elsewhere in the park where sandy pumice soils occur that are very well-drained and generally devoid of organic matter. These soil conditions are most ubiquitous where deep pumice and ash was deposited in valleys during the Mount Mazama eruption. This association occurs at moderate to high elevations in the park. Slopes are often low but occasionally can be steep. Topographic positions are mostly low level and occasionally are lowslope or high slope. Soils are sandy loam, or in some cases, sand. They are predominantly well-drained, but occasionally are rapidly drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1864.5	4.7	49.1	71.5
Range	1754-2001	1-31	250-160	5-91

Vegetation Description: This is a sparse to moderately dense forest association dominated by Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) on extremely well-drained pumice substrata. Mountain hemlock (*Tsuga mertensiana*) may be present as well but with low cover. Trees can be somewhat stunted due to droughty soils, heavy winter snow loads, and short growing season. The understory is very sparse and dominated by long-stolon sedge (*Carex inops* ssp. *inops*) and western needlegrass (*Achnatherum occidentale*) with low cover. Due to the low soil moisture holding capacity and high evaporative demand on many of the sites where this association occurs, sole dominance by Sierra lodgepole pine may be the climax condition of these forest stands.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	2-75	30.0	100
	Needle-leaved evergreen tree	*Tsuga mertensiana*	0-25	2.8	47
	Needle-leaved evergreen tree	*Abies magnifica* var. *shastensis*	0-2	0.3	47
Herb	Graminoid	*Carex inops* ssp. *inops*	0-5	0.4	73
	Graminoid	*Achnatherum occidentale*	0-1	0.2	80

Species Richness:
Plot Vascular Plant Species Richness Average: 8.4
Plot Vascular Plant Species Richness Range: 5-14

Diagnostic Species: None
Constant Species: *Pinus contorta* var. *murrayana*
Other Noteworthy Species: None
Local Range: This association occurs throughout the park but is most commonly found around the Pumice Desert towards the north end of the park, in the Pumice Flat in the southwest portion of the park, and elsewhere in valleys and low lying areas where deep pumice soils were deposited during the Mount Mazama eruption, such as Pinnacle Valley and towards Bald Crater.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 15. Relevés 67; 95; 96; 97; 102; 117; 259; 305; 387; 405; 406; 407; 409; 414, 467
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This forest association is widespread at higher elevations of the Sierra Nevada, California. It is found at the highest elevations of the upper montane, often sharing this position with ~*Abies magnifica - Pinus monticola - Pinus contorta* var. *murrayana* Forest (CEGL008616). Together, they straddle the Sierran crest at higher elevations. Stands can cover extensive areas, but most are less than 100 acres due to natural fragmentation of the landscape. Elevations are mostly above 2590 m (8500 feet) and aspects are variable. Slopes range from gentle to somewhat steep but are predominantly moderate or gentle. The association typically occurs on the lower portions of slopes or benches. Soils are derived from igneous rocks, primarily granite, but also pumice, rhyolite and andesite, and have sandy loam or gravelly loam textures. Soils are typically well-drained, but may be excessively drained. Sites are characterized by significantly higher levels of

surface gravel as compared to other associations in the upper montane of the Sierra Nevada. Litter cover is also generally high.

Global Vegetation Description: Stands of this association are moderately dense forests with open understories. Tree cover is moderate, averaging 59% cover. Tree overstories are dominated by *Pinus contorta* var. *murrayana* with very scattered *Abies magnifica*. *Pinus monticola* is a rare member of the stand. The shrub layer is essentially absent, averaging less than 1%, although *Ribes montigenum* occurs in widely scattered locations, indicating moist conditions. Cover of herbaceous dicots is among the lowest in the upper montane associations, averaging 3%; the species represent a mix of moderate to dry conditions (e.g., *Arabis platysperma* indicating drier sites and *Pyrola picta* and *Thalictrum fendleri* indicating moister sites). Herbaceous monocots average 10% cover, with *Carex rossii* indicating moister conditions and *Achnatherum occidentale* indicating drier conditions. Conifer regeneration is moderate, dominated by *Pinus contorta* var. *murrayana*, with generally more than 250 seedlings per acre.

DISTRIBUTION

Range: This association is widespread at higher elevations of the Sierra Nevada, California. This association is found at the highest elevations of the upper montane, often sharing this position with *~Abies magnifica - Pinus monticola - Pinus contorta* var. *murrayana* Forest (CEGL008616). Together, they straddle the Sierran crest at higher elevations. Stands can cover extensive areas, but most are less than 100 acres due to natural fragmentation of the landscape.
States/Provinces: CA, MX, BC?, NV, OR?

Global Description Reference: T. Keeler-Wolf. 2010. *Pinus contorta* var. *murrayana* / Sparse Understory Forest [05May2010]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Sierra Lodgepole Pine / Sparse Understory Forest at Crater Lake National Park.

70. SIERRA LODGEPOLE PINE – (MOUNTAIN HEMLOCK) / PINEMAT MANZANITA / DAVIDSON'S PENSTEMON WOODLAND

Pinus contorta var. *murrayana* - *(Tsuga mertensiana) / Arctostaphylos nevadensis / Penstemon davidsonii* Woodland

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest
Group: 1.B.2.Nd.4.b - G243 Sierra-Cascade Cold-Dry Subalpine Woodland
Alliance: A3621 Subalpine Sierra Lodgepole Pine Forest & Woodland
Association: *Pinus contorta* var. *murrayana* - (*Tsuga mertensiana*) / *Arctostaphylos nevadensis* / *Penstemon davidsonii* Woodland

USNVC Identifier: CEPP007266

LOCAL INFORMATION

Environmental Description: This vegetation association occurs throughout the park at moderate to relatively high elevations. It occurs on exposed rocky ridges, bedrock, stabilized scree slopes, and other rocky shallow soils. Topographic positions are high level, summit and high slope. Soils in plots were classified as loamy sand or sandy loam and are well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1907.3	11.5	239.6	36.3
Range	1711-2018	6-24	186-340	0-75

Vegetation Description: This is a sparse, open canopy woodland association dominated by Sierra lodgepole pine (*Pinus contorta* var. *murrayana*). Other conifers may be present and can be codominant. These include mountain hemlock (*Tsuga mertensiana*) and western white pine (*Pinus monticola*). The understory is dominated by a dense and often patchy cover of pinemat manzanita (*Arctostaphylos nevadensis*) growing in soil between the rocks. Other species common to rocky exposed sites occur in the understory and include Davidson's penstemon (*Penstemon davidsonii* var. *davidsonii*), Parry's woodrush (*Juncus parryi*) and lace lipfern (*Cheilanthes gracillima*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Tsuga mertensiana*	1-25	8.9	100
	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	1-25	6.3	100
Shrub	Broad-leaved evergreen shrub	*Arctostaphylos nevadensis*	5-25	10.0	100
	Broad-leaved deciduous shrub	*Vaccinium scoparium*	0.1-25	5.0	100
Herb	Subshrub	*Penstemon davidsonii* var. *davidsonii*	0.01-2	1.0	100
	Graminoid	*Juncus parryi*	0.01-5	1.4	100

Species Richness:
Plot Vascular Plant Species Richness Average: 17.5
Plot Vascular Plant Species Richness Range: 15-20

Diagnostic Species: None
Constant Species: *Pinus contorta* var. *murrayana, Arctostaphylos nevadensis, Penstemon davidsonii* var. *davidsonii, Juncus parryi, Vaccinium scoparium, Tsuga mertensiana*
Other Noteworthy Species: *Cheilanthes gracillima*
Local Range: This vegetation association occurs throughout the park at moderate to high elevations on exposed rocky ridges and stabilized scree slopes wherever Sierra lodgepole pine is the dominant overstory tree.

Classification Comments: This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Our association 70. Sierra Lodgepole Pine – (Mountain Hemlock) / Pinemat Manzanita / Davidson's Penstemon Woodland is similar to the *Pinus contorta* var. *murrayana* / *Penstemon newberryi* Woodland (CEGL002748) under the Subalpine Sierra Lodgepole Pine Forest & Woodland Alliance (A3621), except that Davidson's penstemon (*Penstemon davidsonii* var. *davidsonii*) is constant and diagnostic in our association instead of the similar mountain pride (*Penstemon newberryi*). Otherwise, the vegetation and environmental description of this USNVC association (CEGL002748) match that of our association very closely.

It is also possible that very sparsely vegetated stands of our association could be described as a separate provisional association and classified in the Southern Vancouverian Cliff, Scree & Rock Vegetation Group (G573) under the Western North American Cliff, Scree & Rock Vegetation Macrogroup (M887).

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 4. Relevés 228; 242; 271; 391
Crater Lake National Park Notes: None



Above: Sierra Lodgepole Pine – (Mountain Hemlock) / Pinemat Manzanita / Davidson's Penstemon Woodland at Crater Lake National Park.

71. SIERRA LODGEPOLE PINE / SNOWBRUSH CEANOTHUS FOREST

Pinus contorta var. *murrayana / Ceanothus velutinus* Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest
Group: 1.B.2.Nd.4.b - G243 Sierra-Cascade Cold-Dry Subalpine Woodland
Alliance: A3621 Subalpine Sierra Lodgepole Pine Forest & Woodland
Association: *Pinus contorta* var. *murrayana* / *Ceanothus velutinus* Forest

USNVC Identifier: CEPP007283

LOCAL INFORMATION

Environmental Description: This vegetation association occurs within the Panhandle and just to the north in the southernmost portion of the park. Elevations of these locations are relatively low for inside the park. Topographic position is low level. Slopes are nearly level. Soils are sandy loam, loamy sand, and loam and are moderately well-drained to well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1433.4	3.3	66.9	82.4
Range	1420-1448	1-5	38-108	76-88

Vegetation Description: This is an often low-statured forest association dominated by Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) with young trees and saplings of Sierra white fir (*Abies lowiana*) and ponderosa pine (*Pinus ponderosa*) common in the low midstory and understory. There is often a dense shrub layer of snowbrush ceanothus (*Ceanothus velutinus* var. *velutinus*). Pinemat manzanita (*Arctostaphylos nevadensis*) and wax currant (*Ribes cereum* var. *cereum*) are also frequently common in the understory. This association appears to be post-fire early seral forest vegetation where mixed and high severity fires have occurred in forests dominated by Sierra white fir and/or ponderosa pine. A few mature trees of these species that survived previous fires are often present.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	10-75	34.6	100
	Needle-leaved evergreen tree	*Pinus ponderosa*	10-25	11.6	100
	Needle-leaved evergreen tree	*Abies lowiana*	2-25	10.8	100
Shrub	Broad-leaved evergreen shrub	*Ceanothus velutinus* var. *velutinus*	0-50	24.7	80
	Broad-leaved evergreen shrub	*Arctostaphylos nevadensis*	0-5	1.6	80
	Broad-leaved deciduous shrub	*Ribes cereum* var. *cereum*	0-5	2.1	80
Herb	Graminoid	*Carex inops* ssp. *inops*	0-5	2.1	60

Species Richness:
Plot Vascular Plant Species Richness Average: 17.4
Plot Vascular Plant Species Richness Range: 10-25

Diagnostic Species: None
Constant Species: *Pinus contorta var. murrayana, Abies lowiana, Pinus ponderosa*
Other Noteworthy Species: *Ceanothus velutinus* var. *velutinus*
Local Range: This vegetation association is restricted to select locations within the Panhandle and just to the north in the southernmost portion of the park where high severity fires have occurred in forests dominated by Sierra white fir and/or ponderosa pine.

Classification Comments: This association was undergoing peer review for inclusion in the USNVC at the time of the completion of this report. Its scientific name and upper level placement in the USNVC have been reviewed by NatureServe (K. A. Schulz). If this association is ultimately accepted in to the USNVC, its CEPP code will become a CEGL code with the same numeric portion of its code.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 5. Relevés 8**;** 12; 14; 192; 195

Crater Lake National Park Notes: None



Above: Sierra Lodgepole Pine / Snowbrush Ceanothus Forest at Crater Lake National Park.

72. WHITEBARK PINE / DAVIDSON'S PENSTEMON WOODLAND

Pinus albicaulis / Penstemon davidsonii Woodland

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest
Group: 1.B.2.Nd.4.b - G243 Sierra-Cascade Cold-Dry Subalpine Woodland
Alliance: A3622 Sierra Western Juniper - Whitebark Pine Woodland
Association: *Pinus albicaulis* / *Penstemon davidsonii* Woodland

USNVC Identifier: CEGL003134

LOCAL INFORMATION

Environmental Description: This vegetation association occurs at high elevations on and near summits throughout the park, particularly on and around the Crater Lake caldera rim and Mount Scott. This association occurs as patches of trees among open pumice landscapes and/or on rocky ridges around the caldera rim or on buttes, as well as on steep rocky and pumice slopes. However, extensive unbroken stands do occur in places, such as Mount Scott and Cloud Cap. Topographic positions are high slopes and summits, but occasionally are midslopes. Soils are loamy sand, sandy loam, sand, or gravelly. Soils are well-drained to rapidly drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	2390.7	19.2	268.5	40.4
Range	2138-2644	2-40	83-351	2-74

Vegetation Description: This woodland or open forest association is dominated by whitebark pine (*Pinus albicaulis*). Whitebark pine is often the sole dominant tree but it is sometimes codominant with mountain hemlock (*Tsuga mertensiana*). This association often occurs as patches of trees, however, extensive unbroken stands also occur. Trees are often stunted. Davidson's penstemon (*Penstemon davidsonii* var. *davidsonii*), Davis's knotweed (*Polygonum davisiae*) and/or Crater Lake ribes (*Ribes erythrocarpum*) are common in the understory as are squirreltail (*Elymus elymoides* ssp. *elymoides*), spreading phlox (*Phlox diffusa*), and/or Nevada arnica (*Arnica nevadensis*). Ross's sedge (*Carex rossii*) is nearly ubiquitous in this association, but at low cover (~0.1-2%). Cascade desertparsley (*Lomatium martindalei*), Hitchcock's smooth woodrush (*Luzula glabrata* var. *hitchcockii*), Wheeler's bluegrass (*Poa wheeleri*) and a variety of other herbs common to the high elevation fell-fields may also be present.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pinus albicaulis*	2-75	30.9	100
	Needle-leaved evergreen tree	*Tsuga mertensiana*	0-75	6.7	53
	Needle-leaved evergreen tree	*Abies lasiocarpa* var. *lasiocarpa*	0-50	2.4	18
Shrub	Broad-leaved evergreen shrub	*Arctostaphylos nevadensis*	0-50	2.5	18
	Broad-leaved deciduous shrub	*Ribes erythrocarpum*	0-25	1.6	47
Herb	Subshrub	*Phlox diffusa*	0-10	1.1	53
	Subshrub	*Penstemon davidsonii* var. *davidsonii*	0-5	1.0	71
	Perennial herb	*Polygonum davisiae*	0-10	1.0	76
	Perennial herb	*Eucephalus ledophyllus*	0-10	0.9	29
	Perennial herb	*Lupinus andersonii*	0-5	0.9	41

Species Richness:
Plot Vascular Plant Species Richness Average: 20.6
Plot Vascular Plant Species Richness Range: 11-30

Diagnostic Species: *Pinus albicaulis*
Constant Species: *Pinus albicaulis*, *Elymus elymoides* ssp. *elymoides*
Other Noteworthy Species: *Ribes erythrocarpum*, *Arnica nevadensis*
Local Range: This vegetation association occurs at high elevations near summits throughout the park, particularly on and around the Crater Lake caldera rim, as well as on Mount Scott, Red Cone, Crater Peak, and Union Peak.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 17. Relevés 90; 138; 139; 156; 162; 163; 258; 265; 267; 283; 286; 287; 299; 308; 312; 314; 447
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This woodland association is currently only known from Yosemite National Park in California, and the following description is based on occurrences there. Additional information will be added as it becomes available. This association grows on stony sites

with patches of sandy soil between boulders. The elevational range is between 3110 and 3475 m (10,200-11,400 feet). Aspects are west and slopes are moderate.

Global Vegetation Description: This association is dominated by stunted *Pinus albicaulis*. Scattered individuals of Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) may be present. Forbs are scattered and sparse. Common forb associates include *Lupinus lepidus, Eriogonum ovalifolium, Arenaria kingii, Penstemon davidsonii*, and/or *Castilleja nana*. The graminoid species that may be present at low cover values include *Poa glauca* and *Elymus elymoides*.

DISTRIBUTION

Range: This association is only known from the vicinity of Yosemite National Park in California. It is suspected to be in Sequoia and Kings Canyon national parks as well.
States/Provinces: CA.

Global Description References: T. Keeler-Wolf. 2010. *Pinus albicaulis* / *Penstemon davidsonii* Woodland [06May2010]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Whitebark Pine / Davidson's Penstemon Woodland at Crater Lake National Park.

73. SUBALPINE FIR - MOUNTAIN HEMLOCK / ROUGH-FRUIT BERRY FOREST [PROVISIONAL]

Abies lasiocarpa – Tsuga mertensiana / Rubus lasiococcus Forest [Provisional]

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest
Group: 1.B.2.Nd.4.c - G245 North Pacific Mountain Hemlock - Silver Fir Forest & Tree Island
Alliance: A3726 Cascadian Pacific Silver Fir - Mountain Hemlock - Subalpine Fir Forest & Woodland

NPS Unique Identifier: NPSCRLA008

LOCAL INFORMATION

Environmental Description: This forest association is found on the west and south sides of the park often along stream courses and in drainages, near wetlands and springs, on headwalls and at the headwaters of some creeks, and in other low lying areas. This association may occur across a wide range of elevations from low to moderately high. Topographic positions vary and include toeslope, lowslope, midslope, high slope, low level, and high level. Slopes range from nearly level to fairly steep. Soils are mostly sandy loam and are occasionally sandy clay and silt loam. Soils range from well-drained, moderately well-drained, to somewhat poorly drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1737.5	9.5	353.0	79.6
Range	1566-2075	2-36	330-260	30-90

Vegetation Description: This is a dense, multilayered forest association of small to medium sized trees. Subalpine fir (*Abies lasiocarpa* var. *lasiocarpa*) and mountain hemlock (*Tsuga mertensiana*) are codominant in the overstory. Shasta red fir (*Abies magnifica* var. *shastensis*) and Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) are often present, but are usually subordinate in the overstory. The herb layer is often abundant and rich in species, including blue wildrye (*Elymus glaucus*), woodland strawberry (*Fragaria vesca*), and Rydberg's penstemon (*Penstemon rydbergii* var. *oreocharis*) are present and sometimes abundant. Roughfruit berry (*Rubus lasiococcus*) is constant.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Abies lasiocarpa* var. *lasiocarpa*	5-75	24	100
	Needle-leaved evergreen tree	*Tsuga mertensiana*	1-50	15.5	100
	Needle-leaved evergreen tree	*Abies magnifica* var. *shastensis*	0-25	5.8	83
	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0-25	5.1	58
	Needle-leaved evergreen tree	*Pseudotsuga menziesii* var. *menziesii*	0-25	1.9	17
Shrub	Broad-leaved deciduous shrub	*Vaccinium scoparium*	0-25	3.3	75
Herb	Perennial herb	*Senecio triangularis*	0-25	2.3	50
	Perennial herb	*Rubus lasiococcus*	0.01-10	1.1	100
	Graminoid	*Luzula divaricata*	0-25	1.7	8
	Graminoid	*Calamagrostis canadensis*	0-10	1.3	42

Species Richness:
Plot Vascular Plant Species Richness Average: 31.8
Plot Vascular Plant Species Richness Range: 16-49

Diagnostic Species: None
Constant Species: *Abies lasiocarpa* var. *lasiocarpa*, *Tsuga mertensiana*, *Rubus lasiococcus*
Other Noteworthy Species: None
Local Range: This association is found throughout the west and south sides of the park often along drainages, near wetlands, and at the headwaters of some creeks.

Classification Comments: We classified our association 73. Subalpine Fir - Mountain Hemlock / Rough-Fruit Berry Forest [Provisional] under the Cascadian Pacific Silver Fir - Mountain Hemlock - Subalpine Fir Forest & Woodland Alliance (A3726). It is possible that our provisional association is equivalent to the *Abies lasiocarpa* - *Tsuga mertensiana* / *Vaccinium scoparium* Woodland described in the USVNVC under alliance (A3726), however CEGL005522 lacks a description necessary to make a determination and grouse whortleberry (*Vaccinium scoparium*) is not constant in our association as it is in CEGL005522. Further inquiry should reveal whether our association 73. Subalpine Fir - Mountain Hemlock / Rough-Fruit Berry Forest [Provisional] is equivalent to the *Abies lasiocarpa* - *Tsuga mertensiana* / *Vaccinium scoparium* Woodland.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 12. Relevés 239; 241; 254; 274; 366; 367; 394; 410; 413; 436; 494; 543
Crater Lake National Park Notes: None



Above: Subalpine Fir – Mountain Hemlock / Rough-fruit Berry Forest [Provisional] at Crater Lake National Park.

74. MOUNTAIN HEMLOCK – (PACIFIC SILVER FIR, SUBALPINE FIR) / HITCHCOCK'S SMOOTH WOODRUSH WOODLAND

Tsuga mertensiana - (Abies amabilis, Abies lasiocarpa) / Luzula glabrata var. *hitchcockii* Woodland

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest
Group: 1.B.2.Nd.4.c - G245 North Pacific Mountain Hemlock - Silver Fir Forest & Tree Island
Alliance: A3726 Cascadian Pacific Silver Fir - Mountain Hemlock - Subalpine Fir Forest & Woodland
Association: *Tsuga mertensiana* - (*Abies amabilis*, *Abies lasiocarpa*) / *Luzula glabrata* var. *hitchcockii* Woodland

USNVC Identifier: CEGL007381

LOCAL INFORMATION

Environmental Description: This forest association is found at moderate to high elevations on the slopes surrounding the outside of the Crater Lake caldera, around Mount Scott, and southwest of the caldera to the slopes surrounding Union Peak. It may also occur elsewhere throughout the central portion of the park at higher elevations. Topographic positions are lowslope, midslope and high slope. Slopes are low to moderate, but occasionally are fairly high. Soils are sandy loam, loam or loamy sand and moderately well-drained to well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	2055.5	9.2	332.3	86.4
Range	1905-2230	4-28	130-35	81-92

Vegetation Description: This is a dense forest association comprised of intermediate-sized and large mountain hemlock (*Tsuga mertensiana*) trees often with large amounts of down wood. Mountain hemlock is often the sole dominant tree. Shasta red fir (*Abies magnifica* var. *shastensis*) is occasionally codominant, but is usually subordinate or absent. In the understory, Hitchcock's smooth woodrush (*Luzula glabrata* var. *hitchcockii*) is always present often with greater than 2% cover. Unlike most upper montane forest associations, pinemat manzanita (*Arctostaphylos nevadensis*) is absent in this association. Long-stolon sedge (*Carex inops* ssp. *inops*) may be present but with lower cover than Hitchcock's smooth woodrush.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Tsuga mertensiana*	5-95	53.3	100
	Needle-leaved evergreen tree	*Abies magnifica* var. *shastensis*	0-50	6.7	77
Herb	Graminoid	*Luzula glabrata* var. *hitchcockii*	1-50	10.6	100
	Graminoid	*Carex inops* ssp. *inops*	0-5	0.4	62

Species Richness:
Plot Vascular Plant Species Richness Average: 8.7
Plot Vascular Plant Species Richness Range: 4-17

Diagnostic Species: None
Constant Species: *Tsuga mertensiana, Luzula glabrata* var. *hitchcockii*
Other Noteworthy Species: None
Local Range: This association occurs on the slopes surrounding the outside of the Crater Lake caldera, around Mount Scott, and southwest of the caldera on to the slopes surrounding Union Peak. It may also occur elsewhere throughout the central portion of the park at higher elevations.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 13. Relevés 124; 144; 147; 160; 165; 268; 272; 279; 280; 302; 311; 429; 431
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This association occurs in the Cascade Range of Oregon and Washington. This open forest or woodland occurs at high elevations. Sites tend to be upper slopes or ridgetops but can occur on a variety of positions and aspects. It often occurs adjacent to or as patches within the subalpine parkland.

Global Vegetation Description: The canopy is dominated by *Tsuga mertensiana, Abies lasiocarpa,* and/or *Abies amabilis*. *Tsuga mertensiana* is always present and typically occupies over 10% cover. The shrub layer varies from sparse to moderate. *Vaccinium membranaceum* is usually present to prominent. The well-developed herb layer is dominated by *Luzula glabrata* var. *hitchcockii*. Several forbs may be prominent, especially *Arnica latifolia, Rubus lasiococcus, Lupinus arcticus* ssp. *subalpinus, Lupinus latifolius,* and *Valeriana sitchensis*. *Arnica latifolia* is usually present.

DISTRIBUTION

Range: N/A.

States/Provinces: CA?, OR, WA

Global Description Reference: D. Meidinger et al. *Tsuga mertensiana* - (*Abies amabilis, Abies lasiocarpa*) / *Luzula glabrata* var. *hitchcockii* Woodland. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: Mountain Hemlock – (Pacific Silver Fir, Subalpine Fir) / Hitchcock's Smooth Woodrush Woodland at Crater Lake National Park.

75. SUBALPINE FIR - SIERRA LODGEPOLE PINE FOREST [PROVISIONAL]

Abies lasiocarpa – Pinus contorta var. *murrayana* Forest [Provisional]

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.2 Cool Temperate Forest & Woodland
Division: 1.B.2.Nd - D192 Vancouverian Forest & Woodland
Macrogroup: 1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest
Group: 1.B.2.Nd.4.c - G245 North Pacific Mountain Hemlock - Silver Fir Forest & Tree Island
Alliance: A3729 Cascadian Subalpine Fir - Engelmann Spruce Forest

NPS Unique Identifier: NPSCRLA009

LOCAL INFORMATION

Environmental Description: This vegetation association occurs mostly in Munson Valley and Mazama Village however it also occurs elsewhere at moderate to somewhat high elevations in the north and south portions of the park. However, it does not occur on the Crater Lake caldera rim. Topographic positions include low level, midslope, high slope and summit. Slopes are generally level to moderate. Soils are loamy sand or sandy loam and are well-drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1903.3	5.2	85.3	75.1
Range	1820-1991	1-13	40-264	33-90

Vegetation Description: This is a somewhat open to moderately dense forest vegetation association where subalpine fir (*Abies lasiocarpa* var. *lasiocarpa*), Sierra lodgepole pine (*Pinus contorta* var. *murrayana*), and, to a slightly lesser extent, mountain hemlock (*Tsuga mertensiana*) are codominant in the overstory. The herb layer is typically sparse and characterized by species common across drier upland forest, such as long-stolon sedge (*Carex inops* ssp. *inops*), western needlegrass (*Achnatherum occidentale*), and Anderson's lupine (*Lupinus andersonii*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Abies lasiocarpa* var. *lasiocarpa*	5-25	17.1	100
	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	5-50	16.1	100
	Needle-leaved evergreen tree	*Tsuga mertensiana*	2-25	10.7	100
	Needle-leaved evergreen tree	*Abies magnifica* var. *shastensis*	0-10	1.8	50
Shrub	Broad-leaved deciduous shrub	*Vaccinium scoparium*	0-50	12.5	50
Herb	Perennial herb	*Lupinus andersonii*	0-5	1.3	50
	Graminoid	*Carex inops* ssp. *inops*	0-5	1.3	83

Species Richness:
Plot Vascular Plant Species Richness Average: 12.8
Plot Vascular Plant Species Richness Range: 7-20

Diagnostic Species: None
Constant Species: *Abies lasiocarpa* var. *lasiocarpa*, *Pinus contorta* var. *murrayana*, *Tsuga mertensiana*
Other Noteworthy Species: None
Local Range: This association occurs throughout Munson Valley and the Mazama Village area as well as on drier slopes along Annie Creek. It also occurs near Gaywas Peak and near the headwaters of Sun Creek, Red Blanket Creek and Castle Creek.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 6. Relevés 275; 294; 322; 415; 416; 437
Crater Lake National Park Notes: None



Above: Subalpine Fir – Sierra Lodgepole Pine Forest [Provisional] at Crater Lake National Park.

76. BLACK COTTONWOOD - QUAKING ASPEN / BROADLEAF LUPINE FOREST [PROVISIONAL]

Populus balsamifera ssp. *trichocarpa – Populus tremuloides / Lupinus latifolius* ssp. *latifolius* Forest [Provisional]

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.3 Temperate Flooded & Swamp Forest
Division: 1.B.3.Nc - D195 Rocky Mountain-Great Basin Montane Flooded & Swamp Forest
Macrogroup: 1.B.3.Nc.1 - M034 Rocky Mountain-Great Basin Montane Riparian & Swamp Forest
Group: 1.B.3.Nc.1.c - G796 Northern Rocky Mountain Lowland-Foothill Riparian Forest
Alliance: A0311 Northern Rocky Mountain Riparian Black Cottonwood Forest

NPS Unique Identifier: NPSCRLA010

LOCAL INFORMATION

Environmental Description: This vegetation association is found in the Panhandle in a large forested wetland complex as well as along lower Annie Creek. Elevations here are relatively low within the park. Topographic positions are low level and low slope. It occurs on rich organic soils that are completely saturated during the growing season. Soils are loam and range from moderately well-drained to very poorly drained.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1456.3	3	85	84
Range	1442-1476	2-4	70-100	80-86

Vegetation Description: This forested wetland association is an open to dense forest with black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) and quaking aspen (*Populus tremuloides*) codominant in the overstory. Due to the patchiness of the trees in this association, either black cottonwood or quaking aspen may be the sole dominant tree species in the overstory throughout portions of the park where this association occurs. The shrub gray alder (*Alnus incana* ssp. *tenuifolia*) is often abundant. Broadleaf lupine (*Lupinus latifolius* ssp. *latifolius*), bluejoint (*Calamagrostis canadensis*), and blue wildrye (*Elymus glaucus*) dominate a lush herb layer. A variety of other perennial herbs and sedges (*Carex* spp.) are also present.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Broad-leaved deciduous tree	*Populus tremuloides*	0-95	30.0	67
	Broad-leaved deciduous tree	*Populus balsamifera* ssp. *trichocarpa*	0-50	23.2	67
	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0-5	2.0	67
	Needle-leaved evergreen tree	*Abies lowiana*	0.1-5	2.1	100
Shrub	Broad-leaved deciduous shrub	*Alnus incana* ssp. *tenuifolia*	0-25	5.8	33
Herb	Perennial herb	*Lupinus latifolius* ssp. *latifolius*	25-50	40.8	100
	Perennial herb	*Fragaria virginiana*	0.01-5	2.0	100
	Graminoid	*Elymus glaucus*	2-10	4.8	100
	Graminoid	*Calamagrostis canadensis*	2-5	3.5	100

Species Richness:
Plot Vascular Plant Species Richness Average: 38.7
Plot Vascular Plant Species Richness Range: 25-57

Diagnostic Species: *Populus balsamifera* ssp. *trichocarpa, Rosa gymnocarpa, Cirsium vulgare, Solidago canadensis* var. *salebrosa, Carex fracta, Gnaphalium palustre, Tragopogon dubius, Ranunculus uncinatus*
Constant Species: *Populus balsamifera* ssp. *trichocarpa, Lupinus latifolius* ssp. *latifolius, Populus tremuloides, Abies lowiana, Calamagrostis canadensis, Elymus glaucus, Fragaria virginiana, Chamerion angustifolium, Galium triflorum, Mimulus moschatus, Osmorhiza berteroi, Rosa gymnocarpa, Solidago canadensis* var. *salebrosa, Viola glabella*
Other Noteworthy Species: None
Local Range: This vegetation association is found in a large wetland complex, as well as along lower Annie Creek, in the Panhandle in the southeast portion of the park.

Classification Comments: We classified our association 76. Black Cottonwood - Quaking Aspen / Broadleaf Lupine Forest [Provisional] under the Northern Rocky Mountain Riparian Black Cottonwood Forest Alliance (A0311). Our provisional association is very similar in its dominant species and vegetation description to three USNVC associations described under A0311, the *Populus balsamifera* ssp. *trichocarpa / Alnus incana* Riparian Forest (CEGL000667), the *Populus balsamifera* ssp. *trichocarpa* / *Calamagrostis canadensis* Riparian Forest (CEGL005845) and the *Populus balsamifera* ssp. *trichocarpa* - *Populus tremuloides* - Conifer / *Calamagrostis canadensis* Riparian Forest (CEGL005909). However, the variable dominance of *Populus balsamifera* ssp. *trichocarpa* and *Populus tremuloides*, the inconsistent presence of *Alnus incana* ssp. *tenuifolia*, the low conifer cover and the dominance of *Lupinus latifolius* ssp. *latifolius* in the understory of our

provisional association precluded classifying it as equivalent to any of these three USNVC associations. Further inquiry should reveal whether any of these three USNVC associations are equivalent to our provisional association.

Our association 76. Black Cottonwood - Quaking Aspen / Broadleaf Lupine Forest [Provisional] may also be equivalent to the *Populus tremuloides / Calamagrostis canadensis* Riparian Forest (CEGL000574) classified under the Quaking Aspen Riparian Forest (A3760). In addition, classifying our association under the *Populus tremuloides* Riparian Forest Alliance would relate it to montane forests as opposed to the lowland and foothills described in the Northern Rocky Mountain Riparian Black Cottonwood Forest (A0311). However, our provisional association was not considered equivalent to CEGL000574 because it lists *Populus balsamifera* ssp. *trichocarpa* as present only as a sub-dominant (<10%), but it is often dominant over *Populus tremuloides* in our provisional association. Further inquiry should reveal whether our provisional association is equivalent to the *Populus tremuloides / Calamagrostis canadensis* Riparian Forest and/or should be classified under the Quaking Aspen Riparian Forest Alliance in the USNVC.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 3: Relevés 230; 581; 582
Crater Lake National Park Notes: None



Above: Black Cottonwood – Quaking Aspen / Bigleaf Lupine Forest [Provisional] at Crater Lake National Park. The trees in the background are black cottonwoods (*Populus balsamifera* ssp. *trichocarpa*).

77. SUBALPINE FIR - SIERRA LODGEPOLE PINE / BLUEJOINT - SEDGE SPP. FOREST [PROVISIONAL]

Abies lasiocarpa - Pinus contorta var. *murrayana / Calamagrostis canadensis - Carex* spp. Forest [Provisional]

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.3 Temperate Flooded & Swamp Forest
Division: 1.B.3.Ng - D193 Vancouverian Flooded & Swamp Forest
Macrogroup: 1.B.3.Ng.1 - M035 Vancouverian Flooded & Swamp Forest
Group: 1.B.3.Ng.1.b - G507 North Pacific Montane Riparian Woodland
Alliance: A3766 Mountain Hemlock - Pacific Silver Fir Swamp Woodland

NPS Unique Identifier: NPSCRLA011

LOCAL INFORMATION

Environmental Description: This vegetation association occurs throughout the west and south portions of the park at low to moderately high elevations. It occurs in riparian areas and wetlands along larger streams, seeps, springs, in wetland basins, and at the edges of wet meadows. It occurs on rich organic soils that are completely saturated during the growing season. Soils are organic and muck and poorly drained to somewhat poorly drained. Topographic positions are lower level, basin floor and toeslope. Slopes are level to moderate.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1852.3	3.7	206.0	66.3
Range	1701-1925	0-12	145-0	35-86

Vegetation Description: This forested wetland association is an open to dense forest that occurs as an even distribution of trees or groupings of trees interspersed among patches of herbaceous wetland vegetation. The overstory is dominated either by subalpine fir (*Abies lasiocarpa* var. *lasiocarpa*) or Sierra lodgepole pine (*Pinus contorta* var. *murrayana*), or both trees are codominant in the overstory. Mountain hemlock (*Tsuga mertensiana*) is sometimes present and occasionally abundant. The dense herbaceous layer is dominated by sedge (*Carex* spp.) species mountain sedge (*Carex scopularum* var. *bracteosa*) and to a lesser extent woodrush sedge (*Carex luzulina*). Bluejoint (*Calamagrostis canadensis*) is often abundant and sometimes dominant. A variety of forbs are also present and some are occasionally abundant, including primrose monkeyflower (*Mimulus primuloides*), alpine shootingstar (*Dodecatheon alpinum*), subalpine fleabane (*Erigeron peregrinus*), tinker's penny (*Hypericum anagalloides*), Gorman's buttercup (*Ranunculus gormanii*), American bistort (*Polygonum bistortoides*), and arrowleaf ragwort (*Senecio triangularis*).

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	0-95	20.9	83
	Needle-leaved evergreen tree	*Abies lasiocarpa* var. *lasiocarpa*	1-50	15.0	100
	Needle-leaved evergreen tree	*Tsuga mertensiana*	0-25	3.7	67
Shrub	Broad-leaved deciduous shrub	*Vaccinium uliginosum*	0-10	2.5	50
Herb	Perennial herb	*Trifolium longipes*	0-50	6.5	83
	Perennial herb	*Ranunculus gormanii*	0.01-25	3.2	100
	Graminoid	*Calamagrostis canadensis*	0-75	21.1	83
	Graminoid	*Carex scopulorum* var. *bracteosa*	2-25	10.6	100
	Graminoid	*Muhlenbergia filiformis*	0.01-10	2.3	100

Species Richness:
Plot Vascular Plant Species Richness Average: 41.3
Plot Vascular Plant Species Richness Range: 27-59

Diagnostic Species: *Juncus orthophyllus, Carex illota, Carex scopulorum* var. *bracteosa*
Constant Species: *Abies lasiocarpa* var. *lasiocarpa, Ranunculus gormanii, Carex scopulorum* var. *bracteosa, Muhlenbergia filiformis, Carex luzulina, Hypericum anagalloides, Mimulus primuloides, Polygonum bistortoides, Senecio triangularis*
Other Noteworthy Species: *Calamagrostis canadensis*
Local Range: This association occurs in riparian areas along larger streams, seeps and in wetland basins throughout the west and south portions of the park at low to moderately high elevations.

Classification Comments: We classified our association 77. Subalpine Fir - Sierra Lodgepole Pine / Bluejoint - Sedge spp. Forest [Provisional] under the North Pacific Montane Riparian Woodland Group (G507) in the USNVC. It is possible that our provisional association should be classified under the Rocky Mountain-Great Basin Montane Riparian & Swamp Forest Group (G506) because it is similar to two associations under this group: the *Abies lasiocarpa / Carex aquatilis* Swamp Forest (CEGL002636) and the *Abies lasiocarpa - Picea engelmannii / Calamagrostis canadensis* Swamp Forest (CEGL000300). Our provisional association is also similar to the *Pinus contorta / Calamagrostis canadensis* Swamp Forest (CEGL000138) classified in the USNVC under the Sierra Lodgepole Pine - Tall Lodgepole Pine Swamp Forest Alliance (A3758). However, Sierra lodgepole pine (*Pinus contorta* var. *murrayana*) is not constant in our provisional association while it is in A3758 and the USNVC alliances and associations mentioned above describe vegetation from the Rocky Mountains and Sierra Nevada. Despite the similarities with associations described under G506, we decided that our provisional association 77. Subalpine Fir - Sierra Lodgepole Pine / Bluejoint - Sedge spp. Forest [Provisional] would be classified in the North Pacific Montane Riparian

Woodland Group (G507) to relate it to other similar forested wetland associations described in the park. Further inquiry should reveal the proper USNVC placement for this park provisional association.

It was determined through field verification that *Tsuga mertensiana* was misidentified as *Tsuga heterophylla* in relevé 579.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 6. Relevés 318; 319; 470; 545; 550; 579
Crater Lake National Park Notes: None



Above: Subalpine Fir – Sierra Lodgepole Pine / Bluejoint - Sedge Spp. Forest [Provisional] at Crater Lake National Park.

78. WESTERN HEMLOCK - ENGELMANN SPRUCE FOREST [PROVISIONAL]

Tsuga heterophylla – Picea engelmannii Forest [Provisional]

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.3 Temperate Flooded & Swamp Forest
Division: 1.B.3.Ng - D193 Vancouverian Flooded & Swamp Forest
Macrogroup: 1.B.3.Ng.1 - M035 Vancouverian Flooded & Swamp Forest
Group: 1.B.3.Ng.1.b - G507 North Pacific Montane Riparian Woodland
Alliance: A3767 Cascadian Engelmann Spruce Swamp Woodland

NPS Unique Identifier: NPSCRLA012

LOCAL INFORMATION

Environmental Description: This vegetation association occurs in Thousand Springs on the far western side of the park. Elevations for this association are relatively low within the park. The local environment is moist. These forests are associated with seeps, springs or temporarily flooded areas. Soils range from well-drained to poorly drained and this variation may occur at a fine scale with some trees occupying hummocks amid saturated soils. Soils are loamy sand to organic. Topographic position is midslope.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1532.3	5.7	317.5	65.3
Range	1522-1546	4-8	285-50	18-91

Vegetation Description: This is a wet forest association that occurs among the seeps, springs or temporarily flooded areas of Thousands Springs. Western hemlock (*Tsuga heterophylla*) and Engelmann spruce (*Picea engelmannii*) are codominant in the canopy. A wide variety of other montane conifers may be present, such as Sierra white fir (*Abies lowiana*), Shasta red fir (*Abies magnifica* var. *shastensis*) and mountain hemlock (*Tsuga mertensiana*), but are subordinate in the canopy. Blueberry (*Vaccinium* spp.) species are often present in the understory and include thinleaf huckleberry (*Vaccinium membranaceum*) and oval-leaf blueberry (*Vaccinium ovalifolium*). The understory is lush with many mesic site and wetland plants. Panicled bulrush (*Scirpus microcarpus*) is often present and abundant, sometimes exceeding 75% cover. Many varieties of herbs are present but are not consistently abundant.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Tsuga heterophylla*	25-50	35.8	100
	Needle-leaved evergreen tree	*Picea engelmannii*	5-25	12.7	100
	Needle-leaved evergreen tree	*Abies magnifica* var. *shastensis*	0-25	4.2	33
	Needle-leaved evergreen tree	*Tsuga mertensiana*	0-25	4.2	33
Herb	Perennial herb	*Mitella pentandra*	0-5	1.7	33
	Perennial herb	*Tiarella trifoliata* var. *unifoliata*	0.01-5	1.5	100
	Graminoid	*Scirpus microcarpus*	0-95	30.8	67
	Graminoid	*Carex disperma*	0-50	10.0	33
	Fern or fern ally	*Equisetum arvense*	0-25	3.7	33
	Fern or fern ally	*Athyrium filix-femina*	0-5	1.7	67

Species Richness:
Plot Vascular Plant Species Richness Average: 40
Plot Vascular Plant Species Richness Range: 31-49

Diagnostic Species: *Picea engelmannii, Tsuga heterophylla, Tiarella trifoliata* var. *unifoliata, Equisetum arvense, Hemitomes congestum, Vaccinium ovalifolium, Sorbus scopulina, Taxus brevifolia, Carex angustata*
Constant Species: *Picea engelmannii, Tsuga heterophylla, Tiarella trifoliata* var. *unifoliata, Vaccinium membranaceum, Orthilia secunda, Rubus lasiococcus, Senecio triangularis, Vancouveria hexandra*
Other Noteworthy Species: None
Local Range: This association is found in Thousand Springs on the west side of the park.

Classification Comments: We classified our provisional association 78. Western Hemlock - Engelmann Spruce Forest [Provisional] under the USNVC's Cascadian Engelmann Spruce Swamp Woodland Alliance (A3767). Our provisional association is also similar to the *Tsuga mertensiana - Tsuga heterophylla* / *Vaccinium ovalifolium* Forest (CEGL003218) classified under the Mountain Hemlock - Western Hemlock - Alaska-cedar Forest & Woodland Alliance (A3724). However, mountain hemlock (*Tsuga mertensiana*) and oval-leaf blueberry (*Vaccinium ovalifolium*) are not constant in our provisional association while they are in CEGL003218.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 3. Relevés 363; 364; 500
Crater Lake National Park Notes: None



Above**:** Western Hemlock – Engelmann Spruce Forest [Provisional] at Crater Lake National Park. The large tree in the foreground is a western hemlock (*Tsuga heterophylla*) and the trees directly to the left in the background are Engelmann spruce (*Picea engelmannii*).

79. ENGELMANN SPRUCE / BLUEBERRY SPP. FOREST [PROVISIONAL]

Picea engelmannii / *Vaccinium* spp. Forest [Provisional]

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.3 Temperate Flooded & Swamp Forest
Division: 1.B.3.Ng - D193 Vancouverian Flooded & Swamp Forest
Macrogroup: 1.B.3.Ng.1 - M035 Vancouverian Flooded & Swamp Forest
Group: 1.B.3.Ng.1.b - G507 North Pacific Montane Riparian Woodland
Alliance: A3767 Cascadian Engelmann Spruce Swamp Woodland

NPS Unique Identifier: NPSCRLA013

LOCAL INFORMATION

Environmental Description: This vegetation association occurs throughout the west and southeast portions of the park at relatively low elevations. It occurs in riparian areas and wetlands along larger streams, seeps, springs, in wetland basins, and at the edges of wet meadows. It occurs on rich organic soils that are completely saturated during the growing season and in some cases are saturated year round due to the presence of seeps. Slopes are level to moderate. Topographic positions are toeslope and midslope.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1589	7.4	309.3	31.6
Range	1525-1631	1-14	210-35	7-90

Vegetation Description: This forested wetland association is a dense to open forest dominated by Engelmann spruce (*Picea engelmannii*). There is usually a subordinate cover of subalpine fir (*Abies lasiocarpa* var. *lasiocarpa*) and mountain hemlock (*Tsuga mertensiana*). Several blueberry (*Vaccinium* spp.) species are present in the understory. Grouse whortleberry (*Vaccinium scoparium*) is always present along with thinleaf huckleberry (*Vaccinium membranaceum*) and/or bog blueberry (*Vaccinium uliginosum*). The tall shrub gray alder (*Alnus incana* ssp. *tenuifolia*) is sometimes present. The wetland graminoids bluejoint (*Calamagrostis canadensis*) and Sitka sedge (*Carex aquatilis* var. *dives*) are often present and may be abundant in the understory. A rich diversity of forbs are present, including Gray's licorice root (*Ligusticum grayi*), western cowbane (*Oxypolis occidentalis*), white marsh marigold (*Caltha leptosepala*), bride's bonnet (*Clintonia uniflora*), field horsetail (*Equisetum arvense*), twistedstalk (*Streptopus lanceolatus* var. *curvipes*), arrowleaf ragwort (*Senecio triangularis*), and white insideout flower (*Vancouveria hexandra*). While bog blueberry is often present in this association, it is not widespread throughout the park and is mostly restricted to wetlands on the west side at lower elevations.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Picea engelmannii*	5-50	17.7	100
Shrub	Broad-leaved deciduous shrub	*Vaccinium membranaceum*	0-50	7.5	60
	Broad-leaved deciduous shrub	*Alnus incana* ssp. *tenuifolia*	0-10	4.7	60
	Broad-leaved deciduous shrub	*Vaccinium scoparium*	0.1-25	4.2	100
	Broad-leaved deciduous shrub	*Vaccinium uliginosum*	0-25	3.4	60
Herb	Perennial herb	*Oxypolis occidentalis*	0-25	4.6	60
	Graminoid	*Carex aquatilis* var. *dives*	0-75	15.6	40
	Graminoid	*Calamagrostis canadensis*	0-10	2.8	60

Species Richness:
Plot Vascular Plant Species Richness Average: 36.8
Plot Vascular Plant Species Richness Range: 27-48

Diagnostic Species: *Listera cordata*
Constant Species: *Picea engelmannii*, *Vaccinium scoparium*, *Ligusticum grayi*, *Senecio triangularis*
Other Noteworthy Species: *Vaccinium membranaceum*, *Vaccinium uliginosum*
Local Range: This vegetation association occurs in riparian areas, wetlands, springs and seeps throughout the west and southeast portions of the park at relatively low elevations. It is particularly common in Sphagnum Bog and nearby wetlands, Thousand Springs, and along Sand Creek, Castle Creek, Bybee Creek, and Crater Creek.

Classification Comments: We classified our association 79. Engelmann Spruce / Blueberry spp. Forest [Provisional] under the USNVC's Cascadian Engelmann Spruce Swamp Woodland Alliance. Our park provisional association is very similar to the USNVC's *Picea engelmannii / Vaccinium uliginosum* Swamp Woodland (CEGL000380) classified under this same USNVC alliance (A3767), however, bog blueberry (*Vaccinium uliginosum*) is constant in CEGL000380. While bog blueberry is not constant in our association 79. Engelmann Spruce / Blueberry Spp. Forest [Provisional], it is present in three out the five relevés of our association and other blueberry (*Vaccinium* spp.) species are always present and sometimes more abundant. Further inquiry should reveal whether our association 79. Engelmann Spruce / Blueberry spp. Forest [Provisional] is equivalent to the *Picea engelmannii* / *Vaccinium uliginosum* Woodland (CEGL000380) in the USNVC.

Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 5. Relevés 514; 519; 551; 559; 571

Crater Lake National Park Notes: None



Above: Engelmann Spruce / Blueberry spp. Forest [Provisional] at Crater Lake National Park.

80. (TALL LODGEPOLE PINE, SIERRA LODGEPOLE PINE) / BOG BLUEBERRY FOREST

Pinus contorta (var. *latifolia*, var. *murrayana) / Vaccinium uliginosum* Forest

USNVC CLASSIFICATION:
Class: 1 Forest & Woodland
Subclass: 1.B Temperate & Boreal Forest & Woodland
Formation: 1.B.3 Temperate Flooded & Swamp Forest
Division: 1.B.3.Ng - D193 Vancouverian Flooded & Swamp Forest
Macrogroup: 1.B.3.Ng.1 - M035 Vancouverian Flooded & Swamp Forest
Group: 1.B.3.Ng.1.c - G256 North Pacific Maritime Swamp Forest
Alliance: A3755 Lodgepole Pine Swamp Forest
Association: *Pinus contorta* (var. *latifolia*, var. *murrayana*) / *Vaccinium uliginosum* Forest

USNVC Identifier: CEGL000171

LOCAL INFORMATION

Environmental Description: This vegetation association is found on the far west side of the park on rich organic soils that are completely saturated during the growing season. It occurs in riparian area wetlands along larger streams and in wetland basins. Topographic position is midslope. Soils are somewhat poorly drained. Slopes are nearly level.

Metric	Altitude (m)	Slope (degrees)	Aspect (degrees)	Litter cover (%)
Average	1592	3.5	215	74.5
Range	1568-1616	3-4	140-290	72-77

Vegetation Description: This forested wetland association is an open forest of Sierra lodgepole pine (*Pinus contorta* var. *murrayana*), sometimes with subalpine fir (*Abies lasiocarpa* var. *lasiocarpa*), Engelmann spruce (*Picea engelmannii*), and mountain hemlock (*Tsuga mertensiana*). A dense understory of bog blueberry (*Vaccinium uliginosum*) and Sitka sedge (*Carex aquatilis* var. *dives*) is always present growing in saturated soil. A varierty of other herbaceous wetland plants such as alpine bentgrass (*Agrostis thurberiana*), field horsetail (*Equisetum arvense*), bluejoint (*Calamagrostis canadensis*), scentbottle (*Platanthera dilatata*), and white marsh marigold (*Caltha leptosepala*) are also present in the understory.

Most Abundant Species:

Stratum	Lifeform	Species	Cover Range (%)	Average Cover (%)	Constancy (%)
Tree	Needle-leaved evergreen tree	*Pinus contorta* var. *murrayana*	1-50	22	100
	Needle-leaved evergreen tree	*Abies lasiocarpa* var. *lasiocarpa*	0-10	5	50
	Needle-leaved evergreen tree	*Picea engelmannii*	0-10	3	50
Shrub	Broad-leaved deciduous shrub	*Vaccinium uliginosum*	25-50	41.2	50
Herb	Perennial herb	*Streptopus lanceolatus* var. *curvipes*	0-10	3	50
	Perennial herb	*Caltha leptosepala* ssp. *howellii*	0-50	17.5	50
	Perennial herb	*Viola glabella*	0-5	2.5	50
	Graminoid	*Carex aquatilis* var. *dives*	25-95	55	100
	Graminoid	*Agrostis thurberiana*	1-5	3.5	100
	Fern or fern ally	*Equisetum arvense*	0.1-5	2.7	100

Species Richness:
Plot Vascular Plant Species Richness Average: 30.5
Plot Vascular Plant Species Richness Range: 15-46

Diagnostic Species: *Vaccinium uliginosum, Trisetum canescens, Listera convallarioides, Lonicera caerulea*
Constant Species: *Pinus contorta* var. *murrayana, Vaccinium uliginosum, Carex aquatilis* var. *dives, Agrostis thurberiana, Equisetum arvense, Calamagrostis canadensis, Clintonia uniflora, Epilobium ciliatum, Luzula multiflora* ssp. *multiflora, Trisetum canescens, Platanthera dilatata, Tsuga mertensiana*
Other Noteworthy Species: None
Local Range: This association occurs in wetlands on the far west side of the park in Sphagnum Bog and wetlands nearby, as well as near Oasis Springs. It is possible this association also occurs in wetlands near Boundary Springs and Bybee Creek.

Classification Comments: None
Other Comments: None
Local Description Author: D. A. DiPaolo
Number of Plots: 2. Relevés 526; 530
Crater Lake National Park Notes: None

GLOBAL INFORMATION

GLOBAL DESCRIPTION

Global Environmental Description: This lodgepole pine forest association is currently known from Idaho, Oregon and California. This description is currently based on information from Yosemite

National Park in California. Additional global information will be added as it becomes available. In Yosemite, this association is found along small streams and on the edges of meadows, or on slightly higher elevations in meadows, from approximately 2285-2925 m (7500-9600 feet) in elevation on gentle to moderate slopes of variable aspects. Soil textures range from silty loam of granitic origin to muck. Soils are somewhat poorly drained to poorly drained. Litter/duff cover ranges from 20-95%. Sites are palustrine.

Global Vegetation Description: The tree layer is composed almost solely of *Pinus contorta* var. *murrayana*, ranging up to 35 m in height and up to 37% cover. *Vaccinium uliginosum* provides from 15-87% cover in the shrub layer, which is generally under 0.5 m. Other (sub) shrubs include *Vaccinium caespitosum* and *Kalmia polifolia*; *Pinus contorta* var. *murrayana* saplings are also present in the shrub layer. The herb layer is variable, with *Carex utriculata* providing most of the cover in this layer; other species include *Mimulus primuloides, Juncus drummondii*, and *Oreostemma alpigenum* var. *alpigenum*. Moss covers 5-40% of the ground.

DISTRIBUTION

Range: Although the alliance is widespread in the upper montane and subalpine zone of most major mountain ranges of the western U.S., information about its global characteristics is not available without additional inventory. This association is currently reported from California, Oregon, Idaho and Wyoming.

States/Provinces: CA, ID, OR.

Global Description References: T. Keeler-Wolf. 2010. *Pinus contorta* (var. *latifolia*, var. *murrayana*) */ Vaccinium uliginosum* Forest [07May2010]. United States National Vegetation Classification. Federal Geographic Data Committee, Washington, D.C.

Available: http://usnvc.org/explore-classification (Accessed: April 11, 2018).



Above: (Tall Lodgepole Pine, Sierra Lodgepole Pine) / Bog Blueberry Forest at Crater Lake National Park.

Appendix C. Key to Vegetation Associations of Crater Lake National Park

Natural Vegetation (key to groups from A Manual of California Vegetation Sawyer et al. 2009)

1. Sparsely vegetated or no vegetation: total vegetation cover is less than or equal to 5% …… ……...…...…… **Sparse Vegetation**

2. Non-woody herbaceous vegetation dominant throughout stand. When total vegetation cover is less than about 20%, shrubs, sub-shrubs, and/or trees may be present but are less than 2-5% cover and are not evenly distributed across stand. When total vegetation cover is greater than about 20%, the layer of shrubs, sub-shrubs, and trees, if present, are of a lower cover than herbs and typically less than 10%. When cover of herbs is greater than 60%, the cover of low shrubs - which are shorter than herbs - can be as high as 20-25%. ……...…… **Herbaceous Vegetation**

3. Woody shrubs and sub-shrubs conspicuous throughout stand. Shrubs are always at least 10% cover. When total vegetation cover is greater than 20%, the tree layer, if present, is generally less than 10% cover, while herbaceous species may total higher cover than shrubs. In areas where vegetation is less than 20% total cover, shrubs may cover less than 10%, but are evenly distributed across the stand. ……...……... **Shrublands**

4. Trees evenly distributed and conspicuous throughout stand. In areas where vegetation cover is greater than about 20%, tree canopy may be as low as 10% over denser layers of shrubs and herbaceous species. In areas where vegetation is less than 20% total cover, trees may cover less than 10% (as low as 8%) but still evenly distributed across stand…….…. **Forests and Woodlands**

Sparse Vegetation (little or no vegetation)

1. No vegetation or vegetation cover less than or equal to 2%.

2. Permanent or ephemeral pond. ……..… **83. POND**

2’ Not as above.

3. Cliff, scree and rock is the dominant cover. Little or no pumice. ....……..……...…… **81. CLIFF, SCREE & ROCK VEGETATION**

3’ Pumice. Little or no scree and rock. ...……...……..….. **82. PUMICE/SAND**

1’ Sparsely vegetated. Vegetation cover greater than 2%.

4. Permanent or ephemeral pond. Open water ringed by herbaceous wetland vegetation. *Nuphar polysepala* is present or absent. ……...……..… **83. POND**

4’ Not as above.

5. Sparse vegetation consisting of mainly *Pulsatilla occidentalis* and/or *Arnica longifolia.* …….. ……. **29. WHITE PASQUEFLOWER - DAVIDSON'S PENSTEMON SPARSE VEGETATION**

***Pulsatilla occidentalis - Penstemon davidsonii* Sparse Vegetation**

5’ Not as above.

6. Sparse vegetation consisting of mainly *Penstemon davidsonii* and *Penstemon rupicola.* …… ……..…….. **28. DAVIDSON'S PENSTEMON SPARSE VEGETATION**

***Penstemon davidsonii* Sparse Vegetation**

6’ Not as above.

7. Sparse vegetation consisting of mainly *Eriogonum pyrolifolium* and/or *Polygonum davisiae. Eriogonum pyrolifolium* may be absent or rare. ….……..……..…….…… ……..…….…. **26. DAVIS' KNOTWEED - SHASTA BUCKWHEAT FELL-FIELD**

***Polygonum davisiae – Eriogonum pyrolifolium* Fell-field**

7’ Not as above.

8. Cliff, scree and rock is the dominant cover. Little or no pumice. …… ……..….....…….. **81. CLIFF, SCREE & ROCK VEGETATION**

8’ Pumice is the dominant cover. Little or no scree and rock. ……...…….……. ……... **82. PUMICE/SAND**

Herbaceous Vegetation

1. Sites with at least one of the following wetland attributes: hydric soil, hydrophytic vegetation, wetland hydrology (flooded ponds, permanent and seasonal wetlands, seeps, and meadows with soils saturated throughout growing season, hydrothermally active areas). Understory or ground stratum is dominated by obligate wetland species (*Nuphar polysepala,* sedges (*Carex* spp.), rushes (*Juncus* spp.), spikerushes (*Eleocharis* spp.), and/or bulrushes (*Scirpus* spp.) excluding upland *Carex* and *Juncus* species such as *C. inops, C. rossii, C. breweri, and J. parryi.*

2. Aquatic vegetation submerged in water except for mats of floating leaves or moss species are the dominant cover. *Nuphar polysepala* is the dominant cover. *Potamogeton* spp. can exceed the cover of *Nuphar polysepala* in some ponds……..……..…..…… ……..…..……. **1. ROCKY MOUNTAIN POND-LILY AQUATIC VEGETATION**

***Nuphar polysepala* Aquatic Vegetation**

2’ Wetland or wet meadow vegetation, often occurring in dense swards dominated by sedges (*Carex* spp.), rushes (*Juncus* spp.), spikerushes (*Eleocharis* spp.), and/or bulrushes (*Scirpus* spp.) or vegetation dominated by grasses and/or broadleaved perennial forbs. This may include seasonally saturated depressions or lake and wetland margins that are now dry. Vegetation not submerged in water.

3. Vegetation dominated by sedges (*Carex* spp.), rushes (*Juncus* spp.), spikerushes (*Eleocharis* spp.), and/or bulrushes (*Scirpus* spp.), often occurring in dense swards.

4. *Scirpus microcarpus* is the dominant cover or nearly so. No other sedge (*Carex* spp.), rush (*Juncus* spp.), spikerush (*Eleocharis* spp.), and/or bulrush (*Scirpus* spp.) species is more abundant than *Scirpus microcarpus*. ……..…..... **17. PANICLED BULRUSH MARSH**
***Scirpus microcarpus* Marsh**

4' Not as above. Vegetation dominated by sedges (*Carex* spp.), rushes (*Juncus* spp.), and/ or spikerushes (*Eleocharis* spp.).

5. *Carex* spp. are the dominant or codominant cover.

6. *Carex echinata* is the dominant *Carex* spp. cover or nearly so (other *Carex* spp. may have greater cover) and *Eleocharis quinqueflora* is present and abundant. *Carex echinata* and *Eleocharis quinqueflora* combined form the dominant cover. ……..…… …….. **16. FEW-FLOWER SPIKERUSH FEN**
***Eleocharis quinqueflora* Fen**

6' Not as above. *Eleocharis* spp. are absent, rare, or >> the combined cover of the dominant *Carex* species present.

7. *Carex aquatilis* is the dominant or codominant *Carex* spp.

8. *Carex aquatilis* var. *aquatilis* is the dominant *Carex* spp. ……..….. ……. **12. WATER SEDGE WET MEADOW**
***Carex aquatilis* Wet Meadow**

8' *Carex aquatilis* var. *dives* is the dominant *Carex* spp. ……..…… ……... **9. SITKA SEDGE FEN**
***Carex aquatilis* var. *dives* Fen**

7' Not as above. Other *Carex* spp. make up the dominant cover.

9. *Carex lenticularis* and/or *Carex luzulina* are dominant or codominant.

10. *Carex lenticularis* is the dominant *Carex* spp. *Carex luzulina* may be common but is not more abundant than *Carex lenticularis.* …… …… **13. LAKESHORE SEDGE WET MEADOW**
***Carex lenticularis* Wet Meadow**

10’ *Carex luzulina* is the dominant *Carex* spp. *Carex lenticularis* absent or < 5%. *Carex luzulina* and *Mimulus primuloides* combined form the dominant cover. …… ……. **14. WOODRUSH SEDGE WET MEADOW**
***Carex luzulina* Wet Meadow**

9’ Not as above. Other Carex spp. make up the dominant cover.

11. *Carex limosa* is the dominant *Carex* spp. *Eriophorum gracile* present and often codominant with *Carex limosa. Carex limosa* and *Eriophorum gracile* combined form the dominant cover. ……. **8. MUD SEDGE FEN**
***Carex limosa* Fen**

11’ Not as above. Other *Carex* spp. make up the dominant cover.

12. *Carex utriculata* is the dominant *Carex* spp. No other *Carex* spp. with greater cover. ……...…… …….. **10. NORTHWEST TERRITORY SEDGE WET MEADOW**
***Carex utriculata* Wet Meadow**

12’ Not as above. Other *Carex* spp. make up the dominant cover.

13. *Carex nigricans* is often the dominant *Carex* spp. though *C. breweri* may be abundant. *Potentilla flabellifolia* is abundant. *Carex nigricans*, *Potentilla flabellifolia*, and/or *Phyllodoce empetriformis* combined form the dominant cover. …….. **20. BLACK ALPINE SEDGE WET MEADOW**
***Carex nigricans* Wet Meadow**

13’ Not as above.

14. *Carex scopulorum* is the dominant *Carex* spp. No other *Carex* spp. with greater cover. …….. **15. MOUNTAIN SEDGE WET MEADOW**
***Carex scopulorum* Wet Meadow**

14’ Not as above. *Carex straminiformis* is the dominant *Carex* spp. ……... ……..……..……. **7. SHASTA SEDGE GRASSLAND**
***Carex straminiformis* Grassland**

5’ Not as above. *Eleocharis* spp. are abundant. *Eleocharis quinqueflora* and *Carex echinata* together make up the dominant cover. No other *Carex* spp. more abundant than the combined cover of *Eleocharis quinqueflora* and *Carex echinata*. ……..…… ……. **16. FEW-FLOWER SPIKERUSH FEN**
***Eleocharis quinqueflora* Fen**

3’ Wetland or wet meadow vegetation dominated by grasses and/or broadleaved perennial forbs, not dominated by sedges (*Carex* spp.), spikerushes (*Eleocharis* spp.), and/or bulrushes (*Scirpus* spp.).

15. Grass species (*Poaceae* family) make up the dominant cover. *Senecio triangularis* is generally absent or rare (< 5%).

16. *Calamagrostis canadensis* is the dominant cover or codominant.

17. *Calamagrostis canadensis* is the dominant cover or codominant with *Senecio triangularis* and/or *Glyceria striata. Deschampsia cespitosa* may be present but is not more abundant than *Calamagrostis canadensis.* ……...…….……..…… ...…….…. **19. WESTERN BLUEJOINT WET MEADOW**
***Calamagrostis canadensis* Western Wet Meadow**

17’ *Deschampsia cespitosa* is the dominant cover. …….…… …… **11. TUFTED HAIRGRASS WET MEADOW**
***Deschampsia cespitosa* Wet Meadow**

16’ *Calamagrostis canadensis* is absent or not the dominant or codominant cover. *Achnatherum nelsonii* is the dominant cover or codominant with other wet meadow herbaceous species. *Rudbeckia occidentalis* is present and often codominant. *Veratrum viride* is often present and may be abundant. *Carex hoodii* sometimes abundant. *Senecio triangularis* is generally absent or rare (<< 5%). …….…….. …..…. **2. COLUMBIA NEEDLEGRASS – WESTERN CONEFLOWER GRASSLAND [PROVISIONAL]**
***Achnatherum nelsonii – Rudbeckia occidentalis* Grassland [Provisional]**

15’ Broadleaved herbaceous plants are the dominant cover. Often wet meadows.

18. *Senecio triangularis* is the dominant cover or codominant with other wet meadow herbaceous species. ……... **18. ARROWLEAF RAGWORT WET MEADOW**
***Senecio triangularis* Wet Meadow**

18’ *Senecio triangularis* is not the dominant or codominant cover, present << 5%.

19. *Lupinus polyphyllus* and *Heracleum maximum* together are the dominant cover or are codominant with other wet meadow herbaceous species. *Senecio triangularis* absent or much less than combined cover of *Lupinus polyphyllus* and *Heracleum maximum*. …….. …… **6. BIGLEAF LUPINE - COMMON COWPARSNIP MEADOW [PROVISIONAL]**

***Lupinus polyphyllus - Heracleum maximum* Meadow [Provisional]**

19’ *Achnatherum nelsonii* is codominant with other wet meadow herbaceous species. *Rudbeckia occidentalis* is present and often codominant. *Veratrum viride* is often present. *Senecio triangularis* absent or much less than combined cover of *Achnatherum nelsonii* and *Rudbeckia occidentalis.* ……... …….. **2. COLUMBIA NEEDLEGRASS – WESTERN CONEFLOWER GRASSLAND [PROVISIONAL]**

***Achnatherum nelsonii – Rudbeckia occidentalis* Grassland [Provisional]**

1’ Upland vegetation. None of the wetland attributes (hydric soil, hydrophytic vegetation, wetland hydrology) are present. Obligate wetland species absent or very low in cover (<3%). Woody species, except prostrate species (*Eriogonum* spp., *Phlox diffusa, Polygonum shastense* and *Linanthus pungens*) are absent or rare (<5% cover).

20. *Carex inops* and/or *Achnatherum occidentale* absent or rare (<1%). If present >1% than not the dominant cover, << than the combined cover of principle herb species present. Total vegetation cover may be sparse, as low as < 1%.

21. *Linanthus pungens* is present and often dominant. *Eriophyllum lanatum* and *Eriogonum ovalifolium* are present. ……... **22. GRANITE PRICKLY PHLOX - COMMON WOOLLY SUNFLOWER ALPINE FELL-FIELD [PROVISIONAL]**

***Linanthus pungens – Eriophyllum lanatum* Alpine Fell-field [Provisional]**

21’. Not as above.

22. *Pulsatilla occidentalis* and/or *Arnica longifolia* are common and often dominant. …… …….. **29. WHITE PASQUEFLOWER - DAVIDSON'S PENSTEMON SPARSE VEGETATION**

***Pulsatilla occidentalis - Penstemon davidsonii* Sparse Vegetation**

22’ Not as above.

23. *Penstemon davidsonii* is abundant (>3%) and often the dominant species. *Arctostaphylos nevadensis* may be present as high as 5% but not the dominant cover. *Penstemon rupicola* may be present and codominant with *Penstemon davidsonii*. *Sedum oregonense* and *Juncus parryi* often present and sometimes abundant. ……... ……... **28. DAVIDSON'S PENSTEMON SPARSE VEGETATION**

***Penstemon davidsonii* Sparse Vegetation**

23’ *Penstemon davidsonii* absent, rare or not more common than the other principal species present.

24. *Carex breweri* is the dominant species and often abundant (>2%). *Raillardella argentea, Phlox diffusa, Lupinus lepidus* and *Antennaria* spp. are often common and may be more abundant than *C. breweri* but *C. breweri* is always present >2% and evenly distributed throughout the stand. *Penstemon davidsonii* may be present but not more common than the other principal species present. ……... ……..……...….... **21. BREWER'S SEDGE ALPINE MEADOW**
***Carex breweri* Alpine Meadow**

24' *Carex breweri* is absent, rare or not more common than the other principal species present. *Polygonum davisiae* and/or *Polygonum shastense* common.

25. *Polygonum shastense* is dominant or codominant with *Polygonum davisiae*. ……... ……. **27. SHASTA KNOTWEED - DAVIS' KNOTWEED FELL-FIELD**
***Polygonum shastense – Polygonum davisiae* Fell-field**

25' *Polygonum shastense* is absent or rare (≤ 1%).

26. *Polygonum davisiae* is the dominant species or codominant with *Achnatherum occidentale, Lupinus andersonii, Elymus elymoides, Phlox diffusa,* and/or *Carex* sp. Overall vegetation cover is generally >10%. …..…….……..…… …… **25. DAVIS' KNOTWEED - SQUIRRELTAIL FELL-FIELD**
***Polygonum davisiae – Elymus elymoides* Fell-field**

26' *Polygonum davisiae* is the dominant species or codominant with *Eriogonum pyrolifolium. Eriogonum pyrolifolium* may be absent or rare. *Phlox diffusa, Lupinus andersonii, Elymus elymoides, Achnatherum occidentale,* and/or *Carex* sp. generally absent or rare (<1%). When total vegetation cover is low (< 5%) *Eriogonum pyrolifolium* may be the dominant species. Overall vegetation cover is generally sparse (<10%). ……..……...…….. ……... **26. DAVIS' KNOTWEED - SHASTA BUCKWHEAT FELL-FIELD**
***Polygonum davisiae – Eriogonum pyrolifolium* Fell-field**

20' *Carex inops* and/or *Achnatherum occidentale* common, often dominant. If not dominant, *Polygonum davisiae* dominant (>5%).

27. *Polygonum davisiae* is dominant or codominant species with *Lupinus andersonii, Achnatherum occidentale, Polygonum shastense,* and/or *Eriogonum pyrolifolium.*

28. *Polygonum shastense* is dominant or codominant with *Polygonum davisiae*. ……. ……...….. **27. SHASTA KNOTWEED - DAVIS' KNOTWEED FELL-FIELD**
***Polygonum shastense – Polygonum davisiae* Fell-field**

28’ *Polygonum shastense* is absent or rare. *Polygonum davisiae* is the dominant species or codominant with *Achnatherum occidentale, Lupinus andersonii, Elymus elymoides, Phlox diffusa*, and/or *Carex* sp. *Ericameria greenei* is absent or rare (<5%). …… ……...……..... **25. DAVIS' KNOTWEED - SQUIRRELTAIL FELL-FIELD**
***Polygonum davisiae – Elymus elymoides* Fell-field**

27’ *Polygonum davisiae* is absent or rare.

29. *Carex inops* absent or rare (< 1%). If present > 1%, then not dominant or codominant, not more abundant than the combined cover of the other principle species present. *Achnatherum occidentale* common.

30. *Lupinus andersonii* absent or rare. *Eriogonum marifolium* the dominant species or is codominant with *Achnatherum occidentale*. *Polygonum davisiae* may be present up to 1% but often absent. Total vegetation cover often sparse. ……...…. ….. **24. MARUMLEAF BUCKWHEAT - CRATER LAKE SANDWORT FELL-FIELD**
***Eriogonum marifolium - Arenaria pumicola* Fell-field**

30’ *Achnatherum occidentale* is dominant or codominant with *Lupinus andersonii*. *Lupinus andersonii* always present. ……..…… ……. **3. CALIFORNIA NEEDLEGRASS - ANDERSON'S LUPINE GRASSLAND**
***Achnatherum occidentale* ssp. *californicum – Lupinus andersonii* Grassland**

29’ *Carex inops* and/or other dryland *Carex* spp. dominant or codominant with other principle species present. *Achnatherum occidentale* is often present and may have a higher cover than *Carex inops*.

31. *Ericameria bloomeri* common or present with a least 2% cover. …… …… **37. RABBITBUSH SHRUB GRASSLAND [PROVISIONAL]**
***Ericameria bloomeri* Shrub Grassland [Provisional]**

31’ Not as above.

32. *Carex straminiformis* is the dominant *Carex* spp. present. ……..…… …….. **7 SHASTA SEDGE GRASSLAND**
***Carex straminiformis* Grassland**

32’ Not as above. *Carex inops* and/or other dryland *Carex* spp. are the dominant cover or codominant with *Achnatherum occidentale.*

33. *Lupinus andersonii* and/or *Penstemon rydbergii* common (>3% cover).

34. *Carex inops* is dominant or codominant with the other principle species present. *Achnatherum occidentale* is common. *Lupinus andersonii* common and often dominant (>3% cover). *Penstemon rydbergii* is absent or rare. …… …….. **3. CALIFORNIA NEEDLEGRASS - ANDERSON'S LUPINE GRASSLAND**

***Achnatherum occidentale* ssp. *californicum* – *Lupinus andersonii* Grassland**

34’ *Penstemon rydbergii* is common and often codominant with *Carex inops. Lupinus andersonii* may be present and common. ……..…….……... .……. **5. LONG-STOLON SEDGE - RYDBERG'S PENSTEMON GRASSLAND**

***Carex inops* ssp. *inops* – *Penstemon rydbergii* Grassland**

33’ *Lupinus andersonii* and *Penstemon rydbergii* absent or rare (<3% cover). *Carex inops* is the dominant cover or codominant with *Achnatherum occidentale. Carex halliana* may be abundant. …….. …….. **4. LONG-STOLON SEDGE - WESTERN NEEDLEGRASS GRASSLAND**

***Carex inops* ssp. *inops* – *Achnatherum occidentale* Grassland**

Shrubland Vegetation

1. Shrublands of riparian or wetland habitats. Sites have at least one of the following wetland attributes: hydric soil, hydrophytic vegetation, wetland hydrology. The following plants are generally common in the herb layer: *Senecio triangularis, Veratrum viride, Calamagrostis canadensis, Glyceria striata, Mimulus moschatus,* and *Viola glabella*.

2. *Vaccinium uliginosum* or *Spirea douglasii* is the dominant shrub species present, often > 20%.

3. *Spirea douglasii* is the dominant shrub (>20%). *Vaccinium uliginosum* may be present but with << cover than *Spirea douglasii.* …….. **44. ROSE SPIREA WET SHRUBLAND**

***Spiraea douglasii* Wet Shrubland**

3’ *Vaccinium uliginosum* is the dominant shrub (>20%). *Spirea douglasii* may be present but with << cover than *Vaccinium uliginosum.* ……...……...…… ……...……. **43. BOG BLUEBERRY / SITKA SEDGE WET SHRUBLAND**

***Vaccinium uliginosum* / *Carex aquatilis* var. *dives* Wet Shrubland**

2’ Not as above.

4. *Alnus* sp. is the dominant shrub species present.

5. *Alnus incana* is the dominant shrub. ……..… ..……...……. **41. GRAY ALDER / FOWL MANNAGRASS WET SHRUBLAND**

***Alnus incana* / *Glyceria striata* Wet Shrubland**

5’ *Alnus viridis* is the dominant shrub. ……...…….……. ..……...…….. **42. SITKA ALDER / MESIC FORBS WET SHRUBLAND**
***Alnus viridis* ssp. *sinuata* / Mesic Forbs Wet Shrubland**

4’ *Salix* spp. are the dominant shrub species present.

6. *Salix commutata* is the dominant or codominant *Salix* species present, *Salix lucida, S. sitchensis,* and/or *S. scouleri* may be present and codominant with *Salix commutata*. Some stands may have only *Salix lucida, S. sitchensis,* or *S. scouleri* and no *Salix commutata* present. …….. **39. UNDERGREEN WILLOW / MOUNTAIN SEDGE WET SHRUBLAND**
***Salix commutata* / *Carex scopulorum* Wet Shrubland**

6’ *Salix boothii* is the dominant shrub species present. …….. …….. **40. BOOTH'S WILLOW / BLUEJOINT WET SHRUBLAND**
Salix boothii* / *Calamagrostis canadensis Wet Shrubland

1’ Shrublands of upland habitats. None of the wetland attributes (hydric soil, hydrophytic vegetation, wetland hydrology) are present.

7. *Ericameria* spp. are the dominant shrub species present.

8. *Ericameria greenei* common. *Ericameria bloomeri* absent. ……..……. ……. **23. GREENE'S GOLDENBUSH / DAVIS' KNOTWEED SHRUB GRASSLAND**
***Ericameria greenei* / *Polygonum davisiae* Shrub Grassland**

8’ *Ericameria greenei* absent. *Ericameria bloomeri* common or present with a least 2% cover. … …….. **37. RABBITBUSH SHRUB GRASSLAND [PROVISIONAL]**
***Ericameria bloomeri* Shrub Grassland [Provisional]**

7’ *Ericameria* spp. absent, rare (< 1% cover), or not the dominant shrub species present. *Holodiscus discolor, Sambucus racemosa, Arctostaphylos* spp., *Ceanothus* spp., *Garrya fremontii,* and/or *Prunus emarginata* dominant.

9. *Prunus emarginata* is the dominant shrub species present. *Prunus emarginata* may be codominant with other shrub species but no single species except *Arctostaphylos nevadensis* or *Symphoricarpos mollis* has higher cover than *Prunus emarginata* and *Prunus emarginata* has at least 5% cover. …….. **34. BITTER CHERRY SIERRAN CHAPARRAL SHRUBLAND**
***Prunus emarginata* Sierran Chaparral Shrubland**

9’ Not as above and/or *Prunus emarginata* absent or rare.

10. *Garrya fremontii* present and abundant (at least 5% cover) and may be codominant with *Arctostaphylos patula, Ceanothus velutinus,* and/or *Chrysolepis sempervirens.* ……..…… ……...…… **33. BEARBRUSH / LOBB'S FIDDLELEAF SHRUBLAND**
***Garrya fremontii / Nama lobbii* Shrubland**

10' *Garrya fremontii* absent or rare (<5% cover).

11. *Purshia tridentata* is the dominant shrub species present. No other shrub species with greater cover. …….. ……... **38. ANTELOPE BITTERBRUSH / LONG-STOLON SEDGE – WESTERN NEEDLEGRASS SHRUB GRASSLAND**
***Purshia tridentata / Carex inops* ssp. *inops* - *Achnatherum occidentale* Shrub Grassland**

11' *Purshia tridentata* absent or rare (<5% cover).

12. *Arctostaphylos patula* is dominant or codominant with *Ceanothus* spp. *Ceanothus velutinus* may be the dominant shrub.

13. *Arctostaphylos patula* is the dominant shrub or codominant with *Ceanothus velutinus* and *Chrysolepis sempervirens,* however both these species may be absent. *Ceanothus velutinus* may be the dominant shrub. *Ceanothus prostratus* absent, rare or <5%. …….. …… **31. GREENLEAF MANZANITA SIERRAN CHAPARRAL SHRUBLAND**
***Arctostaphylos patula* Sierran Chaparral Shrubland**

13' *Arctostaphylos patula* is the dominant shrub. *Ceanothus prostratus* is always codominant and common (>5% cover). *Ceanothus velutinus* and *Chrysolepis sempervirens* absent or rare, if present then no more than 5%. ……...… …… **30. GREENLEAF MANZANITA – (SNOWBRUSH CEANOTHUS) / PROSTRATE CEANOTHUS SHRUBLAND**
***Arctostaphylos patula* - (*Ceanothus velutinus*) / *Ceanothus prostratus* Shrubland**

12' Not as above. *Arctostaphylos patula* is not the dominant or codominant shrub species present.

14. *Holodiscus discolor* or *Arctostaphylos nevadensis* the dominant or codominant shrub species present.

15. *Holodiscus discolor* is common and often the dominant or codominant shrub species present (>2% and evenly distributed through the stand). *Arctostaphylos*

nevadensis common and may be more abundant than *Holodiscus discolor* though it may be absent. ……... …….. **35. OCEANSPRAY / MARUMLEAF BUCKWHEAT - LONG-STOLON SEDGE SHRUBLAND**
***Holodiscus discolor / Eriogonum marifolium* - *Carex inops* ssp. *inops* Shrubland**

15'*Holodiscus discolor* absent or rare (<2%). *Arctostaphylos nevadensis* is the dominant shrub species present. *Juncus parryi* and *Cheilanthes gracillima* present. A sparse cover of *Pinus contorta* and/or *Tsuga mertensiana* may be present but <<8%. …. ……. **32. PINEMAT MANZANITA / LACE LIPFERN SHRUBLAND**
***Arctostaphylos nevadensis / Cheilanthes gracillima* Shrubland**

14' *Holodiscus discolor* and *Arctostaphylos nevadensis* uncommon or absent (<5%cover).

16. *Alnus viridis* the dominant or codominant shrub species present. …….. ……**42. SITKA ALDER / MESIC FORBS WET SHRUBLAND**
***Alnus viridis* ssp. *sinuata* / Mesic Forbs Wet Shrubland**

16' *Alnus viridis* is absent or rare (<5% cover). *Sambucus racemosa* is the dominant shrub. ……... **36. RED ELDERBERRY / SPEARLEAF ARNICA SHRUBLAND**
***Sambucus racemosa* / *Arnica longifolia* Shrubland [Provisional]**

Forests and Woodlands

1. Riparian or wetland forests and woodlands. Soils remain moist to saturated through much of the growing season. Herbaceous species in the forest or woodland understory are wetland indicator species usually associated with seasonally wet habitats, such as *Carex* spp.

2. Broadleaved deciduous trees the dominant tree species. Conifer species may be present but << combined cover of broadleaved deciduous trees.

3. *Populus balsamifera* is the dominant tree often codominant with *Populus tremuloides*. …… …. **76. BLACK COTTONWOOD - QUAKING ASPEN / BROADLEAF LUPINE FOREST [PROVISIONAL]**
***Populus balsamifera* ssp. *trichocarpa* – *Populus tremuloides* / *Lupinus latifolius* ssp. *latifolius* Forest [Provisional]**

3' *Populus tremuloides* is the dominant tree species. *Populus balsamifera* absent or rare.

4. *Populus tremuloides* dominant or codominant with *Abies lasiocarpa* and/or *Pinus* contorta. *Penstemon rydbergii* usually present in the understory. Mesic site grasses and forbs are abundant. *Abies lasiocarpa* and *Pinus contorta* may be present and abundant. …… …….. **49. QUAKING ASPEN / CALIFORNIA BROME FOREST**
***Populus tremuloides* / *Bromus carinatus* Forest**

4' Conifers associated with *Populus tremuloides* are *Pinus ponderosa* and *Abies lowiana*. *Abies lasiocarpa* and *Penstemon rydbergii* absent or rare (<1% cover). ……..……..…….. …… **48. QUAKING ASPEN – PONDEROSA PINE FOREST [PROVISIONAL]**
***Populus tremuloides - Pinus ponderosa* Forest [Provisional]**

2' Conifer tree species are the dominant cover. Broadleaved deciduous trees may be present but << combined cover of conifer species.

5. *Picea engelmannii* absent or rare or not the dominant or codominant tree in the overstory. *Pinus contorta, Abies lasiocarpa,* and/or *Tsuga mertensiana* dominant or codominant.

6. *Pinus contorta* is dominant in the overstory. *Abies lasiocarpa* and/or *Tsuga mertensiana* may be present but < *Pinus contorta*. *Vaccinium uliginosum* and/or *Carex aquatilis* var. *dives* are abundant in the understory. ……..……. … **80. (TALL LODGEPOLE PINE, SIERRA LODGEPOLE PINE) / BOG BLUEBERRY FOREST**
***Pinus contorta* (*var. latifolia*, var. *murrayana*) / *Vaccinium uliginosum* Forest**

6' *Abies lasiocarpa* and/or *Tsuga mertensiana* dominant or codominant in the overstory. *Pinus contorta* present or absent. *Vaccinium uliginosum* and *Carex aquatilis* var. *dives* may be present but combined are not the dominant species present in the understory.

7. *Abies lasiocarpa* present, often codominant with *Pinus contorta* though *Pinus contorta* may be absent or rare. *Pinus contorta* may be the dominant overstory tree and *Abies lasiocarpa* absent or rare. *Tsuga mertensiana* present or absent and may be abundant. *Picea engelmannii* may be present but not the dominant or codominant tree in the overstory. *Calamagrostis canadensis, Carex scopulorum* and other wetland *Carex* spp. common, often forming dense swards. Wetland site herbaceous species common and diverse. ……. …….. **77. SUBALPINE FIR - SIERRA LODGEPOLE PINE / BLUEJOINT – SEDGE SPP. FOREST [PROVISIONAL]**
***Abies lasiocarpa - Pinus contorta var. murrayana / Calamagrostis canadensis - Carex spp.* Forest [Provisional]**

7' *Abies lasiocarpa* dominant or codominant with *Tsuga mertensiana. Pinus contorta* present or absent. Sites generally not saturated. *Calamagrostis canadensis* and other *Carex* spp. may be present but not forming dense swards. *Rubus lasiococcus* and *Elymus glaucus* often

present. Mesic site herbaceous species common and diverse. Wetland species are not the dominant cover in the understory. ……..…… …...……..…….. **73. SUBALPINE FIR - MOUNTAIN HEMLOCK / ROUGH-FRUIT BERRY FOREST [PROVISIONAL]**
***Abies lasiocarpa – Tsuga mertensiana / Rubus lasiococcus* Forest [Provisional]**

5’ *Picea engelmannii* the dominant or codominant tree or > 7% cover in the overstory.

8. *Tsuga heterophylla* present (>5%) and codominant with *Picea engelmannii.* …….. …… **78. WESTERN HEMLOCK - ENGELMANN SPRUCE FOREST [PROVISIONAL]**
***Tsuga heterophylla – Picea engelmannii* Forest [Provisional]**

8’ *Tsuga heterophylla* absent or rare.

9. *Picea engelmannii* is the dominant tree. *Abies lasiocarpa* and *Tsuga mertensiana* are often present and abundant. Sites are often saturated. Wetland species generally dominate the understory. …….. …….. **79. ENGELMANN SPRUCE / BLUEBERRY SPP. FOREST [PROVISIONAL]**
***Picea engelmannii* / *Vaccinium* spp. Forest [Provisional]**

9’ *Picea engelmannii* is the dominant tree or codominant with *Abies lasiocarpa. Tsuga mertensiana* usually common. *Calamagrostis canadensis* may be present but not forming dense swards. Sites are mesic to cold and dry and generally not saturated. Mesic site herbaceous species common and diverse. Wetland species absent or rare. ……. ……. **47. SUBALPINE FIR - ENGELMANN SPRUCE / GROUSE WHORTLEBERRY FOREST**
***Abies lasiocarpa - Picea engelmannii* / *Vaccinium scoparium* Forest**

1’ Upland forests and woodlands. None of the wetland attributes (hydric soil, hydrophytic vegetation, wetland hydrology) are present. Obligate wetland species absent or very low in cover (<3%). Forest trees common, dominant or sometimes codominant.

10. Broadleaved, deciduous trees dominant or codominant *Populus tremuloides* the only broadleaved deciduous tree present. Conifers (*Abies, Pinus*) often present, generally subordinate.

11. Conifers associated with *Populus tremuloides* typically include *Pinus contorta* and *Abies lasiocarpa*. *Penstemon rydbergii* usually present in the understory. ……..….. ...…… **49. QUAKING ASPEN / CALIFORNIA BROME FOREST**
***Populus tremuloides / Penstemon rydbergii* Forest**

11’ Conifers associated with *Populus tremuloides* typically include *Pinus ponderosa* and *Abies lowiana*. *Abies lasiocarpa*, and *Penstemon rydbergii* absent or rare (<1% cover). ……..… ……...…...…… **48. QUAKING ASPEN – PONDEROSA PINE FOREST [PROVISIONAL]**

***Populus tremuloides - Pinus ponderosa* Forest [Provisional]**

10’ Coniferous trees dominant, broadleaved, deciduous trees absent or rare.

12. *Pinus albicaulis* is common (> 5% cover).

13. *Pinus albicaulis* is codominant with *Tsuga mertensiana* and/or *Pinus contorta*. *Tsuga mertensiana* and/or *Pinus contorta* may be dominant but *Pinus albicaulis* is always present with at least 5% cover. Upper montane, dry-site herbaceous species common. ……. **65. MOUNTAIN HEMLOCK - SIERRA LODGEPOLE PINE - WHITEBARK PINE FOREST**
***Tsuga mertensiana – Pinus contorta var. murrayana – Pinus albicaulis* Forest**

13’ *Pinus albicaulis* is always dominant but may occasionally be codominant with *Tsuga mertensiana* or *Pinus contorta*. *Penstemon davidsonii* and/or *Ribes erythrocarpum* present and often abundant. Sub-alpine herbaceous species common. …….. **72. WHITEBARK PINE / DAVIDSON'S PENSTEMON WOODLAND**
***Pinus albicaulis / Penstemon davidsonii* Woodland**

12’ *Pinus albicaulis* is absent or rare (< 5%).

14. *Calocedrus decurrens* is common, generally > 10% cover, or is codominant with other forest trees present in the canopy.

15. *Pinus ponderosa* is dominant or codominant in the overstory. *Ceanothus prostratus* and/or other dry-site understory species common. *Tsuga mertensiana* and *Abies magnifica* var. *shastensis* generally absent. ……. **55. PONDEROSA PINE – INCENSE CEDAR / PROSTRATE CEANOTHUS WOODLAND [PROVISIONAL]**
***Pinus ponderosa – Calocedrus decurrens / Ceanothus prostratus* Woodland [Provisional]**

15’ *Calocedrus decurrens* dominant or codominant with *Abies lowiana* and/or *Pseudotsuga menziesii*. *Pinus ponderosa* is present or absent. *Abies lowiana* and/or *Pseudotsuga menziesii* may be dominant. *Tsuga mertensiana* and *Abies magnifica* var. *shastensis* may be common. Mesic site forbs generally common. ……... **51. DOUGLAS-FIR – SIERRA WHITE FIR - INCENSE-CEDAR FOREST**
***Pseudotsuga menziesii - Abies lowiana - Calocedrus decurrens* Forest**

14’ *Calocedrus decurrens* is absent or rare (<5% cover).

16. *Abies lowiana, Pseudotsuga menziesii,* or *Pinus ponderosa* common (>10%) in the canopy. *Tsuga mertensiana* and *Abies magnifica* var. *shastensis* may be common and/or codominant but are not the dominant canopy tree.

17. *Pinus ponderosa* is dominant or codominant.

18. *Pinus lambertiana* common, present with at least 5% cover in the overstory and is generally codominant with the other principle tree species present. …… ……. **50. SIERRA WHITE FIR - SUGAR PINE - PONDEROSA PINE / GREENLEAF MANZANITA FOREST**
***Abies lowiana - Pinus lambertiana - Pinus ponderosa* / *Arctostaphylos patula* Forest**

18’ *Pinus lambertiana* absent or rare, (cover <5%) and not codominant in the overstory with the other principle tree species present.

19. *Pinus ponderosa* is the dominant overstory tree. No other tree species present in abundance. *Abies lowiana* or *Pinus contorta* absent or < 5%. *Arctostaphylos patula* often abundant in the understory. …….. …… **45. PONDEROSA PINE / GREENLEAF MANZANITA – ANTELOPE BITTERBRUSH WOODLAND**
***Pinus ponderosa* / *Arctostaphylos patula – Purshia tridentata* Woodland**

19’ *Pinus ponderosa* codominant with other conifer tree species.

20. *Pinus contorta* is codominant with *Pinus ponderosa* in the overstory. *Abies lowiana* may be present in abundance, but generally absent in the overstory.

21. *Pinus contorta* is codominant with *Pinus ponderosa* in the overstory. *Abies lowiana* generally absent. …… …….. **46. PONDEROSA PINE / ANTELOPE BITTERBRUSH / LONG-STOLON SEDGE FOREST**
***Pinus ponderosa* / *Purshia tridentata* / *Carex inops* ssp. *inops* Forest**

21’ *Pinus contorta* is codominant with *Pinus ponderosa* in overstory. The overstory may be sparse (<10%). *Abies lowiana, Ceanothus velutinus,* and/or *Arctostaphylos patula* are common in the understory. Recently burned forest. …….. …… **71. SIERRA LODGEPOLE PINE / SNOWBRUSH CEANOTHUS FOREST**
***Pinus contorta* var. *murrayana / Ceanothus velutinus* Forest**

20’ *Pinus contorta* is generally absent or rare. If present, << 5%. Overstory codominated by *Pinus ponderosa, Abies lowiana* and/or *Abies magnifica* var. *shastensis*.

22. *Pinus ponderosa* and *Abies lowiana* codominate in the overstory *Abies magnifica* var. *shastensis* absent or rare (< 5% cover) and/or is not codominant in the overstory. …….. ……. **56. SIERRA WHITE FIR - PONDEROSA PINE / LONG-STOLON SEDGE FOREST**
***Abies lowiana - Pinus ponderosa / Carex inops* ssp. *inops* Forest**

22’ *Abies magnifica* var. *shastensis* and *A. lowiana* codominate in the overstory. *Pinus ponderosa* may be present in the overstory but is not a codominant. ……... …… **57. SIERRA WHITE FIR - SHASTA RED FIR / PIPSISSEWA FOREST**
***Abies lowiana - Abies magnifica* var. *shastensis* / *Chimaphila umbellata* Forest**

17’ *Abies lowiana* and/or *Pseudotsuga menziesii* are dominant or codominant in the overstory. *Pinus ponderosa* is generally absent or rare (< 5%) in the overstory. If present, << cover of the other principle tree species present.

23. *Pseudotsuga menziesii* is dominant or codominant in the forest overstory.

24. *Abies magnifica* var. *shastensis* is dominant or codominant (>10%) in the forest overstory with *Pseudotsuga menziesii.*

25. *Abies lowiana* is rare or absent (cover < 5%) in the overstory. If present, << the cover of *Abies magnifica* var. *shastensis. Arctostaphylos nevadensis* is often dominant in the understory (>5% cover), *Chimaphila umbellata* is present or absent. ……... **62. SHASTA RED FIR – DOUGLAS-FIR / PINEMAT MANZANITA FOREST**
***Abies magnifica* var. *shastensis - Pseudotsuga menziesii / Arctostaphylos nevadensis* Forest**

25’ *Abies lowiana* is common in the overstory and codominant with *Abies magnifica* var. *shastensis*. *Arctostaphylos nevadensis* is uncommon in the understory (<2% cover). *Chimaphila umbellata* is common in the understory often with a generally high cover of mesic forest species such as *Rubus lasiococcus, Vaccinium membranaceum, Orthilia secunda, Adenocaulon bicolor* and *Achlys triphylla*. …… ……. **60. SHASTA RED FIR / THINLEAF HUCKLEBERRY / PIPSISSEWA FOREST**
***Abies magnifica* var. *shastensis* / *Vaccinium membranaceum* /**

***Chimaphila umbellata* Forest**

24’ *Abies magnifica var*. *shastensis* is rare or absent (cover < 5%). If present, << cover of *Abies lowiana*.

26. *Chrysolepis sempervirens, Ribes viscosissimum, Ribes lacustre,* and/or *Sorbus scopulina* are common in the understory. *Mahonia nervosa, Achlys triphylla* and/or *Anemone deltoidea, Vancouveria hexandra* absent or rare. *Pinus ponderosa* may be present and abundant in the overstory. …….. …… **54. SIERRA WHITE FIR - DOUGLAS-FIR / BUSH CHINQUAPIN FOREST**

***Abies lowiana* - *Pseudotsuga menziesii* / *Chrysolepis sempervirens* Forest**

26’ *Mahonia nervosa, Achlys triphylla, Anemone deltoidea, Vancouveria hexandra* and/or *Rubus ursinus* common in the understory. *Chrysolepis sempervirens* generally absent or rare (<2% cover). …… ……... **53. SIERRA WHITE FIR - DOUGLAS-FIR / CASCADE BARBERRY FOREST**

***Abies lowiana* - *Pseudotsuga menziesii* / *Mahonia nervosa* Forest**

23’ *Pseudotsuga menziesii* is not dominant or codominant in the forest overstory, absent or rare (<5% cover). *Abies lowiana* is dominant or codominant in the overstory.

27. *Abies magnifica* var. *shastensis* is rare or absent (cover < 5%) *Pinus ponderosa* generally absent or rare (< 5% cover), or not codominant in the overstory. …… ……... **52. SIERRA WHITE FIR / PIPSISSEWA FOREST**

***Abies lowiana / Chimaphila umbellata* Forest**

27’ *Abies magnifica* var. *shastensis* and *A. lowiana* codominate in the overstory *Pinus ponderosa* generally absent or rare (< 5% cover), or not codominant in the overstory.……...……. …….. **57. SIERRA WHITE FIR - SHASTA RED FIR / PIPSISSEWA FOREST**

***Abies lowiana* - *Abies magnifica* var. *shastensis* / *Chimaphila umbellata* Forest**

16’ *Abies lowiana, Pseudotsuga menziesii*, and/or *Pinus ponderosa* generally absent (<5%) in the overstory. *Tsuga mertensiana, Abies magnifica* var. *shastensis, Abies lasiocarpa, Pinus contorta, Pinus monticola,* or *Picea engelmannii* are the dominant and/or codominant canopy tree species.

28. *Abies lasiocarpa* and/or *Picea engelmannii* common in the forest overstory (cover > 5%), often dominant or codominant. *Tsuga mertensiana* present or absent and may be common and/or codominant in the forest overstory.

29. *Picea engelmannii* is dominant or codominant (>10% cover). *Abies lasiocarpa* is present or absent and may be common and codominant with *Picea engelmannii*.

30. *Tsuga heterophylla* present (>5%) and codominant with *Picea engelmannii.* …… ……... **78. WESTERN HEMLOCK - ENGELMANN SPRUCE FOREST [PROVISIONAL]**
***Tsuga heterophylla – Picea engelmannii* Forest [Provisional]**

30' *Tsuga heterophylla* generally absent or rare (<5%).

31. *Abies lasiocarpa* is dominant or codominant with *Picea engelmannii.* ……... ……. **47. SUBALPINE FIR - ENGELMANN SPRUCE / GROUSE WHORTLEBERRY FOREST**
***Abies lasiocarpa - Picea engelmannii* / *Vaccinium scoparium* Forest**

31' *Abies lasiocarpa* is absent or rare. If present, then not the dominant cover, << than the combined cover of principle tree species present. *Abies magnifica* var. *shastensis* and/or *Pseudotsuga menziesii* dominant or codominant with *Picea engelmannii.* Non-wetland sites. …… …….. **60. SHASTA RED FIR / THINLEAF HUCKLEBERRY / PIPSISSEWA FOREST**
***Abies magnifica* var. *shastensis* / *Vaccinium membranaceum* / *Chimaphila umbellata* Forest**

29' *Picea engelmannii* is absent or rare (<5% cover). *Abies lasiocarpa* is dominant or codominant, > 5% cover in the overstory.

32. *Abies lasiocarpa* is dominant or codominant with *Tsuga mertensiana* and *Abies magnifica* var. *shastensis. Pinus contorta* present or absent and may be common. *Rubus lasiococcus* present. Herb layer is generally abundant with mesic site species. *Elymus glaucus, Fragaria vesca, Collomia mazama* and/or *Penstemon rydbergii* are often common in the understory. *Vaccinium* species common. …….. …….. **73. SUBALPINE FIR - MOUNTAIN HEMLOCK / ROUGH-FRUIT BERRY FOREST [PROVISIONAL]**
***Abies lasiocarpa – Tsuga mertensiana / Rubus lasiococcus* Forest [Provisional]**

32' *Abies lasiocarpa* is dominant or codominant with *Pinus contorta. Tsuga mertensiana* present or absent and may be common. *Rubus lasiococcus, Fragaria vesca, Collomia mazama, Penstemon rydbergii,* and/or mesic and wet site herbaceous

species absent or rare (<1% cover). Herb layer is generally sparse and of species common in drier upland sites. …… …….. **75. SUBALPINE FIR - SIERRA LODGEPOLE PINE FOREST [PROVISIONAL]**

***Abies lasiocarpa – Pinus contorta* var. *murrayana* Forest [Provisional]**

28’ Not as above. Abies lasiocarpa and Picea engelmannii generally absent or rare (<5% cover).

33. *Pinus monticola* and *Abies magnifica* var. *shastensis* are codominant in the overstory. *Pinus contorta* present or absent.

34. *Pinus monticola* and *Abies magnifica* var. *shastensis* are codominant in the overstory. *Arctostaphylos nevadensis* is generally present and common, though may be absent. *Pinus contorta* is often present in the overstory and can be a codominant overstory tree. *Penstemon davidsonii* absent. …… ……... **63. CALIFORNIA RED FIR – WESTERN WHITE PINE / PINEMAT MANZANITA FOREST**

***Abies magnifica - Pinus monticola / Arctostaphylos nevadensis* Forest**

34’ *Pinus contorta* is absent or rare. *Penstemon davidsonii* generally present. Total tree cover can be sparse (< 10%). ……. …….. **58. SHASTA RED FIR – WESTERN WHITE PINE / DAVIDSON'S PENSTEMON FOREST [PROVISIONAL]**

***Abies magnifica* var. *shastensis - Pinus monticola / Penstemon davidsonii* Forest [Provisional]**

33’ Not as above.

35. *Pinus contorta* is the sole dominant tree present in the overstory or nearly so. *Abies magnifica* var. *shastensis*, *Pinus monticola*, *Tsuga mertensiana* may be present in the forest canopy layer, but their combined cover is << than that of *Pinus contorta*.

36. *Purshia tridentata* present (>1%) in the understory. …… …… **68. LODGEPOLE PINE / ANTELOPE BITTER-BRUSH / LONG-STOLON SEDGE FOREST**

***Pinus contorta / Purshia tridentata / Carex inops* ssp. *inops* Forest**

36’ *Purshia tridentata* absent or rare (<<1%) in the understory.

37. *Arctostaphylos nevadensis* common in the understory.

38. Trees often sparse. *Cheilanthes gracillima* always present. *Juncus parryi*, *Sedum oregonense*, *Penstemon davidsonii*, and/or *P. rupicola* are often present. Understory strongly dominated by *Arctostaphylos nevadensis*. *Tsuga mertensiana* may be codominant with *Pinus contorta.* ……. …….. **70. SIERRA LODGEPOLE PINE – (MOUNTAIN HEMLOCK) / PINEMAT MANZANITA / DAVIDSON'S PENSTEMON WOODLAND**
***Pinus contorta* var. *murrayana* - (*Tsuga mertensiana*) / *Arctostaphylos nevadensis* / *Penstemon davidsonii* Woodland**

38' Not as above. *Cheilanthes gracillima* absent. *Juncus parryi* and *Penstemon davidsonii* may be present but generally <<1% cover. *Abies magnifica* var. *shastensis* and/or *Tsuga mertensiana* are often present, but are clearly subordinate in the forest canopy layer. …… ……. **66. (TALL LODGEPOLE PINE, SIERRA LODGEPOLE PINE) / PINEMAT MANZANITA FOREST**
***Pinus contorta* (var. *latifolia*, var. *murrayana*) / *Arctostaphylos nevadensis* Forest**

37' *Arctostaphylos nevadensis* uncommon in the understory (<2%).

39. Understory with *Achnatherum occidentale, Lupinus andersonii,* and/or *Carex inops,* their combined cover generally exceeding 2%. ……. ……. **67. SIERRA LODGEPOLE PINE / LONG-STOLON SEDGE FOREST**
***Pinus contorta* var. *murrayana* / *Carex inops* spp. *inops* Forest**

39' Understory very sparse. Total combined cover of all understory species is generally less than 2%. …… ……. **69. SIERRA LODGEPOLE PINE / SPARSE UNDERSTORY FOREST**
***Pinus contorta* var. *murrayana* / Sparse Understory Forest**

35' Not as above.

40. *Pinus contorta* shares overstory dominance with *Abies magnifica* var. *shastensis*, *Pinus monticola*, *Tsuga mertensiana* and/or *Pinus ponderosa*.

41. *Pinus contorta* is codominant with *Pinus ponderosa* in the overstory. *Abies lowiana* may be present in abundance, but generally absent in the overstory.

42. *Pinus contorta* is codominant with *Pinus ponderosa* in the overstory. *Abies lowiana* generally absent. …….

……. **46. PONDEROSA PINE / ANTELOPE BITTER-BRUSH / LONG-STOLON SEDGE FOREST**
***Pinus ponderosa* / *Purshia tridentata* / *Carex inops* ssp. *inops* Forest**

42’ *Pinus contorta* is codominant with *Pinus ponderosa* in overstory. *Abies lowiana, Ceanothus velutinus,* and/or *Arctostaphylos patula* are common in the understory. The overstory may be spares (<10%). Recently burned forest. …… ……... **71. SIERRA LODGEPOLE PINE / SNOWBRUSH CEANOTHUS FOREST**
Pinus contorta var. murrayana / Ceanothus velutinus Forest

41’ *Pinus ponderosa* is absent or rare. *Pinus contorta* is codominant with *Tsuga mertensiana, Abies magnifica* var. *shastensis,* and/or *Pinus monticola. Arctostaphylos nevadensis* common in the understory.

43. *Pinus contorta* is dominant in the canopy at the plot center but ≤ 0.5 ha, and the remainder of the plot is dominated by *Tsuga mertensiana,* and these two dominant canopy trees occur in a mosaic of patches typically ≤ 0.5 ha in the area surrounding the plot. ……. ……. **84. MOUNTAIN HEMLOCK FOREST – LODGEPOLE PINE FOREST COMPLEX**

43’ Not as above.

44. *Pinus contorta* is codominant with *Tsuga mertensiana* and/or *Pinus monticola*. Trees often sparse. *Cheilanthes gracillima* always present. *Juncus parryi, Sedum oregonense, Penstemon davidsonii,* and/or *P. rupicola* are often present. Understory strongly dominated by *Arctostaphylos nevadensis.* …….. ……..… **70. SIERRA LODGEPOLE PINE – (MOUNTAIN HEMLOCK) / PINEMAT MANZANITA / DAVIDSON'S PENSTEMON WOODLAND**
***Pinus contorta* var. *murrayana* - (*Tsuga mertensiana*) / *Arctostaphylos nevadensis* / *Penstemon davidsonii* Woodland**

44’ Not as above. *Cheilanthes gracillima* absent. *Juncus parryi* and *Penstemon davidsonii* may be present but generally <1%.

45. *Pinus contorta* is dominant in the overstory. *Abies magnifica* var. *shastensis* and/or *Tsuga mertensiana* present, but are clearly subordinate in the forest canopy layer. …….. …… **66. (TALL LODGEPOLE PINE, SIERRA LODGEPOLE PINE) / PINEMAT MANZANITA FOREST**

***Pinus contorta* (var. *latifolia*, var. *murrayana*) / *Arctostaphylos nevadensis* Forest**

45’ *Pinus contorta* shares dominance with *Abies magnifica* var. *shastensis* and *Pinus monticola* in the forest canopy. ……. …….. **63. CALIFORNIA RED FIR – WESTERN WHITE PINE / PINEMAT MANZANITA FOREST**

***Abies magnifica* - *Pinus monticola* / *Arctostaphylos nevadensis* Forest**

40’ *Abies magnifica* var. *shastensis* and/or *Tsuga mertensiana* dominant or codominant overstory tree. *Pinus contorta* if present, it is clearly subordinate to one or more other conifers present.

46. *Abies magnifica* var. *shastensis* is codominant in the overstory with *Abies lowiana*, *Pinus ponderosa*, and/or *Pseudotsuga menziesii*.

47. *Pseudotsuga menziesii* is present in the forest overstory with *Abies magnifica* var. *shastensis*.

48. *Pinus contorta* is absent or rare in the overstory. *Abies lowiana* is generally common in the overstory (> 3% cover) but may be absent. *Arctostaphylos nevadensis* is generally uncommon (< 2% cover). Mesic site herbs generally common in the understory. …… ……. **60. SHASTA RED FIR / THINLEAF HUCKLEBERRY / PIPSISSEWA FOREST**

***Abies magnifica* var. *shastensis* / *Vaccinium membranaceum* / *Chimaphila umbellata* Forest**

48’ *Pinus contorta* is generally common in the overstory but may be absent. *Abies lowiana* is generally uncommon in the overstory (< 3%). *Arctostaphylos nevadensis* is common in the understory (>3% cover). Herbaceous layer is sparse and/or of drier site species. ……. …….. **62. SHASTA RED FIR – DOUGLAS-FIR / PINEMAT MANZANITA FOREST**

***Abies magnifica* var. *shastensis* - *Pseudotsuga menziesii* / *Arctostaphylos nevadensis* Forest**

47’ *Pseudotsuga menziesii* is absent or rare. *Abies magnifica* var. *shastensis* and *A. lowiana* codominate in the overstory. *Tsuga mertensiana* generally absent or rare. …….. **57. SIERRA WHITE FIR - SHASTA RED FIR / PIPSISSEWA FOREST**

Abies lowiana* - *Abies magnifica* var. *shastensis* / *Chimaphila umbellata

46’ Abies lowiana, Pinus ponderosa, and/or Pseudotsuga menziesii absent or rare (< 5%).

49. *Abies magnifica* var. *shastensis* is the dominant overstory tree or codominant in the overstory with *Tsuga mertensiana, Pinus monticola,* and/or *Pinus contorta*.

50. *Abies magnifica* var. *shastensis* is the dominant overstory tree with *Pinus monticola* common in the overstory. *Pinus monticola* may be codominant with *Abies magnifica* var. *shastensis. Tsuga mertensiana* may be present but is clearly subordinate to *Abies magnifica* var. *shastensis* in the overstory (< 5% cover).

51. *Penstemon davidsonii* present. *Pinus contorta* is absent or rare. *Tsuga mertensiana* present or absent. Total tree cover often sparse (< 5%). …….. ……. **58. SHASTA RED FIR – WESTERN WHITE PINE / DAVIDSON'S PENSTEMON FOREST [PROVISIONAL]**
***Abies magnifica* var. *shastensis* - *Pinus monticola* / *Penstemon davidsonii* Forest [Provisional]**

51’ *Penstemon davidsonii* generally absent.

52. *Abies magnifica* var. *shastensis* is the sole dominant overstory tree or nearly so. *Pinus monticola* generally uncommon. *Tsuga mertensiana* may be present but is clearly subordinate to *Abies magnifica* var. *shastensis* in the overstory (< 5% cover). ……. **61. SHASTA RED FIR / LONG-STOLON SEDGE FOREST**
***Abies magnifica* var. *shastensis* / *Carex inops* ssp. *inops* Forest**

52’ *Abies magnifica* var. *shastensis* is the dominant overstory tree with *Pinus monticola* common in the overstory. *Pinus monticola* may be codominant with *Abies magnifica* var. *shastensis. Tsuga mertensiana* generally absent or rare. *Pinus contorta* is generally common. *Arctostaphylos nevadensis* is generally common (>2% cover) in the understory but may be absent. …… **63. CALIFORNIA RED FIR – WESTERN WHITE PINE / PINEMAT MANZANITA FOREST**
***Abies magnifica - Pinus monticola* / *Arctostaphylos nevadensis* Forest**

50’ *Abies magnifica* var. *shastensis* is codominant with *Tsuga mertensiana* in the overstory or *Tsuga mertensiana* present in the overstory > 5% and

Arctostaphylos nevadensis, *Vaccinium scoparium* and/or *Chimaphila umbellata* generally common (>2% cover) in the understory. *Pinus monticola* is present or absent. …. **59. SHASTA RED FIR - MOUNTAIN HEMLOCK / PINEMAT MANZANITA FOREST**
***Abies magnifica* var. *shastensis* - *Tsuga mertensiana* / *Arctostaphylos nevadensis* Forest**

49' *Tsuga mertensiana* is the dominant overstory tree or codominant in the overstory with *Abies magnifica* var. *shastensis*, *Pinus monticola*, and/or *Pinus contorta*.

53. *Tsuga mertensiana* is dominant in the canopy at the plot center but ≤ 0.5 ha, and the remainder of the plot is dominated by *Pinus contorta*, and these two dominant canopy trees occur in a mosaic of patches typically ≤ 0.5 ha in the area surrounding the plot. …….. ……... **84. MOUNTAIN HEMLOCK FOREST – LODGEPOLE PINE FOREST COMPLEX**

53' Not as above.

54. *Tsuga mertensiana* is the dominant overstory tree. *Arctostaphylos nevadensis* and *Chimaphila umbellata* are absent or rare. *Pinus monticola* generally uncommon.

55. *Tsuga mertensiana* is the dominant overstory tree or codominant with *Pinus contorta*. *Abies magnifica* var. *shastensis* may be codominant in the overstory. If *Abies magnifica* var. *shastensis* is common, *Tsuga mertensiana* is generally more abundant than *Abies magnifica* var. *shastensis* in the overstory and *Arctostaphylos nevadensis* and *Chimaphila umbellata* are absent or rare (<2% cover) in the understory. *Luzula glabrata* is generally absent or rare. *Vaccinium scoparium* may be present. …… …….. **64. MOUNTAIN HEMLOCK / SPARSE UNDERSTORY FOREST**
***Tsuga mertensiana* / Sparse Understory Forest**

55' *Tsuga mertensiana* is the sole overstory tree or nearly so. *Abies magnifica* var. *shastensis* generally absent or rare but may be present as high as 10% in the overstory *Luzula glabrata* is common (>2%) in the understory. …….. ……... **74. MOUNTAIN HEMLOCK – (PACIFIC SILVER FIR, SUBALPINE FIR) / HITCHCOCK'S SMOOTH WOODRUSH WOODLAND**

***Tsuga mertensiana* - (*Abies amabilis, Abies lasiocarpa*) / *Luzula glabrata* var. *hitchcockii* Woodland**

54’ *Tsuga mertensiana* and/or *Abies magnifica* var. *shastensis* are codominant in the overstory. *Arctostaphylos nevadensis* and *Chimaphila umbellata* are common. *Pinus monticola* generally present and may be common in the overstory. If *Pinus contorta* is common in the forest canopy layer, then the combined cover of *Abies magnifica* var. *shastensis* and *Tsuga mertensiana* > total cover of *Pinus contorta*. If *Tsuga mertensiana* is generally >> more abundant than *Abies magnifica* var. *shastensis* in the overstory then *Arctostaphylos nevadensis* and *Chimaphila umbellata* are common (>2% cover) in the understory. …… …….. **59. SHASTA RED FIR - MOUNTAIN HEMLOCK / PINEMAT MANZANITA FOREST**

***Abies magnifica* var. *shastensis* - *Tsuga mertensiana* / *Arctostaphylos nevadensis* Forest**

Appendix D. Field Data Forms and Instructions

Instructions for Crater Lake Vegetation Mapping Field Form

Survey Date — date the survey was taken; year, month, day.

Polygon Code — Code indicating the vegetation polygon where the plot was taken.

Plot Code — Code indicating the specific plot within the vegetation polygon. This field will begin with either 9999 or 8888 and increment upward.

Surveyors — Names (and addresses, if appropriate) of surveyors, principle surveyor listed first.

Latitude N Use UTM coordinates from GPS

Longitude E Use UTM coordinates from GPS

GPS Error — enter the error inherent in the GPS type/model used.

Plot Length and Plot Width — enter width and length dimensions for rectangular (or square) plots, or radius length for circular plots. Choose the appropriate plot size based on the following:

Forest:	1000 m^2
Shrubland:	400 m^2
Grassland/Meadow	100 m^2

ENVIRONMENTAL DESCRIPTION

Elevation — elevation of the plot (meters above mean sea level).

Slope — measure slope degrees using a clinometer.

Aspect — enter slope aspect; use a compass (be sure to correct for the magnetic declination).

Topographic Position — Topographic position of the plot. NOTE: A comprehensive list of topographic positions is being developed. The list below provides an example of the topographic positions that might be included.

Vegetation Mapping Definitions

Plot Size

Forest:	1000 m^2
Shrubland:	400 m^2
Grassland/Meadow	100 m^2

Topographic Position

INTERFLUVE (crest, summit, ridge): Linear top of ridge, hill, or mountain; the elevated area between two fluves (drainageways) that sheds water to the drainageways.

HIGH SLOPE (shoulder slope, upper slope, convex creep slope): Geomorphic component that forms the uppermost inclined surface at the top of a slope. Comprises the transition zone from backslope to summit. Surface is dominantly convex in profile and erosional in origin.

HIGH LEVEL (mesa): Level top of plateau.

MIDSLOPE (transportational midslope, middle slope): Intermediate slope position.

BACKSLOPE (dipslope): Subset of midslopes that are steep, linear, and may include cliff segments (fall faces).

STEP IN SLOPE (ledge, terracette): Nearly level shelf interrupting a steep slope, rock wall, or cliff face.

LOWSLOPE (lower slope, foot slope, colluvial footslope): Inner gently inclined surface at the base of a slope. Surface profile is generally concave and a transition between midslope or backslope, and toeslope.

TOESLOPE (alluvial toeslope): Outermost gently inclined surface at base of a slope. In profile, commonly gentle and linear and characterized by alluvial deposition.

LOW LEVEL (terrace): Valley floor or shoreline representing the former position of an alluvial plain, lake, or shore.

CHANNEL WALL (bank): Sloping side of a channel.

CHANNEL BED (narrow valley bottom, gully arroyo): Bed of single or braided watercourse commonly barren of vegetation and formed of modern alluvium.

BASIN FLOOR (depression): Nearly level to gently sloping, bottom surface of a basin.

Soil Texture Key

A1 Soil does not remain in a ball when squeezed.....sand

A2 Soil remains in a ball when squeezed.....B

B1 Squeeze the ball between your thumb and forefinger, attempting to make a ribbon that you push up over your finger. Soil makes no ribbon.....loamy sand

B2 Soil makes a ribbon; may be very short.....C

C1 Ribbon extends less than 1 inch before breaking.....D

C2 Ribbon extends 1 inch or more before breaking.....E

D1 Add excess water to small amount of soil; soil feels at least slightly gritty .....loam or sandy loam

D2 Soil feels smooth.....silt loam

E1 Soil makes a ribbon that breaks when 1-2 inches long; cracks if bent into a ring .....F

E2 Soil makes a ribbon 2+ inches long; does not crack when bent into a ring .....G

F1 Add excess water to small amount of soil; soil feels at least slightly gritty .....sandy clay loam or clay loam

F2 Soil feels smooth.....silty loam or silt

G1 Add excess water to a small amount of soil; soil feels at least slightly gritty .....sandy clay or clay

G2 Soil feels smooth.....silty clay

Strata/Lifeform, Height, Cover, Diagnostic Species — Visually divide the community into vegetation layers (strata). Indicate the average height of the stratum in the first column, and average percent cover (using the cover scale below) of the whole stratum in the second column. Trees are defined as single-stemmed woody plants, generally 5m in height or greater at maturity and under optimal growing conditions. Shrubs are defined as multiple-stemmed woody plants generally known to be diagnostic of a particular vegetation type are present, list them. Leave blank if the diagnostics are not known.

Vegetation Strata

T1 (20-35 m) = Emergent Tree

T2 (10-20 m) = Tree Canopy

T3 (5-10 m) = Tree Subcanopy

S1 (2-5 m) = Tall Shrub

S2 (1-2 m) = Short Shrub

S3 (.5-1 m) = Dwarf Shrub

H (<.5 m) = Herbaceous

Physiognomic Class

FOREST — Trees usually over 5m tall with crowns interlocking (generally forming 60-100% cover). Shrubs, herbs and nonvascular plants may be present at any cover value.

WOODLAND — Open stands of trees usually over 5m tall with crowns not usually touching (generally forming 25-60% cover). Shrubs, herbs, and nonvascular plants may be present at any cover value.

SPARSE WOODLAND — Trees usually over 5m tall with widely spaced crowns (generally forming 10-25% canopy cover. Shrubs, herbs, and non-vascular plants may be present with any cover value.

SHRUBLAND — Shrubs and/or small trees usually 0.5-5.0 meters tall with individuals or clumps not touching to interlocking (generally forming >25% canopy cover). Trees may be present, but with cover 10% or less. Herbs and nonvascular plants may be present at any cover value.

SPARSE SHRUBLAND — Shrubs and/or small trees usually 0.5-5m tall with individuals or clumps widely spaced (generally forming 10-25% canopy cover. Trees may be present, but with cover 10% or less. Herbs and nonvascular plants may be present at any cover value.

DWARF SHRUBLAND — Low growing shrubs and/or dwarf trees are usually under 0.5m tall (though known dwarf forms between 0.5 and 1m can be included), individuals or clumps not touching to interlocking (generally forming >25% cover). Trees and shrubs greater than 0.5m may be present but cover with canopy cover 10% or less. Herbs and nonvascular plants may be present at any cover value.

SPARSE DWARF SHRUBLAND — Low growing shrubs and/or dwarf trees usually under 0.5m (though known dwarf forms between 0.5m and 1m can be included) with individuals or clumps widely spaced (generally with 10-25% cover). Trees and shrubs greater than 0.5m may be present, but with cover 10% or less. Herbs and nonvascular plants may be present at any cover value.

HERBACEOUS — Graminoids and/or forbs (including ferns) generally forming >10% cover. Trees, shrubs, and dwarf shrubs may be present, but with cover 10% or less. Nonvascular may be present at any cover value.

SPARSE VASCULAR VEGETATION/NON-VASCULAR — Vascular vegetation is scattered or nearly absent. The cover of each vascular lifeform (tree, shrub, dwarf shrub, herb) is at most 10%; in some cases the total cover of vascular vegetation may exceed 10%. Cover of nonvascular plants (mosses and lichens) may be absent to continuous.

Non-Vegetative Cover

Bedrock- solid rock surface

Litter and Duff- Litter is the top layer of the forest, shrubland, or grassland floor, directly above the duff layer, including freshly fallen leaves, needles, bark flakes, cone scales, fruits (including acorns and cones), dead matted grass and other vegetative parts that are little altered in structure by decomposition. Does not include twigs and larger stems.

Small rocks - <6 inches diameter

Large rocks- >6 inches diameter

Wood- includes twigs and larger material

Bare soil-does not include duff if exposed

Sand- see soil texture key

Water—standing water

Other—describe what it is.

Species/Percent Cover

Start with the uppermost stratum, list all the species present and the percent cover (using the scale provided below) of each species in the stratum. For the tallest stratum, list the estimated average DBH for trees above 10cm diameter.

Cover Scale for Species Percent Cover

1=trace

2=a few (<1%)

3=1-2%

4=2-5%

5=5-10%

6=10-25%

7=25-50%

8=50-75%

9=75-100%

Crater Lake Vegetation Mapping Relevé Data Sheet

Survey Date _____

Plot Code_____Park Code CRLA _____Polygon code_____

Surveyors_____

Latitude___ ___ ___ ___ ___ ___ Longitude___ ___ ___ ___ ___ ___ GPS Error_____

Directions to Plot

Plot representativeness:_____

Plot length_____ Plot width_____ Plot diameter (circular plots)_____

Photographer_____Photograph #_____

This photographs shows the habitat types at site: CRLA_____

Photographer_____Photograph #_____

This photographs shows the habitat types at site: CRLA_____

Photographer_____Photograph #_____

Photographer_____Photograph #_____

Topographic Position Data Sheet (circle one)

INTERFLUVE = (crest, summit, ridge)	LOWSLOPE =(lower slope, foot slope, colluvial footslope)
HIGH SLOPE = (shoulder slope, upper slope, convex slope)	TOESLOPE = (alluvial toeslope)
HIGH LEVEL = (mesa)	LOW LEVEL = (terrace)
MIDSLOPE = (intermediate slope position)	CHANNEL WALL = (bank)
BACKSLOPE = (dipslope)	CHANNEL BED = (narrow valley bottom, gully arroyo)
STEP IN SLOPE (ledge, terracette)	BASIN FLOOR (depression)
Elevation _____**Slope (deg)** _____**Aspect**_____	
Soil Texture___ sand ___ sandy loam ___ loam ___ silt loam ___ clay loam ___ clay ___ peat ___ muck **Non-vegetated surface**: %bedrock___ %litter/duff____ %small rocks____ %large rocks____ %wood____ % bare soil____ %sand____ %water___% other_____describe:_____	
Physiognomic class Forest ____Woodland____Sparse Woodland____Shrubland_____Sparse Shrubland____Dwarf Shrubland ____ Sparse Dwarf Shrubland___Herbaceous Vegetation ____Sparse Vascular Vegetation____	

Species and Percent Cover Data Sheet

Species/percent cover: starting with the uppermost stratum, list all species and % cover for each in the stratum. For forests and woodlands, the estimated average DBH of trees in the tallest stratum. Cover values are: 1=trace, 2=a few (<1%), 3=1-2%, 4=2-5%, 5=5-10%, 6=10-25%, 7=25-50%, 8=50-75%, 9=75-100%.

Disturbance notes (e.g., logging)

Strata	Height	%Cover
T1 Emergent		
T2 Canopy		
T3 Sub canopy (>5m)		
S1 Tall Shrub (2-5 m)		
S2 Short Shrub (<2m)		
S3 Dwarf Shrub (<0.5m)		
H Herbaceous		
N Non-vascular		
V Vine		

Accuracy Assessment Data Sheets

CRLA AA 2017 - Name: _____ Date _____ Waypoint number _____

Coordinates: X _____ Y _____ Elevation _____ M

Plot offset? _____ GPS Error _____ Plot Size _____ Plot Shape _____

Slope _____ Aspect _____ Photo 1 _____ Photo 2 _____

Primary vegetation type in key _____ % _____

Secondary vegetation type in key _____ % _____

Vegetation description if not in key _____

Map Unit in key _____ % _____

Dominant Trees (0-5) _____

Dominant Shrubs (0-5) _____

Dominant Herbs (0-5) _____

CRLA AA 2017 - Name: _____ Date _____ Waypoint number _____

Coordinates: X _____ Y _____ Elevation _____ M

Plot offset? _____ GPS Error _____ Plot Size _____ Plot Shape _____

Slope _____ Aspect _____ Photo 1 _____ Photo 2 _____

Primary vegetation type in key _____ % _____

Secondary vegetation type in key _____ % _____

Vegetation description if not in key _____

Map Unit in key _____ % _____

Dominant Trees (0-5) _____

Dominant Shrubs (0-5) _____

Dominant Herbs (0-5) _____

Appendix E. Classification of the Vegetation of Crater Lake National Park Based on the National Vegetation Classification Hierarchy

Classification Version March 30, 2017

1 Forest & Woodland Class
1.B Temperate & Boreal Forest & Woodland Subclass
1.B.2 Cool Temperate Forest & Woodland Formation
1.B.2.Nb - D194 Rocky Mountain Forest & Woodland Division
1.B.2.Nb.2 - M501 Central Rocky Mountain Dry Lower Montane-Foothill Forest Macrogroup
1.B.2.Nb.2.a - G213 Central Rocky Mountain Ponderosa Pine Open Woodland Group
A3446 Central Rocky Mountain Ponderosa Pine / Shrub Woodland Alliance
Ponderosa Pine / Greenleaf Manzanita - Antelope Bitterbrush Woodland (CEGL000063)
Pinus ponderosa / *Arctostaphylos patula - Purshia tridentata* Woodland

Ponderosa Pine / Antelope Bitterbrush / Long-Stolon Sedge Forest (CEGL000193)
Pinus ponderosa / *Purshia tridentata* / *Carex inops* ssp. *inops* Forest

1.B.2.Nb.5 - M020 Rocky Mountain Subalpine-High Montane Conifer Forest Macrogroup
1.B.2.Nb.5.b - G219 Rocky Mountain Subalpine Dry-Mesic Spruce - Fir Forest & Woodland Group
A3643 Rocky Mountain Dry-Mesic Subalpine Fir - Engelmann Spruce Forest Alliance
Subalpine Fir - Engelmann Spruce / Grouse Whortleberry Forest (CEGL000344)
Abies lasiocarpa - Picea engelmannii / *Vaccinium scoparium* Forest

1.B.2.Nb.5.d - G222 Rocky Mountain Subalpine-Montane Aspen Forest & Woodland Group
A2036 Rocky Mountain Aspen Forest & Woodland Alliance
Quaking Aspen - Ponderosa Pine Forest [Provisional]
Populus tremuloides - Pinus ponderosa Forest [Provisional]

Quaking Aspen / California Brome Forest (CEGL000573)
Populus tremuloides / *Bromus carinatus* Forest

1.B.2.Nd - D192 Vancouverian Forest & Woodland Division
1.B.2.Nd.2 - M023 Southern Vancouverian Montane-Foothill Forest Macrogroup
1.B.2.Nd.2.a - G344 Californian Montane Conifer Forest & Woodland Group
A3672 White Fir - Sugar Pine Forest Alliance
Sierra White Fir - Sugar Pine - Ponderosa Pine / Greenleaf Manzanita Forest (CEGL000016)
Abies lowiana - Pinus lambertiana - Pinus ponderosa / *Arctostaphylos patula* Forest

A3673 Ponderosa Pine - Incense-cedar - Douglas-fir Forest Alliance

Douglas-fir - Sierra White Fir - Incense-Cedar Forest (CEGL005813)

Pseudotsuga menziesii - Abies lowiana - Calocedrus decurrens Forest

A3674 Coastal, Cascadian & Sierran White Fir - Douglas-fir Forest Alliance

Sierra White Fir / Pipsissewa Forest (CEGL000015)

Abies lowiana / Chimaphila umbellata Forest

Sierra White Fir - Douglas-fir / Cascade Barberry Forest (CEGL000019)

Abies lowiana - Pseudotsuga menziesii / *Mahonia nervosa* Forest

Sierra White Fir - Douglas-fir / Bush Chinquapin Forest (CEPP007202)

Abies lowiana - Pseudotsuga menziesii / Chrysolepis sempervirens Forest

A3677 Eastern Sierran White Fir - Ponderosa Pine Forest & Woodland Alliance

Ponderosa Pine - Incense Cedar Woodland / Prostrate Ceanothus Woodland [Provisional]

Pinus ponderosa - Calocedrus decurrens / Ceanothus prostratus Woodland [Provisional]

Sierra White Fir - Ponderosa Pine / Long-Stolon Sedge Forest (CEGL000257)

Abies lowiana - Pinus ponderosa / *Carex inops* ssp. *inops* Forest

A3678 Sierra White Fir - California Red Fir - Shasta Red Fir Forest Alliance

Sierra White Fir - Shasta Red Fir / Pipsissewa Forest (CEGL000030)

Abies lowiana - Abies magnifica var. *shastensis* / *Chimaphila umbellata* Forest

1.B.2.Nd.4 - M025 Vancouverian Subalpine Forest Macrogroup

1.B.2.Nd.4.a - G749 Sierra-Cascade Red Fir - Mountain Hemlock Forest Group

A3619 Sierra-Cascade Red Fir Forest Alliance

Shasta Red Fir - Western White Pine / Davidson's Penstemon Forest [Provisional]

Abies magnifica var. *shastensis - Pinus monticola / Penstemon davidsonii* Forest [Provisional]

Shasta Red Fir - Mountain Hemlock / Pinemat Manzanita Forest (CEGL000035)

Abies magnifica var. *shastensis - Tsuga mertensiana / Arctostaphylos nevadensis* Forest

Shasta Red Fir / Thinleaf Huckleberry / Pipsissewa Forest (CEGL000037)

Abies magnifica var. *shastensis* / *Vaccinium membranaceum* / *Chimaphila umbellata* Forest

Shasta Red Fir / Long-Stolon Sedge Forest (CEGL000348)

Abies magnifica var. *shastensis* / *Carex inops* ssp. *inops* Forest

Shasta Red Fir -Douglas-fir / Pinemat Manzanita Forest (CEPP007203)

Abies magnifica var. *shastensis - Pseudotsuga menziesii* / *Arctostaphylos nevadensis* Forest

California Red Fir - Western White Pine / Pinemat Manzanita Forest (CEGL008615)
Abies magnifica - Pinus monticola / Arctostaphylos nevadensis Forest

A3620 Sierra-Cascade Mountain Hemlock - Lodgepole Pine Forest Alliance

Mountain Hemlock / Sparse Understory Forest (CEGL008685)
Tsuga mertensiana / Sparse Understory Forest

Mountain Hemlock - Sierra Lodgepole Pine - Whitebark Pine Forest (CEGL008692)
Tsuga mertensiana - Pinus contorta var. *murrayana - Pinus albicaulis* Forest

1.B.2.Nd.4.b - G243 Sierra-Cascade Cold-Dry Subalpine Woodland Group

A3621 Subalpine Sierra Lodgepole Pine Forest & Woodland Alliance

(Tall Lodgepole Pine, Sierra Lodgepole Pine) / Pinemat Manzanita Forest (CEGL000133)
Pinus contorta (var. *latifolia*, var. *murrayana*) / *Arctostaphylos nevadensis* Forest

Sierra Lodgepole Pine / Long-Stolon Sedge Forest (CEGL000143)
Pinus contorta var. *murrayana / Carex inops* ssp. *inops* Forest

Lodgepole Pine / Antelope Bitterbrush / Long-Stolon Sedge Forest (CEGL000159)
Pinus contorta / Purshia tridentata / Carex inops ssp. *inops* Forest

Sierra Lodgepole Pine / Sparse Understory Forest (CEGL003069)
Pinus contorta var. *murrayana* / Sparse Understory Forest

Sierra Lodgepole Pine - (Mountain Hemlock) / Pinemat Manzanita / Davidson's Penstemon Woodland (CEPP007266)
Pinus contorta var. *murrayana* - (*Tsuga mertensiana*) / *Arctostaphylos nevadensis* / *Penstemon davidsonii* Woodland

Sierra Lodgepole Pine / Snowbrush Ceanothus Forest (CEPP007283)
Pinus contorta var. *murrayana* / *Ceanothus velutinus* Forest

A3622 Sierra Western Juniper - Whitebark Pine Woodland Alliance

Whitebark Pine / Davidson's Penstemon Woodland (CEGL003134)
Pinus albicaulis / *Penstemon davidsonii* Woodland

1.B.2.Nd.4.c - G245 North Pacific Mountain Hemlock - Silver Fir Forest & Tree Island Group

A3726 Cascadian Pacific Silver Fir - Mountain Hemlock - Subalpine Fir Forest & Woodland Alliance

Subalpine Fir - Mountain Hemlock / Roughfruit Berry Forest [Provisional]

Abies lasiocarpa - Tsuga mertensiana / Rubus lasiococcus Forest [Provisional]

Mountain Hemlock - (Pacific Silver Fir, Subalpine Fir) / Hitchcock's Smooth Woodrush Woodland (CEGL007381)
Tsuga mertensiana - (*Abies amabilis, Abies lasiocarpa*) / *Luzula glabrata* var. *hitchcockii* Woodland

A3729 Cascadian Subalpine Fir - Engelmann Spruce Forest Alliance
Subalpine Fir - Sierra Lodgepole Pine Forest [Provisional]
Abies lasiocarpa - Pinus contorta var. *murrayana* Forest [Provisional]

1.B.3 Temperate Flooded & Swamp Forest
1.B.3.Nc - D195 Rocky Mountain-Great Basin Montane Flooded & Swamp Forest Division
1.B.3.Nc.1 - M034 Rocky Mountain-Great Basin Montane Riparian & Swamp Forest Macrogroup
1.B.3.Nc.1.c - G796 Northern Rocky Mountain Lowland-Foothill Riparian Forest Group
A0311 Northern Rocky Mountain Riparian Black Cottonwood Forest Alliance
Black Cottonwood - Quaking Aspen / Broadleaf Lupine Forest [Provisional]
Populus balsamifera ssp. *trichocarpa - Populus tremuloides* / *Lupinus latifolius* ssp. *latifolius* Forest [Provisional]

1.B.3.Ng - D193 Vancouverian Flooded & Swamp Forest Division
1.B.3.Ng.1 - M035 Vancouverian Flooded & Swamp Forest Macrogroup
1.B.3.Ng.1.b - G507 North Pacific Montane Riparian Woodland Group
A3766 Mountain Hemlock - Pacific Silver Fir Swamp Woodland Alliance
Subalpine Fir - Sierra Lodgepole Pine / Bluejoint - Sedge Spp. Forest [Provisional]
Abies lasiocarpa - Pinus contorta var. *murrayana* / *Calamagrostis canadensis - Carex* spp. Forest [Provisional]

A3767 Cascadian Engelmann Spruce Swamp Woodland Alliance
Western Hemlock - Engelmann Spruce Forest [Provisional]
Tsuga heterophylla - Picea engelmannii Forest [Provisional]

Engelmann Spruce / Blueberry Spp. Forest [Provisional]
Picea engelmannii / *Vaccinium* spp. Forest [Provisional]

1.B.3.Ng.1.c - G256 North Pacific Maritime Swamp Forest Group
A3755 Lodgepole Pine Swamp Forest Alliance
(Tall Lodgepole Pine, Sierra Lodgepole Pine) / Bog Blueberry Forest (CEGL000171)
Pinus contorta (var. *latifolia*, var. *murrayana*) / *Vaccinium uliginosum* Forest

2 Shrub & Herb Vegetation Class
2.B Temperate & Boreal Grassland & Shrubland Subclass

2.B.2 Temperate Grassland & Shrubland Formation

2.B.2.Na - D022 Western North American Grassland & Shrubland Division

2.B.2.Na.2 - M048 Central Rocky Mountain Montane-Foothill Grassland & Shrubland Macrogroup

2.B.2.Na.2.a - G267 Central Rocky Mountain Montane Grassland Group

A4254 Cascadian Subalpine - Montane Grassland Alliance

Columbia Needlegrass - Western Coneflower Grassland [Provisional]
Achnatherum nelsonii - Rudbeckia occidentalis Grassland [Provisional]

California Needlegrass - Anderson's Lupine Grassland (CEPP007204)
Achnatherum occidentale ssp. *californicum - Lupinus andersonii* Grassland

Long-Stolon Sedge - Western Needlegrass Grassland (CEPP007243)
Carex inops ssp. *inops - Achnatherum occidentale* Grassland

Long-Stolon Sedge - Rydberg's Penstemon Grassland (CEPP007248)
Carex inops ssp. *inops - Penstemon rydbergii* Grassland

2.B.2.Na.3 - M168 Rocky Mountain-Vancouverian Subalpine-High Montane Mesic Meadow Macrogroup

2.B.2.Na.3.b - G271 Rocky Mountain-North Pacific Subalpine-Montane Mesic Grassland & Meadow Group

A3951 Montane Licorice-root - Lupine - Larkspur Mesic Meadow Alliance

Bigleaf Lupine - Common Cowparsnip Meadow [Provisional]
Lupinus polyphyllus - Heracleum maximum Meadow [Provisional]

A4119 Shasta Sedge - Canada Goldenrod Meadow Alliance

Shasta Sedge Grassland (CEGL001793)
Carex straminiformis Grassland

2.B.2.Nd - D061 Western North American Interior Chaparral Division

2.B.2.Nd.1 - M094 Cool Interior Chaparral Macrogroup

2.B.2.Nd.1.a - G282 Western North American Montane Sclerophyll Scrub Group

A0788 Greenleaf Manzanita - Pinemat Manzanita Shrubland Alliance

Greenleaf Manzanita - (Snowbrush Ceanothus) / Prostrate Ceanothus Shrubland (CEGL000957)
Arctostaphylos patula - (*Ceanothus velutinus*) / *Ceanothus prostratus* Shrubland

Greenleaf Manzanita Sierran Chaparral Shrubland (CEGL005820)
Arctostaphylos patula Sierran Chaparral Shrubland

Pinemat Manzanita / Lace Lipfern Shrubland (CEPP007205)

Arctostaphylos nevadensis / Cheilanthes gracillima Shrubland

Bearbrush / Lobb's Fiddleleaf Shrubland (CEPP007263)
Garrya fremontii / Nama lobbii Shrubland

A3918 Californian Montane Bitter Cherry - Oceanspray Shrubland Alliance
Bitter Cherry Sierran Chaparral Shrubland (CEGL005822)
Prunus emarginata Sierran Chaparral Shrubland

Oceanspray / Marumleaf Buckwheat - Long-Stolon Sedge Shrubland (CEPP007264)
Holodiscus discolor / *Eriogonum marifolium* - *Carex inops* ssp. *inops* Shrubland

Red Elderberry / Spearleaf Arnica Shrubland (CEPP007280)
Sambucus racemosa / *Arnica longifolia* Shrubland

2.C Shrub & Herb Wetland Subclass
2.C.2 Temperate to Polar Bog & Fen Formation
2.C.2.Na - D029 North American Bog & Fen Division
2.C.2.Na.2 - M877 North American Boreal & Sub-boreal Alkaline Fen Macrogroup
2.C.2.Na.2.c - G516 Rocky Mountain Alkaline Fen Group
A3435 Rocky Mountain Alkaline Sedge Graminoid Fen Alliance
Mud Sedge Fen (CEGL001811)
Carex limosa Fen

2.C.2.Na.3 - M063 North Pacific Bog & Fen Macrogroup
2.C.2.Na.3.a - G285 North Pacific Alkaline Open Fen Group
A3433 North Pacific Sedge Graminoid Fen Alliance
Sitka Sedge Fen (CEGL001826)
Carex aquatilis var. *dives* Fen

2.C.4 Temperate to Polar Freshwater Marsh, Wet Meadow & Shrubland Formation
2.C.4.Nb - D031 Western North American Temperate & Boreal Freshwater Marsh, Wet Meadow & Shrubland Division
2.C.4.Nb.2 - M075 Western North American Montane-Subalpine-Boreal Marsh, Wet Meadow & Shrubland Macrogroup
2.C.4.Nb.2.b - G521 Vancouverian-Rocky Mountain Montane Wet Meadow & Marsh Group
A3804 Water Sedge - Northwest Territory Sedge - Tufted Hairgrass Wet Meadow Alliance
Northwest Territory Sedge Wet Meadow (CEGL001562)
Carex utriculata Wet Meadow

Tufted Hairgrass Wet Meadow (CEGL001599)
Deschampsia cespitosa Wet Meadow

Water Sedge Wet Meadow (CEGL001802)
Carex aquatilis Wet Meadow

Lakeshore Sedge Wet Meadow (CEPP007249)
Carex lenticularis Wet Meadow

Woodrush Sedge Wet Meadow (CEPP007253)
Carex luzulina Wet Meadow

A3806 Clustered Field Sedge - Mountain Sedge - Few-flower Spikerush Wet Meadow Alliance

Mountain Sedge Wet Meadow (CEGL001822)
Carex scopulorum Wet Meadow

Few-flower Spikerush Fen (CEGL001836)
Eleocharis quinqueflora Fen

A3808 Western Mannagrass Wet Meadow Alliance

Panicled Bulrush Marsh (CEGL003322)
Scirpus microcarpus Marsh

A3810 Brook Saxifrage - Arrowleaf Ragwort - Mountain Bluebells Wet Meadow Alliance

Arrowleaf Ragwort Wet Meadow (CEGL001987)
Senecio triangularis Wet Meadow

A3815 Bluejoint - Slimstem Reedgrass - Bluegrass Wet Meadow Alliance

Western Bluejoint Wet Meadow (CEGL001559)
Calamagrostis canadensis Western Wet Meadow

2.C.4.Nb.2.c - G520 Vancouverian-Rocky Mountain Subalpine-Alpine Snowbed, Wet Meadow & Dwarf-shrubland Group

A3832 Black Alpine Sedge - Sibbaldia - Globeflower Wet Meadow Alliance

Black Alpine Sedge Wet Meadow (CEGL001816)
Carex nigricans Wet Meadow

2.C.4.Nb.2.d - G527 Western Montane-Subalpine Riparian & Seep Shrubland Group

A1003 Cascadian Undergreen Willow Wet Shrubland Alliance

Undergreen Willow / Mountain Sedge Wet Shrubland (CEGL001189)

Salix commutata / *Carex scopulorum* Wet Shrubland [Provisional]

A3769 Western Montane Tall Willow Wet Shrubland Alliance

Booth's Willow / Bluejoint Wet Shrubland (CEGL001175)

Salix boothii / *Calamagrostis canadensis* Wet Shrubland

A3771 Western Alder Wet Shrubland Alliance

Gray Alder / Fowl Mannagrass Wet Shrubland (CEGL000228)

Alnus incana / *Glyceria striata* Wet Shrubland

Sitka Alder / Mesic Forbs Wet Shrubland (CEGL002633)

Alnus viridis ssp. *sinuata* / Mesic Forbs Wet Shrubland

2.C.4.Nb.4 - M073 Vancouverian Lowland Marsh, Wet Meadow & Shrubland Macrogroup

2.C.4.Nb.4.c - G322 Vancouverian Wet Shrubland Group

A1123 Pacific Northwest Blueberry Wet Shrubland Alliance

Bog Blueberry / Sitka Sedge Wet Shrubland (CEGL001249)

Vaccinium uliginosum / *Carex aquatilis* var. *dives* Wet Shrubland

A3835 Pacific Willow - Rose Spirea Wet Shrubland Alliance

Rose Spirea Wet Shrubland (CEGL001129)

Spiraea douglasii Wet Shrubland

3 Desert & Semi-Desert Class

3.B Cool Semi-Desert Scrub & Grassland Subclass

3.B.1 Cool Semi-Desert Scrub & Grassland Formation

3.B.1.Ne - D040 Western North American Cool Semi-Desert Scrub & Grassland Division

3.B.1.Ne.3 - M169 Great Basin-Intermountain Tall Sagebrush Steppe & Shrubland Macrogroup

3.B.1.Ne.3.b - G302 Intermountain Mesic Tall Sagebrush Steppe & Shrubland Group

A3179 Antelope Bitterbrush - Big Sagebrush Mesic Steppe & Shrubland Alliance

Rabbitbush Shrub Grassland [Provisional]

Ericameria bloomeri Shrub Grassland [Provisional]

Antelope Bitterbrush / Long-Stolon Sedge - Western Needlegrass Shrub Grassland (CEGL001492)

Purshia tridentata / Carex inops ssp. *inops - Achnatherum occidentale* Shrub Grassland

4 Polar & High Montane Scrub, Grassland & Barrens Class

4.B Temperate to Polar Alpine & Tundra Vegetation Subclass

4.B.1 Temperate & Boreal Alpine Tundra Formation

4.B.1.Nb - D043 Western North American Alpine Tundra Division

4.B.1.Nb.2 - M101 Vancouverian Alpine Tundra Macrogroup
4.B.1.Nb.2.b - G320 North Pacific Alpine-Subalpine Tundra Group
A3337 North Pacific Fescue Alpine Meadow Alliance

Brewer's Sedge Alpine Meadow (CEGL001805)
Carex breweri Alpine Meadow

A4255 Southern Cascadian Pumice Desert Fell-field Alliance

Granite Prickly Phlox - Common Woolly Sunflower Alpine Fell-field [Provisional]
Linanthus pungens - Eriophyllum lanatum Alpine Fell-field [Provisional]

Greene's Goldenbush / Davis' Knotweed Shrub Grassland (CEPP007257)
Ericameria greenei / Polygonum davisiae Shrub Grassland

Marumleaf Buckwheat - Crater Lake Sandwort Fell-field (CEPP007262)
Eriogonum marifolium - Arenaria pumicola Fell-field [Provisional]

Davis' Knotweed - Squirreltail Fell-field (CEPP007270)
Polygonum davisiae - Elymus elymoides Fell-field [Provisional]

Davis' Knotweed - Shasta Buckwheat Fell-field (CEPP007271)
Polygonum davisiae - Eriogonum pyrolifolium Fell-field [Provisional]

Shasta Knotweed - Davis' Knotweed Fell-field (CEPP007275)
Polygonum shastense - Polygonum davisiae Fell-field [Provisional]

5 Aquatic Vegetation Class
5.B Freshwater Aquatic Vegetation Subclass
5.B.2 Temperate to Polar Freshwater Aquatic Vegetation Formation
5.B.2.Na - D049 North American Freshwater Aquatic Vegetation Division
5.B.2.Na.2 - M109 Western North American Freshwater Aquatic Vegetation Macrogroup
5.B.2.Na.2.a - G544 Western North American Temperate Freshwater Aquatic Vegetation Group
A3926 Western Pond-lily Aquatic Vegetation Alliance

Rocky Mountain Pond-lily Aquatic Vegetation (CEGL002001)
Nuphar lutea Aquatic Vegetation

6 Open Rock Vegetation Class
6.B Temperate & Boreal Open Rock Vegetation Subclass
6.B.1 Temperate & Boreal Cliff, Scree, & Other Rock Vegetation Formation
6.B.1.Nb - D052 Western North American Temperate & Boreal Cliff, Scree & Rock Vegetation Division
6.B.1.Nb.1 - M887 Western North American Cliff, Scree & Rock Vegetation Macrogroup

6.B.1.Nb.1.c - G573 Southern Vancouverian Cliff, Scree & Rock Vegetation Group
A3787 Lemmon's Needlegrass - Dense Rock Moss Sparse Cliff, Bald & Outcrop
Davidson's Penstemon Sparse Vegetation (CEPP007265)
Penstemon davidsonii Sparse Vegetation

White Pasqueflower - Davidson's Penstemon Sparse Vegetation (CEPP007276)
Pulsatilla occidentalis - Penstemon davidsonii Sparse Vegetation

Appendix F. Accuracy Assessment Contingency Table for the 2018 Vegetation Map Units of Crater Lake National Park

Table F-1. Accuracy assessment contingency table.

Vegetation Map Unit	1. Pond	2. Montane Grassland	3. Montane Wet Meadow & Marsh	4. Subalpine Wet Meadow & Dwarf-shrubland	5. Subalpine Fell-field	6. Greenleaf Manzanita - Pinemat Manzanita Shrubland	7. Bitter Cherry - Oceanspray Shrubland	8. Antelope Bitterbrush Shrubland	9. Willow Wet Shrubland	10. Western Alder Wet Shrubland	11. Bog Blueberry Wet Shrubland	12. Ponderosa Pine Woodland	13. Quaking Aspen Forest	14. Montane Conifer Forest	15. Shasta Red Fir Forest	16. Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest	17. Lodgepole Pine Forest	18. Whitebark Pine Woodland	19. Subalpine Fir Forest	20. Mountain Hemlock Forest	21. Black Cottonwood - Riparian Forest	22. Subalpine Fir - Lodgepole Pine Riparian Woodland	23. Engelmann Spruce Swamp Woodland	24. Mountain Hemlock Forest - Lodgepole Pine Forest Complex	25. Cliff, Scree, & Rock Vegetation	26. Pumice/Sand	ROW TOTAL (nii)	USER'S PERCENT ACCURACY (Pj=x|i=x)
1. Pond	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	7	71.4
2. Montane Grassland	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	100.0
3. Montane Wet Meadow & Marsh	0	0	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36	100.0
4. Subalpine Wet Meadow & Dwarf-shrubland	0	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	83.3
5. Subalpine Fell-field	0	0	0	0	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	100.0
6. Greenleaf Manzanita - Pinemat Manzanita Shrubland	0	0	0	0	0	28	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	33	84.8
7. Bitter Cherry - Oceanspray Shrubland	0	0	1	0	1	1	23	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	2	0	30	76.7
8. Antelope Bitterbrush Shrubland	0	7	0	0	0	1	0	18	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	30	60.0
9. Willow Wet Shrubland	0	0	4	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	63.6
10. Western Alder Wet Shrubland	0	0	0	0	0	0	1	0	0	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	96.3
11. Bog Blueberry Wet Shrubland	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	100.0
12. Ponderosa Pine Woodland	0	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	100.0
13. Quaking Aspen Forest	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	2	0	0	0	0	0	0	0	12	83.3
14. Montane Conifer Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	33	0	0	0	0	0	0	0	0	0	0	0	0	33	100.0
15. Shasta Red Fir Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	8	54	0	1	0	0	4	0	0	0	0	0	0	67	80.6
16. Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	18	2	0	1	2	0	0	0	0	0	0	30	60.0
17. Lodgepole Pine Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0	0	0	0	0	0	0	0	0	28	100.0
18. Whitebark Pine Woodland	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	29	0	1	0	0	0	0	0	0	32	90.6
19. Subalpine Fir Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	24	3	0	1	0	1	0	1	31	77.4
20. Mountain Hemlock Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	1	0	0	23	0	0	0	0	0	0	28	82.1
21. Black Cottonwood - Riparian Forest	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	6	66.7
22. Subalpine Fir - Lodgepole Pine Riparian Woodland	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2	0	25	2	0	0	0	32	78.1
23. Engelmann Spruce Swamp Woodland	0	1	0	0	0	0	0	0	0	0	0	0	0	3	1	0	0	0	1	0	0	0	26	0	0	0	32	81.3
24. Mountain Hemlock Forest - Lodgepole Pine Forest Complex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	21	0	0	25	84.0
25. Cliff, Scree, & Rock Vegetation	0	0	0	0	5	4	7	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	9	0	26	34.6
26. Pumice/Sand	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	34	36	94.4
COLUMN TOTAL (n_{+j})	5	38	43	5	38	34	35	19	7	28	9	30	10	45	71	21	39	29	30	35	4	26	28	23	12	35	698	N/A
AREA WEIGHTED PRODUCERS' ACCURACY (Pi=Y|J=Y) %	100	78.9	83.7	100	81.6	82.4	65.7	94.7	100	92.9	100	100	100	73.3	76.1	85.7	71.8	100	80.0	65.7	100	96.2	92.9	91.3	75.0	97.1	698	86.2

Note: Accuracy was calculated according to Lea and Curtis (2010). The rows in the table represent the map, and the columns represent the field AA points.

Appendix G. Subtypes in the 1936 map used to calculate the acreage of vegetation types for comparison with our map.

Table G-1. 1936 vegetation subtypes used to calculate acreage for the 2018 vegetation map units.

2018 Vegetation Map Unit	1936 Vegetation Subtype	Area (ha)
2. Montane Grassland	Grass	86.8
	Grass—Herbaceous	38.6
	Grass—Herbaceous Semi-barren	11.6
	Meadow	6.8
	Grass—Herbaceous—*Ribes cereum*—*Pinus contorta*	4.8
	Grass—*Purshia tridentata*	65.2
	Total	**213.8**
5. Subalpine Fell Field	*Polygonum newberryi*—Grass	63.2
	Polygonum newberryi—Grass Semi-barren	1653.7
	Polygonum newberryi—Herbaceous (semi-barren)	88.7
	Polygonum newberryi (semi-barren)	84.8
	Chrysothamnus bloomeri—*Polygonum newberryi*—Herbaceous (semi-barren)	3.9
	Polygonum newberryi—Grass—*Chrysothamnus bloomeri*	62.7
	Polygonum newberryi—Grass—Herbaceous	46.3
	Polygonum newberryi—Grass—Herbaceous Semi-barren	5.8
	Herbaceous (semi-barren)	8.7
	Polygonum newberryi—*Lupinus* sp.—Grass—*Chrysothamnus bloomeri* (semi-barren)	7.7
	Total	**2025.5**
6. Greenleaf Manzanita - Pinemat Manzanita Shrubland	*Arctostaphylos patula*—*Ceanothus velutinus*	294.1
	Arctostaphylos patula—*Castanopsis sempervirens*	4.8
	Arctostaphylos patula—*Ceanothus velutinus*—*Arctostaphylos nevadensis*	2.9
	Ceanothus velutinus	10.6
	Ceanothus velutinus—*Prunus emarginata*	15.5
	Arctostaphylos nevadensis—*Chrysothamnus bloomeri*—*Arctostaphylos patula*—*Ceanothus velutinus*—Grass—Herbaceous	61.7
	Arctostaphylos patula	1.0
	Ceanothus velutinus—*Arctostaphylos patula*—*Salix* sp.	27.0
	Ceanothus velutinus—*Castanopsis sempervirens*—*Arctostaphylos patula*	60.8
	Ceanothus velutinus—*Salix* sp.—*Prunus emarginata*—Grass	6.7
	Grass—Annual—*Arctostaphylos patula*—*Prunus emarginata*	6.8
	Grass—Herbaceous—*Arctostaphylos patula*—*Ceanothus velutinus*	46.3
	Herbaceous—*Ceanothus velutinus*—*Salix* sp. (semi-barren)	15.4
	Ceanothus velutinus—*Ribes cereum*	1.9
	Arctostaphylos patula—*Arctostaphylos nevadensis*—*Salix* sp.	4.8
	Total	**560.3**

Table G-1 (continued). 1936 vegetation subtypes used to calculate acreage for the 2018 vegetation map units.

2018 Vegetation Map Unit	1936 Vegetation Subtype	Area (ha)
12. Ponderosa Pine Woodland	*Pinus ponderosa*	1760.9
	Pinus ponderosa—Pinus contorta	366.4
	Pinus ponderosa—Pinus monticola	89.7
	Pinus ponderosa—Purshia tridentata	1.9
	Pinus ponderosa—Ceanothus velutinus—Arctostaphylos patula	190.9
	Grass—*Purshia tridentata—Pinus ponderosa*	25.1
	Pinus contorta—Pinus ponderosa	27.0
	Pinus contorta—Pinus ponderosa—Ceanothus velutinus—Arctostaphylos patula	14.5
	Ceanothus velutinus—Arctostaphylos patula—Pinus ponderosa—Abies magnifica shastensis	3.9
	Total	**2,480.3**
14. Montane Conifer Forest	*Abies concolor—Abies magnifica shastensis—Pinus ponderosa—Pinus contorta*	135.77
	Abies concolor—Ceanothus velutinus—Arctostaphylos patula	16.67
	Pinus ponderosa—Abies concolor	1498.6
	Pinus ponderosa—Abies concolor—Abies magnifica shastensis	807.1
	Pinus ponderosa—Abies concolor—Ceanothus velutinus	36.6
	Pinus ponderosa—Pinus lambertiana—Abies concolor—Ceanothus velutinus	38.6
	Pinus ponderosa—Abies concolor—Abies magnifica shastensis—Pinus lambertiana	33.7
	Pseudotsuga taxifolia	133.1
	Pseudotsuga taxifolia—Abies magnifica shastensis—Abies concolor	60.8
	Pseudotsuga taxifolia—Abies concolor	112.8
	Pseudotsuga taxifolia—Abies concolor—Populus tremuloides	22.1
	Pinus contorta—Abies concolor—Abies magnifica shastensis—Tsuga mertensiana	201.5
	Total	**3097.3**
15. Shasta Red Fir Forest	*Abies magnifica shastensis—Tsuga mertensiana—Pinus contorta*	5125.4
	Abies magnifica shastensis—Pinus monticola—Tsuga mertensiana	1454.2
	Abies magnifica shastensis—Pinus monticola—Tsuga mertensiana Semi-barren	59.8
	Abies magnifica shastensis—Pinus ponderosa—Pinus contorta	53.0
	Abies magnifica shastensis—Pinus ponderosa	48.2
	Abies magnifica shastensis—Pinus contorta—Pinus monticola—Tsuga mertensiana	978.8
	Abies magnifica shastensis—Pinus ponderosa—Pinus monticola	38.6
	Abies magnifica shastensis—Pinus monticola	406.0
	Abies magnifica shastensis—Pinus contorta—Pinus ponderosa	9.6
	Abies magnifica shastensis—Pinus monticola—Semi-barren	114.8
	Abies magnifica shastensis—Abies concolor—Pinus contorta	74.3
	Abies magnifica shastensis—Pinus monticola—Pinus contorta—Pinus ponderosa	90.6

Table G-1 (continued). 1936 vegetation subtypes used to calculate acreage for the 2018 vegetation map units.

2018 Vegetation Map Unit	1936 Vegetation Subtype	Area (ha)
15. Shasta Red Fir Forest (cont.)	*Abies magnifica shastensis—Pinus monticola—Pinus contorta—Pinus ponderosa Semi-barren*	61.7
	Abies magnifica shastensis—Tsuga mertensiana—Pinus contorta— Grass	38.6
	Ceanothus velutinus—Abies magnifica shastensis—Pinus contorta	46.3
	Abies magnifica shastensis—Pseudotsuga taxifolia—Pinus monticola	12.5
	Abies magnifica shastensis—Tsuga mertensiana	5517.9
	Abies magnifica shastensis—Abies concolor	448.4
	Abies magnifica shastensis—Arctostaphylos patula	2.9
	Abies magnifica shastensis	723.3
	Abies magnifica shastensis—Pseudotsuga taxifolia—Abies concolor	249.8
	Abies magnifica shastensis—Pseudotsuga taxifolia—Ceanothus velutinus	2.9
	Abies magnifica shastensis—Ceanothus velutinus	57.9
	Abies magnifica shastensis—Arctostaphylos patula—Ceanothus velutinus	36.6
	Pinus contorta—Abies magnifica shastensis— Pinus monticola	2016.4
	Pinus contorta—Abies magnifica shastensis	2054.0
	Pinus contorta—Abies magnifica shastensis—Grass	86.8
	Total	**19,809.3**
16. Mountain Hemlock – Lodgepole Pine – Whitebark Pine Forest	*Tsuga mertensiana—Pinus contorta—Pinus albicaulis*	38.6
	Tsuga mertensiana—Pinus albicaulis	176.5
	Tsuga mertensiana—Pinus albicaulis Semi-barren	20.2
	Polygonum newberryi—Tsuga mertensiana—Pinus albicaulis	6.7
	Tsuga mertensiana—Pinus albicaulis—Grass	20.3
	Tsuga mertensiana—Pinus contorta—Pinus albicaulis Semi-barren	19.3
	Arctostaphylos nevadensis—Tsuga mertensiana—Pinus albicaulis	9.6
	Polygonum newberryi—Grass—*Tsuga mertensiana—Pinus albicaulis*	47.3
	Total	**338.5**
17. Lodgepole Pine Forest	*Pinus contorta—Pinus contorta* (dead)*—Abies magnifica shastensis*	19.3
	Pinus contorta	7906.4
	Pinus contorta—Grass	165.9
	Pinus contorta—Pinus contorta (dead)*—Polygonum newberryi*	25.1
	Pinus contorta—Pinus contorta (dead)	6265.3
	Pinus contorta—Pinus monticola	37.6
	Pinus contorta—Ceanothus velutinus	22.2
	Pinus contorta—Pinus contorta (dead)—Grass	71.4
	Total	**14,513.2**

Table G-1 (continued). 1936 vegetation subtypes used to calculate acreage for the 2018 vegetation map units.

2018 Vegetation Map Unit	1936 Vegetation Subtype	Area (ha)
18. Whitebark Pine Woodland	*Polygonum newberryi—Pinus albicaulis—Tsuga mertensiana*	16.4
	Pinus albicaulis—Tsuga mertensiana—Arctostaphylos nevadensis	9.6
	Pinus albicaulis	65.6
	Pinus albicaulis—Grass	18.3
	Pinus albicaulis—Tsuga mertensiana	77.1
	Pinus albicaulis—Tsuga mertensiana Semi-barren	38.6
	Total	**225.6**
19. Subalpine Fir Forest	*Pinus contorta—Abies lasiocarpa*—Herbaceous	43.4
	Abies lasiocarpa—Pinus contorta—Salix sp.	2.9
	Pinus monticola—Abies lasiocarpa—Tsuga mertensiana—Pinus contorta	96.4
	Pinus monticola—Abies lasiocarpa—Tsuga mertensiana—Pinus contorta Semi-barren	225.7
	Abies magnifica shastensis—Abies lasiocarpa—Tsuga mertensiana—Pinus monticola	42.4
	Abies concolor—Pinus monticola—Abies lasiocarpa	6.7
	Abies magnifica shastensis—Tsuga mertensiana—Abies lasiocarpa	81.0
	Abies magnifica shastensis—Abies lasiocarpa	23.1
	Abies magnifica shastensis—Abies lasiocarpa—Semi-barren	34.7
	Grass—Herbaceous—*Abies lasiocarpa—Abies magnifica shastensis*	14.5
	Tsuga mertensiana—Pseudotsuga taxifolia—Abies lasiocarpa—Salix sp.	54.0
	Tsuga mertensiana—Abies lasiocarpa	51.1
	Tsuga mertensiana—Abies magnifica shastensis—Abies lasiocarpa	5.8
	Abies contorta—Abies lasiocarpa—Abies magnifica shastensis	8.7
	Abies lasiocarpa—Pinus contorta	65.6
	Pseudotsuga taxifolia—Abies concolor—Abies lasiocarpa	48.2
	Pseudotsuga taxifolia—Tsuga mertensiana—Abies lasiocarpa	29.9
	Abies magnifica shastensis—Pinus contorta—Tsuga mertensiana—Abies lasiocarpa	69.4
	Pinus contorta—Abies lasiocarpa—Grass	51.1
	Pinus contorta—Abies lasiocarpa—Tsuga mertensiana	199.6
	Total	**1154.2**
20. Mountain Hemlock Forest	*Tsuga mertensiana— Pinus contorta—Pinus monticola*	307.6
	Tsuga mertensiana—Abies magnifica shastensis	4866.0
	Tsuga mertensiana—Abies magnifica shastensis Semi-barren	51.1
	Tsuga mertensiana	5119.6
	Tsuga mertensiana Semi-barren	25.1
	Tsuga mertensiana—Pinus contorta	3972.1
	Tsuga mertensiana—Pinus contorta Semi-barren	1.9
	Tsuga mertensiana—Grass	77.1
	Tsuga mertensiana—Abies concolor—Abies magnifica shastensis	121.5
	Tsuga mertensiana—Pinus contorta—Herbaceous	9.6
	Tsuga mertensiana—Polygonum newberryi—Grass	216.0

Table G-1 (continued). 1936 vegetation subtypes used to calculate acreage for the 2018 vegetation map units.

2018 Vegetation Map Unit	1936 Vegetation Subtype	Area (ha)
20. Mountain Hemlock Forest (cont.)	*Tsuga mertensiana—Polygonum newberryi*	55.9
	Tsuga mertensiana—Herbaceous	23.1
	Tsuga mertensiana—Pinus monticola	25.1
	Tsuga mertensiana—Pinus contorta—Pinus monticola	18.3
	Tsuga mertensiana—Grass—Herbaceous	13.5
	Tsuga mertensiana—Pinus contorta—Grass	13.5
	Tsuga mertensiana—Arctostaphylos patula	13.5
	Tsuga mertensiana—Arctostaphylos nevadensis	3.9
	Total	**14,934.4**

Appendix H. List of Vascular Plant Species Identified in Relevé Plots Sampled for the 2018 Vegetation Classification and Mapping of Crater Lake National Park

Table H-1. List of vascular plant species.

Scientific Name	Common Name	Family	Origin	# of Observations (out of 600)
*Abies amabilis**	Pacific silver fir	Pinaceae	Native	2
Abies lowiana	Sierra white fir	Pinaceae	Native	124
*Abies grandis**	grand fir	Pinaceae	Native	1
Abies lasiocarpa var. *lasiocarpa*	subalpine fir	Pinaceae	Native	50
Abies magnifica var. *shastensis*	Shasta red fir	Pinaceae	Native	219
Acer glabrum var. *douglasii*	Douglas maple	Aceraceae	Native	1
Achillea millefolium	common yarrow	Asteraceae	Native	2
Achlys triphylla	sweet after death	Berberidaceae	Native	33
Achnatherum lemmonii var. *lemmonii*	Lemmon's needlegrass	Poaceae	Native	2
Achnatherum nelsonii ssp. *dorei*	Dore's needlegrass	Poaceae	Native	20
Achnatherum occidentale ssp. *californicum*	California needlegrass	Poaceae	Native	93
Achnatherum occidentale ssp. *occidentale*	western needlegrass	Poaceae	Native	1
Achnatherum occidentale ssp. *pubescens*	pubescent western needlegrass	Poaceae	Native	131
Aconitum columbianum ssp. *viviparum*	Columbian monkshood	Ranunculaceae	Native	21
Actaea rubra	red baneberry	Ranunculaceae	Native	8
Adenocaulon bicolor	American trailplant	Asteraceae	Native	35
Ageratina occidentalis	western snakeroot	Asteraceae	Native	6
Agoseris aurantiaca	orange agoseris	Asteraceae	Native	9
Agoseris glauca	pale agoseris	Asteraceae	Native	2
Agoseris glauca var. *monticola*	pale agoseris	Asteraceae	Native	17
Agoseris grandiflora	bigflower agoseris	Asteraceae	Native	1
Agoseris heterophylla	annual agoseris	Asteraceae	Native	1
Agoseris retrorsa	spearleaf agoseris	Asteraceae	Native	2
Agrostis capillaris	colonial bentgrass	Poaceae	Native	1
Agrostis exarata	spike bentgrass	Poaceae	Native	4
Agrostis gigantea	redtop	Poaceae	Non-native	2
Agrostis humilis	alpine bentgrass	Poaceae	Native	6
Agrostis idahoensis	Idaho bentgrass	Poaceae	Native	4
Agrostis pallens	seashore bentgrass	Poaceae	Native	1
Agrostis scabra	rough bentgrass	Poaceae	Native	4
*Agrostis thurberiana**	alpine bentgrass	Poaceae	Native	27
Agrostis variabilis	mountain bentgrass	Poaceae	Native	1

Scientific Name	Common Name	Family	Origin	# of Observations (out of 600)
*Allium amplectens**	narrowleaf onion	Liliaceae	Native	1
Allium validum	Pacific onion	Liliaceae	Native	1
Allotropa virgata	sugarstick	Monotropaceae	Native	20
Alnus incana ssp. *tenuifolia*	thinleaf alder	Betulaceae	Native	2
Alnus viridis ssp. *sinuata*	Sitka alder	Betulaceae	Native	4
Amelanchier alnifolia var. *semiintegrifolia*	Saskatoon serviceberry	Rosaceae	Native	45
*Amelanchier utahensis**	Utah serviceberry	Rosaceae	Native	1
Anaphalis margaritacea	western pearly everlasting	Asteraceae	Native	9
Anemone deltoidea	Columbian windflower	Ranunculaceae	Native	45
Anemone drummondii ssp. *drummondii*	Drummond's anemone	Ranunculaceae	Native	2
Anemone lyallii	Little Mountain thimbleweed	Ranunculaceae	Native	5
Anemone oregana var. *oregana*	blue windflower	Ranunculaceae	Native	13
Antennaria howellii ssp. *neodioica*	Howell's pussytoes	Asteraceae	Native	2
Antennaria media	Rocky Mountain pussytoes	Asteraceae	Native	10
Antennaria racemosa	raceme pussytoes	Asteraceae	Native	3
Antennaria rosea	rosy pussytoes	Asteraceae	Native	18
Apocynum androsaemifolium	spreading dogbane	Apocynaceae	Native	47
Aquilegia formosa	western columbine	Ranunculaceae	Native	9
Arabis × *divaricarpa*	spreadingpod rockcress	Brassicaceae	Native	4
Arabis glabra	tower rockcress	Brassicaceae	Native	2
Arabis holboellii var. *pinetorum*	Holboell's rockcress	Brassicaceae	Native	1
Arabis holboellii var. *retrofracta*	second rockcress	Brassicaceae	Native	4
Arabis lemmonii var. *lemmonii*	Lemmon's rockcress	Brassicaceae	Native	2
Arabis lyallii var. *lyallii*	Lyall's rockcress	Brassicaceae	Native	5
Arabis platysperma var. *howellii*	Howell's pioneer rockcress	Brassicaceae	Native	53
Arabis platysperma var. *platysperma*	pioneer rockcress	Brassicaceae	Native	5
Arabis rectissima var. *rectissima*	bristlyleaf rockcress	Brassicaceae	Native	3
Arabis suffrutescens var. *horzontalis*	horizontal woody rockcress	Brassicaceae	Native	3
Arceuthobium campylopodum	western dwarf mistletoe	Viscaceae	Native	2
Arctostaphylos nevadensis	pinemat manzanita	Ericaceae	Native	119
Arctostaphylos patula	greenleaf manzanita	Ericaceae	Native	78
Arenaria pumicola	Crater Lake sandwort	Caryophyllaceae	Native	42
Arnica × *diversifolia Greene*	rayless arnica	Asteraceae	Native	1
Arnica cordifolia	heartleaf arnica	Asteraceae	Native	4
Arnica longifolia	spearleaf arnica	Asteraceae	Native	9
Arnica mollis	hairy arnica	Asteraceae	Native	8
Arnica nevadensis	Nevada arnica	Asteraceae	Native	8
Arnica viscosa	Mt. Shasta arnica	Asteraceae	Native	3
Asarum caudatum	British Columbia wildginger	Aristolochiaceae	Native	2

Scientific Name	Common Name	Family	Origin	# of Observations (out of 600)
Asyneuma prenanthoides	California harebell	Campanulaceae	Native	5
Athyrium filix-femina	common ladyfern	Dryopteridaceae	Native	9
Berula erecta	cutleaf waterparsnip	Apiaceae	Native	1
Botrychium lanceolatum	lanceleaf grapefern	Ophioglossaceae	Native	1
Botrychium multifidum	leathery grapefern	Ophioglossaceae	Native	2
Botrychium pumicola	Crater Lake grapefern	Ophioglossaceae	Native	1
Bromus carinatus	California brome	Poaceae	Native	49
*Bromus ciliatus**	fringed brome	Poaceae	Native	2
Bromus laevipes	Chinook brome	Poaceae	Native	7
Bromus orcuttianus	Orcutt's brome	Poaceae	Native	11
Bromus suksdorfii	Suksdorf's brome	Poaceae	Native	3
Bromus vulgaris	Columbia brome	Poaceae	Native	32
Calamagrostis canadensis	bluejoint	Poaceae	Native	21
Calocedrus decurrens	incense cedar	Cupressaceae	Native	24
Calochortus elegans	elegant mariposa lily	Liliaceae	Native	6
Caltha leptosepala	white marsh marigold	Ranunculaceae	Native	2
Calypso bulbosa	fairy slipper	Orchidaceae	Native	2
Calystegia occidentalis ssp. *occidentalis*	chaparral false bindweed	Convolvulaceae	Native	1
Camassia leichtlinii ssp. *suksdorfii*	Suksdorf's large camas	Liliaceae	Native	1
*Camassia leichtlinii**	Suksdorf's large camas	Liliaceae	Native	8
Campanula scouleri	pale bellflower	Campanulaceae	Native	16
Canadanthus modestus	giant mountain aster	Asteraceae	Native	1
Cardamine bellidifolia	alpine bittercress	Brassicaceae	Native	1
*Cardamine pensylvanica**	Pennsylvania bittercress	Brassicaceae	Native	2
*Carex abrupta**	abruptbeak sedge	Cyperaceae	Native	2
*Carex angustata**	widefruit sedge	Cyperaceae	Native	2
Carex aquatilis var. *aquatilis*	water sedge	Cyperaceae	Native	2
Carex aquatilis var. *dives*	Sitka sedge	Cyperaceae	Native	6
Carex athrostachya	slenderbeak sedge	Cyperaceae	Native	4
*Carex bolanderi**	Bolander's sedge	Cyperaceae	Native	1
Carex brainerdii	Brainerd's sedge	Cyperaceae	Native	14
Carex breweri	Brewer's sedge	Cyperaceae	Native	33
Carex canescens ssp. *canescens*	silvery sedge	Cyperaceae	Native	3
Carex disperma	softleaf sedge	Cyperaceae	Native	3
Carex echinata ssp. *echinata*	star sedge	Cyperaceae	Native	8
*Carex exsiccata**	western inflated sedge	Cyperaceae	Native	2
Carex fracta	fragile sheath sedge	Cyperaceae	Native	1
Carex halliana	Hall's sedge	Cyperaceae	Native	43
Carex hoodii	Hood's sedge	Cyperaceae	Native	6
Carex illota	sheep sedge	Cyperaceae	Native	3
Carex inops ssp. *inops*	long-stolon sedge	Cyperaceae	Native	268

Scientific Name	Common Name	Family	Origin	# of Observations (out of 600)
*Carex integra**	smoothbeak sedge	Cyperaceae	Native	2
Carex jonesii	Jones' sedge	Cyperaceae	Native	15
Carex laeviculmis	smoothstem sedge	Cyperaceae	Native	3
Carex lenticularis	lakeshore sedge	Cyperaceae	Native	15
*Carex leporinella**	Sierra hare sedge	Cyperaceae	Native	4
Carex leptopoda	taperfruit shortscale sedge	Cyperaceae	Native	3
Carex limosa	mud sedge	Cyperaceae	Native	1
Carex luzulina	woodrush sedge	Cyperaceae	Native	13
Carex mertensii	Mertens' sedge	Cyperaceae	Native	1
Carex microptera	smallwing sedge	Cyperaceae	Native	4
Carex neurophora	alpine nerve sedge	Cyperaceae	Native	11
Carex nigricans	black alpine sedge	Cyperaceae	Native	1
Carex pachystachya	chamisso sedge	Cyperaceae	Native	5
Carex preslii	Presl's sedge	Cyperaceae	Native	2
Carex raynoldsii	Raynolds' sedge	Cyperaceae	Native	2
Carex rossii	Ross' sedge	Cyperaceae	Native	140
Carex scopulorum var. *bracteosa*	mountain sedge	Cyperaceae	Native	8
Carex spectabilis	showy sedge	Cyperaceae	Native	2
Carex straminiformis	Shasta sedge	Cyperaceae	Native	14
Carex subfusca	brown sedge	Cyperaceae	Native	15
*Carex utriculata**	Northwest Territory sedge	Cyperaceae	Native	8
Castilleja applegatei ssp. *applegatei*	wavyleaf Indian paintbrush	Scrophulariaceae	Native	3
Castilleja applegatei ssp. *pinetorum*	wavyleaf Indian paintbrush	Scrophulariaceae	Native	25
Castilleja arachnoidea	cobwebby Indian paintbrush	Scrophulariaceae	Native	26
Castilleja miniata ssp. *miniata*	giant red Indian paintbrush	Scrophulariaceae	Native	6
Ceanothus integerrimus	deerbrush	Rhamnaceae	Native	2
Ceanothus prostratus	prostrate ceanothus	Rhamnaceae	Native	14
Ceanothus velutinus var. *velutinus*	snowbrush ceanothus	Rhamnaceae	Native	64
*Cerastium fontanum**	common mouse-ear chickweed	Caryophyllaceae	Non-native	1
Chaenactis douglasii var. *douglasii*	Douglas' dustymaiden	Asteraceae	Native	1
Chamaesyce serpyllifolia	thymeleaf sandmat	Euphorbiaceae	Native	1
Chamerion angustifolium ssp. *circumvagum*	fireweed	Onagraceae	Native	75
Cheilanthes gracillima	lace lipfern	Pteridaceae	Native	17
Chimaphila menziesii	little prince's pine	Pyrolaceae	Native	91
Chimaphila umbellata	pipsissewa	Pyrolaceae	Native	178
Chrysolepis chrysophylla var. *chrysophylla*	giant chinquapin	Fagaceae	Native	6
Chrysolepis sempervirens	bush chinquapin	Fagaceae	Native	37
Cicuta douglasii	western water hemlock	Apiaceae	Native	1

Scientific Name	Common Name	Family	Origin	# of Observations (out of 600)
Cinna latifolia	drooping woodreed	Poaceae	Native	4
Circaea alpina ssp. *pacifica*	small enchanter's nightshade	Onagraceae	Native	8
Cirsium vulgare	bull thistle	Asteraceae	Non-native	3
Cistanthe umbellata	Mt. Hood pussypaws	Portulacaceae	Native	71
Claytonia sibirica	Siberian springbeauty	Portulacaceae	Native	5
Clinopodium douglasii	yerba buena	Lamiaceae	Native	1
Clintonia uniflora	bride's bonnet	Liliaceae	Native	29
Collinsia parviflora	maiden blue eyed Mary	Scrophulariaceae	Native	9
Collomia grandiflora	grand collomia	Polemoniaceae	Native	6
Collomia heterophylla	variableleaf collomia	Polemoniaceae	Native	4
Collomia linearis	tiny trumpet	Polemoniaceae	Native	6
Collomia mazama	Mt. Mazama collomia	Polemoniaceae	Native	7
Collomia tinctoria	staining collomia	Polemoniaceae	Native	9
Corallorhiza maculata	summer coralroot	Orchidaceae	Native	26
Corallorhiza mertensiana	Pacific coralroot	Orchidaceae	Native	18
Corallorhiza striata	hooded coralroot	Orchidaceae	Native	3
Cornus sericea	redosier dogwood	Cornaceae	Native	2
Corylus cornuta var. *californica*	California hazelnut	Betulaceae	Native	1
Crepis pleurocarpa	nakedstem hawksbeard	Asteraceae	Native	1
Cryptantha affinis	quill cryptantha	Boraginaceae	Native	2
Cryptantha sobolifera	Waterton Lakes cryptantha	Boraginaceae	Native	1
Cryptogramma cascadensis	Cascade rockbrake	Pteridaceae	Native	5
Cynoglossum occidentale	western hound's tongue	Boraginaceae	Native	5
Cystopteris fragilis	brittle bladderfern	Dryopteridaceae	Native	5
Danthonia intermedia	timber oatgrass	Poaceae	Native	2
Danthonia unispicata	onespike danthonia	Poaceae	Native	2
Delphinium glaucum	Sierra larkspur	Ranunculaceae	Native	3
Delphinium menziesii	Menzies' larkspur	Ranunculaceae	Native	1
Delphinium nuttallianum	twolobe larkspur	Ranunculaceae	Native	4
Deschampsia cespitosa	tufted hairgrass	Poaceae	Native	4
Deschampsia danthonioides	annual hairgrass	Poaceae	Native	1
Deschampsia elongata	slender hairgrass	Poaceae	Native	1
Descurainia incana var. *viscosa*	mountain tansymustard	Brassicaceae	Native	1
Dicentra formosa	Pacific bleeding heart	Fumariaceae	Native	26
Dodecatheon alpinum	alpine shootingstar	Primulaceae	Native	11
Drosera rotundifolia	roundleaf sundew	Droseraceae	Native	1
*Eleocharis palustris**	common spikerush	Cyperaceae	Native	3
Eleocharis quinqueflora	fewflower spikerush	Cyperaceae	Native	8
Elymus elymoides ssp. *elymoides*	squirreltail	Poaceae	Native	181
Elymus glaucus	blue wildrye	Poaceae	Native	77
Epilobium anagallidifolium	pimpernel willowherb	Onagraceae	Native	1

Scientific Name	Common Name	Family	Origin	# of Observations (out of 600)
Epilobium brachycarpum	tall annual willowherb	Onagraceae	Native	5
Epilobium ciliatum ssp. *ciliatum*	fringed willowherb	Onagraceae	Native	7
Epilobium ciliatum ssp. *glandulosum*	fringed willowherb	Onagraceae	Native	6
Epilobium foliosum	leafy willowherb	Onagraceae	Native	1
Epilobium glaberrimum ssp. *fastigiatum*	glaucus willowherb	Onagraceae	Native	3
Epilobium glaberrimum ssp. *glaberrimum*	glaucus willowherb	Onagraceae	Native	5
*Epilobium glaberrimum**	glaucus willowherb	Onagraceae	Native	3
Epilobium halleanum	glandular willowherb	Onagraceae	Native	1
Epilobium hornemannii	Hornemann's willowherb	Onagraceae	Native	2
Epilobium minutum	chaparral willowherb	Onagraceae	Native	3
Epilobium oregonense	Oregon willowherb	Onagraceae	Native	9
*Epilobium palustre**	marsh willowherb	Onagraceae	Native	1
Equisetum arvense	field horsetail	Equisetaceae	Native	10
Equisetum hyemale var. *affine*	scouringrush horsetail	Equisetaceae	Native	2
Ericameria bloomeri	rabbitbush	Asteraceae	Native	37
Ericameria greenei	Greene's goldenbush	Asteraceae	Native	54
Erigeron aliceae	Alice Eastwood's fleabane	Asteraceae	Native	8
Erigeron foliosus var. *confinis*	leafy fleabane	Asteraceae	Native	3
Erigeron inornatus	California rayless fleabane	Asteraceae	Native	1
Erigeron peregrinus	subalpine fleabane	Asteraceae	Native	9
Eriogonum marifolium	marumleaf buckwheat	Polygonaceae	Native	100
Eriogonum nudum var. *nudum*	naked buckwheat	Polygonaceae	Native	3
Eriogonum ovalifolium var. *nivale*	cushion buckwheat	Polygonaceae	Native	2
Eriogonum polyanthum	sulphur-flower buckwheat	Polygonaceae	Native	3
Eriogonum pyrolifolium var. *coryphaeum*	Shasta buckwheat	Polygonaceae	Native	38
Eriophorum gracile	slender cottongrass	Cyperaceae	Native	1
Eriophyllum lanatum var. *achillaeoides*	common woolly sunflower	Asteraceae	Native	4
Eriophyllum lanatum var. *integrifolium*	common woolly sunflower	Asteraceae	Native	1
*Erythronium grandiflorum**	yellow avalanche-lily	Liliaceae	Native	1
Erythronium klamathense	Klamath fawnlily	Liliaceae	Native	1
Eucephalus ledophyllus	Cascade aster	Asteraceae	Native	43
Eurybia radulina	roughleaf aster	Asteraceae	Native	2
Festuca idahoensis	Idaho fescue	Poaceae	Native	2
Festuca occidentalis	western fescue	Poaceae	Native	20
*Festuca subulata**	bearded fescue	Poaceae	Native	2
Fragaria vesca	woodland strawberry	Rosaceae	Native	34
Fragaria virginiana	Virginia strawberry	Rosaceae	Native	28
Frangula purshiana	Cascara buckthorn	Rhamnaceae	Native	3

Scientific Name	Common Name	Family	Origin	# of Observations (out of 600)
Fritillaria atropurpurea	spotted fritillary	Liliaceae	Native	1
Galium aparine	stickywilly	Rubiaceae	Native	15
*Galium bifolium**	twinleaf bedstraw	Rubiaceae	Native	12
Galium oreganum	Oregon bedstraw	Rubiaceae	Native	1
Galium trifidum ssp. *columbianum*	threepetal bedstraw	Rubiaceae	Native	5
Galium triflorum	fragrant bedstraw	Rubiaceae	Native	24
Garrya fremontii	bearbrush	Garryaceae	Native	5
Gaultheria humifusa	alpine spicywintergreen	Ericaceae	Native	1
Gaultheria ovatifolia	western teaberry	Ericaceae	Native	6
Gayophytum diffusum	spreading groundsmoke	Onagraceae	Native	47
Gayophytum diffusum ssp. *parviflorum*	spreading groundsmoke	Onagraceae	Native	16
Gayophytum heterozygum	zigzag groundsmoke	Onagraceae	Native	1
Gayophytum humile	dwarf groundsmoke	Onagraceae	Native	1
Gentianopsis simplex	oneflower fringed gentian	Gentianaceae	Native	2
*Geum macrophyllum**	largeleaf avens	Rosaceae	Native	9
*Glyceria borealis**	small floating mannagrass	Poaceae	Native	3
Glyceria striata	fowl mannagrass	Poaceae	Native	5
Gnaphalium palustre	western marsh cudweed	Asteraceae	Native	1
Goodyera oblongifolia	western rattlesnake plantain	Orchidaceae	Native	47
Hackelia micrantha	Jessica sticktight	Boraginaceae	Native	13
Hemitomes congestum	coneplant	Monotropaceae	Native	1
Hemizonella minima	opposite-leaved tarweed	Asteraceae	Native	1
Heracleum maximum	common cowparsnip	Apiaceae	Native	7
Hieracium albiflorum	white hawkweed	Asteraceae	Native	81
Hieracium gracile	slender hawkweed	Asteraceae	Native	16
Hieracium horridum	prickly hawkweed	Asteraceae	Native	6
Hieracium scouleri	Scouler's woollyweed	Asteraceae	Native	2
Holodiscus discolor	oceanspray	Rosaceae	Native	32
Hordeum brachyantherum	meadow barley	Poaceae	Native	2
Hulsea nana	dwarf alpinegold	Asteraceae	Native	3
*Hydrophyllum fendleri**	Fendler's waterleaf	Hydrophyllaceae	Native	2
Hypericum anagalloides	tinker's penny	Clusiaceae	Native	13
Hypericum scouleri	Scouler's St. Johnswort	Clusiaceae	Native	6
Ipomopsis aggregata ssp. *formosissima*	scarlet gilia	Polemoniaceae	Native	11
Iris chrysophylla	yellowleaf iris	Iridaceae	Native	27
Isoetes tenella	spiny-spore quillwort	Isoetaceae	Native	1
Juncus arcticus	arctic rush	Juncaceae	Native	1
Juncus drummondii	Drummond's rush	Juncaceae	Native	7
Juncus effusus	common rush	Juncaceae	Native	1

Scientific Name	Common Name	Family	Origin	# of Observations (out of 600)
Juncus ensifolius	swordleaf rush	Juncaceae	Native	7
*Juncus howellii**	Howell's rush	Juncaceae	Native	15
Juncus mertensianus	Mertens' rush	Juncaceae	Native	3
Juncus orthophyllus	straightleaf rush	Juncaceae	Native	5
Juncus parryi	Parry's rush	Juncaceae	Native	45
Kalmia microphylla	alpine laurel	Ericaceae	Native	3
Kelloggia galioides	milk kelloggia	Rubiaceae	Native	56
Kyhosia bolanderi	Bolander's madia	Asteraceae	Native	5
Lathyrus lanszwertii	Nevada pea	Fabaceae	Native	2
Lathyrus nevadensis ssp. *nevadensis*	Sierra pea	Fabaceae	Native	12
Leptosiphon harknessii	Harkness' flaxflower	Polemoniaceae	Native	1
*Lewisia triphylla**	threeleaf lewisia	Portulacaceae	Native	2
Ligusticum grayi	Gray's licorice-root	Apiaceae	Native	34
*Lilium pardalinum**	leopard lily	Liliaceae	Native	1
Lilium washingtonianum	Washington lily	Liliaceae	Native	2
Linanthus pungens	granite prickly phlox	Polemoniaceae	Native	1
Linnaea borealis	twinflower	Caprifoliaceae	Native	26
Linum lewisii var. *lewisii*	prairie flax	Linaceae	Native	1
Listera caurina	northwestern twayblade	Orchidaceae	Native	53
*Listera convallarioides**	broadlipped twayblade	Orchidaceae	Native	1
*Listera cordata**	heartleaf twayblade	Orchidaceae	Native	2
Lomatium martindalei	cascade desertparsley	Apiaceae	Native	43
Lomatium triternatum var. *triternatum*	nineleaf biscuitroot	Apiaceae	Native	5
*Lonicera caerulea**	bluefly honeysuckle	Caprifoliaceae	Native	3
*Lonicera conjugialis**	purpleflower honeysuckle	Caprifoliaceae	Native	1
Lonicera involucrata	twinberry honeysuckle	Caprifoliaceae	Native	1
Lotus oblongifolius var. *oblongifolius*	streambank bird's-foot trefoil	Fabaceae	Native	4
Luetkea pectinata	partridgefoot	Rosaceae	Native	8
Lupinus andersonii	Anderson's lupine	Fabaceae	Native	113
Lupinus latifolius ssp. *latifolius*	broadleaf lupine	Fabaceae	Native	2
Lupinus lepidus	Pacific lupine	Fabaceae	Native	53
Lupinus polyphyllus	bigleaf lupine	Fabaceae	Native	5
Lupinus sellulus	Donner Lake lupine	Fabaceae	Native	1
Luzula glabrata var. *hitchcockii*	Hitchcock's smooth woodrush	Juncaceae	Native	53
Luzula multiflora ssp. *multiflora*	common woodrush	Juncaceae	Native	10
Luzula parviflora	smallflowered woodrush	Juncaceae	Native	2
Luzula piperi	Piper's woodrush	Juncaceae	Native	4
Luzula subcongesta	Donner woodrush	Juncaceae	Native	2
Lysichiton americanus	American skunkcabbage	Araceae	Native	1

Scientific Name	Common Name	Family	Origin	# of Observations (out of 600)
Machaeranthera canescens var. *shastensis*	Shasta tansyaster	Asteraceae	Native	27
Mahonia aquifolium	hollyleaved barberry	Berberidaceae	Native	2
Mahonia nervosa	Cascade barberry	Berberidaceae	Native	28
Maianthemum racemosum	feathery false lily of the valley	Liliaceae	Native	13
Maianthemum stellatum	starry false lily of the valley	Liliaceae	Native	46
Melica aristata	bearded melicgrass	Poaceae	Native	31
Melica harfordii	Harford's oniongrass	Poaceae	Native	4
Melica subulata	Alaska oniongrass	Poaceae	Native	33
Menyanthes trifoliata	buckbean	Menyanthaceae	Native	1
Mertensia paniculata var. *borealis*	northern bluebells	Boraginaceae	Native	5
Microseris nutans	nodding microseris	Asteraceae	Native	9
Microsteris gracilis	slender phlox	Polemoniaceae	Native	2
Mimulus alsinoides	wingstem monkeyflower	Scrophulariaceae	Native	2
Mimulus breweri	Brewer's monkeyflower	Scrophulariaceae	Native	3
Mimulus guttatus	seep monkeyflower	Scrophulariaceae	Native	19
Mimulus jepsonii	Jepson's monkeyflower	Scrophulariaceae	Native	1
Mimulus lewisii	purple monkeyflower	Scrophulariaceae	Native	6
Mimulus moschatus	muskflower	Scrophulariaceae	Native	13
Mimulus nanus	dwarf purple monkeyflower	Scrophulariaceae	Native	1
Mimulus primuloides	primrose monkeyflower	Scrophulariaceae	Native	15
*Mimulus tilingii**	Tiling's monkeyflower	Scrophulariaceae	Native	3
Mitella breweri	Brewer's miterwort	Saxifragaceae	Native	2
Mitella pentandra	fivestamen miterwort	Saxifragaceae	Native	1
Mitella trifida	threeparted miterwort	Saxifragaceae	Native	12
Moehringia macrophylla	largeleaf sandwort	Caryophyllaceae	Native	20
Monotropa hypopitys	pinesap	Monotropaceae	Native	15
*Montia chamissoi**	water minerslettuce	Portulacaceae	Native	1
Muhlenbergia filiformis	pullup muhly	Poaceae	Native	14
Nama lobbii	Lobb's fiddleleaf	Hydrophyllaceae	Native	4
Navarretia divaricata	divaricate navarretia	Polemoniaceae	Native	1
Nemophila parviflora var. *parviflora*	smallflower nemophila	Hydrophyllaceae	Native	1
Nothocalais alpestris	alpine lake false dandelion	Asteraceae	Native	22
Nuphar lutea ssp. *polysepala*	Rocky Mountain pond-lily	Nymphaeaceae	Native	2
Orobanche fasciculata	clustered broomrape	Orobanchaceae	Native	1
Orobanche pinorum	conifer broomrape	Orobanchaceae	Native	1
Orthilia secunda	sidebells wintergreen	Pyrolaceae	Native	119
Orthocarpus imbricatus	mountain owl's-clover	Scrophulariaceae	Native	5
Osmorhiza berteroi	sweetcicely	Apiaceae	Native	38
Osmorhiza depauperata	bluntseed sweetroot	Apiaceae	Native	12
Osmorhiza occidentalis	western sweetroot	Apiaceae	Native	1

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*Osmorhiza purpurea**	purple sweetroot	Apiaceae	Native	5
Oxypolis occidentalis	western cowbane	Apiaceae	Native	10
Packera pseudaurea var. *pseudaurea*	falsegold groundsel	Asteraceae	Native	2
Parnassia fimbriata var. *hoodiana*	fringed grass of Parnassus	Saxifragaceae	Native	3
Paxistima myrsinites	Oregon boxleaf	Celastraceae	Native	45
Pedicularis groenlandica	elephanthead lousewort	Scrophulariaceae	Native	7
Pedicularis racemosa	sickletop lousewort	Scrophulariaceae	Native	21
Penstemon anguineus	Siskiyou beardtongue	Scrophulariaceae	Native	2
Penstemon cinicola	ash penstemon	Scrophulariaceae	Native	4
Penstemon davidsonii var. *davidsonii*	Davidson's penstemon	Scrophulariaceae	Native	51
Penstemon deustus var. *deustus*	scabland penstemon	Scrophulariaceae	Native	1
Penstemon rupicola	cliff beardtongue	Scrophulariaceae	Native	8
Penstemon rydbergii var. *oreocharis*	herbaceous penstemon	Scrophulariaceae	Native	11
Penstemon speciosus	royal penstemon	Scrophulariaceae	Native	1
*Perideridia gairdneri**	Gardner's yampah	Apiaceae	Native	2
Phacelia hastata var. *compacta*	compact phacelia	Hydrophyllaceae	Native	16
Phacelia hastata var. *hastata*	silverleaf phacelia	Hydrophyllaceae	Native	46
Phleum alpinum	alpine timothy	Poaceae	Native	6
Phlox diffusa	spreading phlox	Polemoniaceae	Native	47
*Phyllodoce empetriformis**	pink mountainheath	Ericaceae	Native	3
Picea engelmannii	Engelmann spruce	Pinaceae	Native	13
Pinus albicaulis	whitebark pine	Pinaceae	Native	46
Pinus contorta var. *murrayana*	Sierra lodgepole pine	Pinaceae	Native	223
Pinus lambertiana	sugar pine	Pinaceae	Native	20
Pinus monticola	western white pine	Pinaceae	Native	124
Pinus ponderosa	ponderosa pine	Pinaceae	Native	101
Piperia unalascensis	slender-spire orchid	Orchidaceae	Native	6
Platanthera dilatata	scentbottle	Orchidaceae	Native	9
Platanthera stricta	slender bog orchid	Orchidaceae	Native	5
Pleuropogon refractus	nodding semaphoregrass	Poaceae	Native	2
*Poa bolanderi**	Bolander's bluegrass	Poaceae	Native	1
Poa cusickii ssp. *purpurascens*	Cusick's bluegrass	Poaceae	Native	1
Poa leptocoma	marsh bluegrass	Poaceae	Native	1
Poa pratensis	Kentucky bluegrass	Poaceae	Native	4
Poa secunda	Sandberg bluegrass	Poaceae	Native	5
Poa wheeleri	Wheeler's bluegrass	Poaceae	Native	35
*Polemonium californicum**	moving polemonium	Polemoniaceae	Native	1
*Polemonium occidentale**	western polemonium	Polemoniaceae	Native	7
Polemonium pulcherrimum ssp. *pulcherrimum*	Jacob's-ladder	Polemoniaceae	Native	2
*Polygonum amphibium**	water knotweed	Polygonaceae	Native	2

Scientific Name	Common Name	Family	Origin	# of Observations (out of 600)
Polygonum bistortoides	American bistort	Polygonaceae	Native	19
Polygonum davisiae	Davis' knotweed	Polygonaceae	Native	82
Polygonum douglasii	Douglas' knotweed	Polygonaceae	Native	4
Polygonum minimum	broadleaf knotweed	Polygonaceae	Native	4
Polygonum polygaloides ssp. *kelloggii*	Kellogg's knotweed	Polygonaceae	Native	1
Polygonum shastense	Shasta knotweed	Polygonaceae	Native	17
Polystichum imbricans ssp. *imbricans*	narrowleaf swordfern	Dryopteridaceae	Native	6
*Polystichum lonchitis**	northern hollyfern	Dryopteridaceae	Native	2
Polystichum munitum	western swordfern	Dryopteridaceae	Native	9
Populus balsamifera ssp. *trichocarpa*	black cottonwood	Salicaceae	Native	1
Populus tremuloides	quaking aspen	Salicaceae	Native	7
*Potamogeton gramineus**	variableleaf pondweed	Potamogetonaceae	Native	2
*Potentilla drummondii**	Drummond's cinquefoil	Rosaceae	Native	2
*Potentilla flabellifolia**	high mountain cinquefoil	Rosaceae	Native	6
Potentilla glandulosa	sticky cinquefoil	Rosaceae	Native	12
Prosartes hookeri	drops-of-gold	Liliaceae	Native	4
Prunella vulgaris ssp. *lanceolata*	lance selfheal	Lamiaceae	Native	6
Prunus emarginata	bitter cherry	Rosaceae	Native	12
Pseudognaphalium canescens ssp. *thermale*	Wright's cudweed	Asteraceae	Native	8
Pseudotsuga menziesii var. *menziesii*	Douglas-fir	Pinaceae	Native	73
Pteridium aquilinum var. *pubescens*	hairy brackenfern	Dennstaedtiaceae	Native	18
Pterospora andromedea	woodland pinedrops	Monotropaceae	Native	11
Pulsatilla occidentalis	white pasqueflower	Ranunculaceae	Native	13
Purshia tridentata	antelope bitterbrush	Rosaceae	Native	47
Pyrola asarifolia	liverleaf wintergreen	Pyrolaceae	Native	6
Pyrola minor	snowline wintergreen	Pyrolaceae	Native	1
Pyrola picta	whiteveined wintergreen	Pyrolaceae	Native	99
Quercus garryana	Oregon white oak	Fagaceae	Native	2
Raillardella argentea	silky raillardella	Asteraceae	Native	18
Ranunculus gormanii	Gorman's buttercup	Ranunculaceae	Native	6
*Ranunculus occidentalis**	western buttercup	Ranunculaceae	Native	1
Ranunculus uncinatus	woodland buttercup	Ranunculaceae	Native	1
Ribes binominatum	ground gooseberry	Grossulariaceae	Native	16
Ribes cereum var. *cereum*	wax currant	Grossulariaceae	Native	45
Ribes erythrocarpum	Crater Lake currant	Grossulariaceae	Native	14
Ribes lacustre	prickly currant	Grossulariaceae	Native	26
Ribes lobbii	gummy gooseberry	Grossulariaceae	Native	7
Ribes roezlii	Sierra gooseberry	Grossulariaceae	Native	2

Scientific Name	Common Name	Family	Origin	# of Observations (out of 600)
Ribes viscosissimum	sticky currant	Grossulariaceae	Native	24
Rorippa curvisiliqua	curvepod yellowcress	Brassicaceae	Native	2
Rosa gymnocarpa	dwarf rose	Rosaceae	Native	27
Rubus lasiococcus	roughfruit berry	Rosaceae	Native	52
Rubus leucodermis	whitebark raspberry	Rosaceae	Native	5
Rubus parviflorus	thimbleberry	Rosaceae	Native	11
Rubus ursinus	California blackberry	Rosaceae	Native	28
Rudbeckia occidentalis	western coneflower	Asteraceae	Native	13
Rumex acetosella	common sheep sorrel	Polygonaceae	Non-native	2
Rumex salicifolius var. *mexicanus*	Mexican dock	Polygonaceae	Native	1
*Sagina saginoides**	arctic pearlwort	Caryophyllaceae	Native	5
Salix boothii	Booth's willow	Salicaceae	Native	4
Salix commutata	undergreen willow	Salicaceae	Native	4
Salix eastwoodiae	mountain willow	Salicaceae	Native	1
Salix geyeriana	Geyer willow	Salicaceae	Native	2
Salix lemmonii	Lemmon's willow	Salicaceae	Native	15
*Salix lucida**	Pacific willow	Salicaceae	Native	1
*Salix sitchensis**	Sitka willow	Salicaceae	Native	4
Sambucus racemosa	red elderberry	Caprifoliaceae	Native	13
Sanicula graveolens	northern sanicle	Apiaceae	Native	1
*Saxifraga ferruginea**	russethair saxifrage	Saxifragaceae	Native	1
*Saxifraga odontoloma**	brook saxifrage	Saxifragaceae	Native	1
Saxifraga oregana	Oregon saxifrage	Saxifragaceae	Native	1
Saxifraga tolmiei	Tolmie's saxifrage	Saxifragaceae	Native	3
Scirpus congdonii	Congdon's bulrush	Cyperaceae	Native	3
Scirpus microcarpus	panicled bulrush	Cyperaceae	Native	3
*Scrophularia lanceolata**	lanceleaf figwort	Scrophulariaceae	Native	1
Sedum oregonense	cream stonecrop	Crassulaceae	Native	12
Senecio integerrimus var. *exaltatus*	Columbia ragwort	Asteraceae	Native	8
Senecio triangularis	arrowleaf ragwort	Asteraceae	Native	36
Sibbaldia procumbens	creeping sibbaldia	Rosaceae	Native	1
Sidalcea oregana ssp. *spicata*	Oregon checkerbloom	Malvaceae	Native	1
Silene bernardina	Palmer's catchfly	Caryophyllaceae	Native	1
*Silene menziesii**	Menzies' campion	Caryophyllaceae	Native	1
Sisyrinchium idahoense	Idaho blue-eyed grass	Iridaceae	Native	5
Solidago canadensis var. *salebrosa*	rough Canada goldenrod	Asteraceae	Native	3
*Sonchus asper**	spiny sowthistle	Asteraceae	Non-native	1
*Sorbus californica**	California mountain ash	Rosaceae	Native	2
Sorbus scopulina	Greene's mountain ash	Rosaceae	Native	9
*Sparganium natans**	small bur-reed	Sparganiaceae	Native	2
Sphenosciadium capitellatum	woollyhead parsnip	Apiaceae	Native	2

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Spiraea douglasii var. *douglasii*	rose spirea	Rosaceae	Native	3
Spiraea splendens	rose meadowsweet	Rosaceae	Native	1
Spiranthes romanzoffiana	hooded lady's tresses	Orchidaceae	Native	3
*Stachys cooleyae**	coastal hedgenettle	Lamiaceae	Native	2
Stachys rigida	rough hedgenettle	Lamiaceae	Native	9
*Stellaria borealis**	Sitka starwort	Caryophyllaceae	Native	2
Stellaria calycantha	northern starwort	Caryophyllaceae	Native	3
Stellaria crispa	curled starwort	Caryophyllaceae	Native	5
Stellaria longifolia	longleaf starwort	Caryophyllaceae	Native	1
Stellaria obtusa	Rocky Mountain chickweed	Caryophyllaceae	Native	1
*Stellaria umbellata**	umbrella starwort	Caryophyllaceae	Native	1
Stephanomeria lactucina	lettuce wirelettuce	Asteraceae	Native	49
*Streptopus amplexifolius**	claspleaf twistedstalk	Liliaceae	Native	4
Streptopus lanceolatus var. *curvipes*	twistedstalk	Liliaceae	Native	2
Symphoricarpos mollis	creeping snowberry	Caprifoliaceae	Native	55
Symphyotrichum foliaceum var. *parryi*	Parry's aster	Asteraceae	Native	2
Symphyotrichum spathulatum var. *spathulatum*	western mountain aster	Asteraceae	Native	1
Taraxacum officinale	common dandelion	Asteraceae	Non-native	8
Taxus brevifolia	Pacific yew	Taxaceae	Native	1
Thalictrum sparsiflorum	fewflower meadow-rue	Ranunculaceae	Native	2
Tiarella trifoliata var. *unifoliata*	oneleaf foamflower	Saxifragaceae	Native	15
*Tofieldia glutinosa**	sticky tofieldia	Liliaceae	Native	11
*Torreyochloa erecta**	spiked false mannagrass	Poaceae	Native	12
Torreyochloa pallida var. *pauciflora*	pale false mannagrass	Poaceae	Native	3
*Torreyochloa pallida**	pale false mannagrass	Poaceae	Native	5
Tragopogon dubius	yellow salsify	Asteraceae	Non-native	1
Triantha occidentalis ssp. *brevistyla*	sticky tofieldia	Liliaceae	Native	7
Trientalis borealis ssp. *latifolia*	broadleaf starflower	Primulaceae	Native	15
Trifolium longipes	longstalk clover	Fabaceae	Native	13
Trillium ovatum	Pacific trillium	Liliaceae	Native	21
Trisetum canescens	tall trisetum	Poaceae	Native	15
Trisetum spicatum	spike trisetum	Poaceae	Native	37
Trisetum wolfii	Wolf's trisetum	Poaceae	Native	3
Tsuga heterophylla	western hemlock	Pinaceae	Native	8
Tsuga mertensiana	mountain hemlock	Pinaceae	Native	190
Utricularia intermedia	flatleaf bladderwort	Lentibulariaceae	Native	2
*Utricularia macrorhiza**	common bladderwort	Lentibulariaceae	Native	1
Vaccinium cespitosum	dwarf bilberry	Ericaceae	Native	4
Vaccinium membranaceum	thinleaf huckleberry	Ericaceae	Native	38
Vaccinium ovalifolium	oval-leaf blueberry	Ericaceae	Native	2

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Vaccinium scoparium	grouse whortleberry	Ericaceae	Native	78
Vaccinium uliginosum	bog blueberry	Ericaceae	Native	6
Vahlodea atropurpurea	mountain hairgrass	Poaceae	Native	5
Valeriana acutiloba var. *glabra*	California valerian	Valerianaceae	Native	1
Valeriana californica	California valerian	Valerianaceae	Native	4
Valeriana sitchensis	Sitka valerian	Valerianaceae	Native	6
Vancouveria hexandra	white insideout flower	Berberidaceae	Native	35
Veratrum viride	green false hellebore	Liliaceae	Native	17
Veronica americana	American speedwell	Scrophulariaceae	Native	2
Veronica serpyllifolia ssp. *humifusa*	brightblue speedwell	Scrophulariaceae	Native	2
Veronica wormskjoldii	American alpine speedwell	Scrophulariaceae	Native	6
Vicia americana	American vetch	Fabaceae	Native	13
Viola adunca	hookedspur violet	Violaceae	Native	3
Viola bakeri	Baker's violet	Violaceae	Native	5
Viola glabella	pioneer violet	Violaceae	Native	50
Viola macloskeyi	small white violet	Violaceae	Native	6
Viola orbiculata	darkwoods violet	Violaceae	Native	9
Viola purpurea ssp. *integrifolia*	goosefoot violet	Violaceae	Native	54
Viola purpurea ssp. *venosa*	goosefoot violet	Violaceae	Native	7
Viola sheltonii	Shelton's violet	Violaceae	Native	2

*Indicates species that only occurred in relevé plots from Adamus and Bartlett (2008) that were used in our classification

The Department of the Interior protects and manages the nation’s natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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