Ecological site AX001X01X405
Mesic Udic Dry Shallow Outcrop

Last updated: 5/15/2025
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General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 001X–Northern Pacific Coast Range, Foothills, and Valleys

This area consists of a long and narrow range of mountains with associated foothills and valleys that parallels the Pacific Ocean. This area is entirely within the Pacific Border Province of the Pacific Mountain System in Oregon and Washington. MLRA 1 is bounded on the north by the highest elevations of the Olympic Mountains and the strait of Juan de Fuca, and by the Klamath Mountains on the south. The Washington portion of this MLRA is primarily composed of young Tertiary sedimentary rocks (siltstone and sandstone) mixed with some volcanic rocks of the same age. Glacial till and outwash deposits are also found in the northern half of this area in Washington. Much of this area is accreted terrane formed by tectonic processes. The average annual precipitation ranges from 60 to 200 inches (1,525 to 5,580 millimeters), increasing with elevation. Most of the precipitation in this area occurs during low-intensity, Pacific frontal storms and is evenly distributed throughout fall, winter, and spring. The dominant soil orders in this MLRA are Andisols, Inceptisols, and Ultisols. Soil depths broadly range from shallow to very deep. Soils are primarily well drained, however poorly drained soils may be found in depressional areas and on alluvial floodplains. Surface textures are typically medial and loamy or clayey. Soils in this area dominantly have a mesic or frigid temperature regime and a udic moisture regime. Soils with aquic moisture regimes and cryic temperature regimes also occur.

Ecological site concept

Mesic Udic Dry Shallow Outcrop sites occur on less stable landscape positions on glacial valley walls in the mesic temperature zone. These sites are found on shallow soils which have limited available water. As a result, these sites tend to favor species tolerant of low effective precipitation such as Pacific madrone (Arbutus menziesii) and oceanspray (Holodiscus discolor). The reference community composition will vary depending on soil depth. Soils that are exceptionally shallow and have extremely limited available water capacity may not support trees, and therefore will not progress to mid and late-seral communities until enough soil has developed on the site. Sites with deeper soils and adequate available water to support tree growth will express a forested reference community. Mesic Udic Dry Shallow Outcrop sites in the forested phase are characterized by an overstory of Douglas-fir (Pseudotsuga menziesii) and pacific madrone (Arbutus menziesii), accompanied by an understory shrub community of oceanspray and Cascade barberry (Mahonia nervosa). The herbaceous layer is dominated by western swordfern (Polystichum munitum) and pipsissewa (Chimaphila umbellata).

Associated sites

AX001X01X004	**Mesic Aquic Forest** Mesic Aquic Forest sites may occur downslope of Dry Shallow Outcrops and receive run-on moisture from Dry Shallow Outcrop sites.

Similar sites

AX001X01X403	**Mesic Udic Dry Forest** Soils on Mesic Udic Dry Forest sites are moderately deep or deeper. Mesic Udic Dry Forests do not support Pacific madrone (Arbutus menziesii).

Table 1. Dominant plant species

Tree	(1) *Pseudotsuga menziesii* (2) *Arbutus menziesii*
Shrub	(1) *Holodiscus discolor* (2) *Mahonia nervosa*
Herbaceous	(1) *Polystichum munitum* (2) *Chimaphila umbellata*

Legacy ID

F001XA405WA

Physiographic features

This site primarily occurs on glacial valley walls on mountains. These upland forest sites are strongly influenced by slope gradient. Mesic Udic Dry Shallow Outcrop sites typically are found on less stable slope positions and generate run-off that is collected by more stable Mesic Udic Moist Forest, Mesic Aquic Forest, or Temperate Wet Meadow sites. These sites lose a significant amount of moisture from run-off which exacerbates the plant-available moisture deficit that results from shallow soils on site.

Table 2. Representative physiographic features

Landforms	(1) Mountains > Glacial-valley wall
Flooding frequency	None
Ponding frequency	None
Elevation	300 – 1,000 m
Slope	40 – 100 %
Water table depth	150 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

This site occurs in a mesic temperature and udic moisture regime. Precipitation arrives mostly via low-intensity, Pacific frontal storms. Precipitation is unevenly distributed, with the lowest amounts on the leeward side of the Coast Range mountains. Precipitation falls largely as snow in higher elevations. Precipitation is evenly distributed throughout the fall, winter, and spring, while summers are dry. Air temperatures vary significantly along the elevation gradient.

Table 3 Representative climatic features

Frost-free period (characteristic range)	180-240 days

Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	990-1,400 mm

Influencing water features

There are no dominant water features influencing plant community dynamics on site.

Soil features

The soils that support this ecological site occur in the mesic soil temperature regime and the udic soil moisture regime. Dodgerpoint soils are well drained, shallow, formed from residuum from metasedimentary rock, and are found on glacial valley walls. Saturated hydraulic conductivity is high or very high throughout. These soils have greater than 35 percent rock fragments in the control section and loam and sandy loam textures. The limiting factors to plant growth for these soils are shallow to bedrock and low available water. Although these soils may occur on all aspects, they are most typically found on south-facing slopes. Although representative of this site, these soils may exist across multiple ecological sites because of naturally variable slope, texture, rock fragments, and pH. An on-site soil pit and the most current ecological site key are necessary to classify a site.

Table 4. Representative soil features

Parent material	(1) Residuum – metasedimentary rock
Surface texture	(1) Extremely gravelly loam (2) Very gravelly sandy loam
Drainage class	Well drained
Soil depth	30 – 50 cm
Surface fragment cover <=3"	0 – 10 %
Surface fragment cover >3"	Not specified
Available water capacity (0-101.6cm)	1.27 – 2.54 cm
Soil reaction (1:1 water) (0-25.4cm)	4.5 – 5.5
Subsurface fragment volume <=3" (0-50.8cm)	20 – 50 %

Subsurface fragment volume >3" (0-50.8cm)	0 – 30 %

Ecological dynamics

Mesic Udic Dry Shallow Outcrop sites are subject to relatively frequent fire events. Understory and mixed-intensity fires are most common, with a return interval of 50 to 150 years. Stand-replacing fires occur less frequently and have a return interval of 250 to 500 years (FEIS, 2012). Especially low soil moisture during the summer months and well-developed shrub and forb layers provide favorable burning conditions. Douglas-fir (Pseudotsuga menziesii) and Pacific madrone (Arbutus menziesii) are the dominant tree species on this site. The regeneration of these species both benefit from mixed and stand-replacement intensity wildfires. Douglas-fir and Pacific madrone seeds germinate preferentially in bare mineral soils and require high light density for early survival and growth. The removal of woody biomass from the site via burning provides large openings that favor recruitment of Douglas-fir and Pacific madrone.

Mesic Udic Dry Shallow Outcrop sites are also vulnerable to disturbance from high-intensity winds and mass-movement events. Wind may blow down individual trees, creating small canopy gaps in varying stages of regeneration. Douglas-fir may be especially vulnerable to blowdown since it is susceptible to a variety of root and butt rot fungi. High-intensity Pacific frontal windstorms may cause high tree mortality and have a stand-replacing effect (Van Pelt, 2007). Mass movement generated from upslope sites can cause significant plant mortality and cover the ground with newly deposited regolith. Landslides occur frequently within the park, owing to its steep terrain and sedimentary geology (Gavin, 2014). Areas of bare regolith will undergo the stand initiation phase of primary succession. Mass movement events may create favorable conditions for the establishment of non-shade tolerant Douglas-fir and Pacific madrone (Geertsema & Pojar, 2007).

State and transition model

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 6. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 7. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 8. Community 1.4 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 9. Community 1.5 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Other references

Breemen, Nico van. “How Sphagnum Bogs down Other Plants.” Trends in Ecology & Evolution 10, no. 7 (July 1, 1995): 270–75. 90007-1.

Dwire, K. and Kauffman, J. 2003. Fire and Riparian Ecosystems in Landscapes in the Western United States. Forest Ecology and Management, Vol. 178 pg. 61-74.

Franklin, Jerry F.; Cromack, Kermit, Jr.; Denison, William; [and others]. 1981. Ecological characteristics of old-growth Douglas-fir forests. Gen. Tech. Rep. PNW-118. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 48 p. [7551]

Gavin, D., Brubaker, L. (2015). The Modern Landscape of the Olympic Peninsula. In: Late Pleistocene and Holocene Environmental Change on the Olympic Peninsula, Washington. Ecological Studies, vol 222. Springer, Cham. https://doi.org/10.1007/978-3-319-11014-1_1

Geertsema, Marten & Pojar, James. (2007). Influence of landslides on biophysical diversity — A perspective from British Columbia.

Geomorphology. 89. 55-69. 10.1016/j.geomorph.2006.07.019.

Goheen, E.M. and Willhite, E.A. 2006. Field Guide to Common Diseases and Inspect Pests of Oregon and Washington Conifers. Portland, Oregon: USDA Forest Service, Pacific Northwest Region R6-NR-FID-PR-01-06.

Hanley, D.P and D.M. Baumgartner. 2002. Forest Ecology in Washington. Washington State University Extension Publishing. Technical Report EB 1943.

Hanson, E.J., D.L. Azuma and B.A. Hiserote. 2002. Site Index Equations and Mean Annual Increment Equations for Pacific Northwest Research Station Forest Inventory and Analysis Inventories, 1985-2001. USDA Forest Service Pacific Northwest Research Station, Research Note PNW-RN-533.

Hemstrom, M., Franklin, J. 1982. Fire and Other Disturbances of the Forests in Mount Rainier National Park. Quaternary Research, Vol 18 pp 32-61.

James K. Agee and Mark H. Huff. 1987. Fuel succession in a western hemlock/Douglas-fir forest. Canadian Journal of Forest Research. 17(7): 697-704. https://doi.org/10.1139/x87-112

Nielsen, E. M., R. L. Brunner, C. Copass and L. K. Wise, 2021. Olympic National Park map class descriptions. National Park Service, Fort Collins.

Pojar J., and MacKinnon. 1994. Plants of the Pacific Northwest Coast. Lone Pine, Vancouver, British Columbia. 528 pages.

PRISM Climate Group, Oregon State University, http://prism.orgeonstate.edu, visited October 2023.

Reed Wendel, Darlene Zabowskl "Fire History within the Lower Elwha River Watershed, Olympic National Park, Washington," Northwest Science, 84(1), 88-97, (1 January 2010)

Rochefort, R.M. and Peterson, D.L. 1996. Temporal and Spatial Distribution of Trees in Subalpine Meadows of Mount Rainier National Park. Arctic and Alpine Research, Vol. 28, No. 1 pp 52-59.

Seastedt, T.R., Adams, G.A. 2001. Effects of Mobile Tree Islands on Alpine Tundra Soils. Ecology, Vol 82 pp 8-17.

Smith, K., G. Kuhn, and L. Townsend. 2008. Culmination of Mean Annual Increment for Indicator Tree Species in the State of Washington. USDA-NRCS Technical Note Forestry-9.

United States Department of Agriculture, Forest Service, 2015. Silvics Manual Vol 1. http://na.fs.fed.us/spfo/pubs/silvics_manual/Volume_1/vol1_Table_of_contents.htm, visited December 2015.

United States Department of Agriculture, Natural Resources Conservation Service, and United States Department of the Interior, National Park Service. 2014. Ecological Site Descriptions for North Cascades National Park Complex, Washington.

United States Department of Agriculture, Natural Resources Conservation Service, and United States Department of the Interior, National Park Service. Ecological Site Descriptions for Mount Rainier National Park, Washington.

Van Pelt, R. 2007. Identifying Mature and Old Forests in Western Washington. Washington State Department of Natural Resources, Olympia, WA. 104 p

Washington Department of Natural Resources, Natural Heritage Program. 2015. Ecological Systems of Washington State. A Guide to Identification.

Wood, David, and Moral, Roger del. “Mechanisms of Early Primary Succession in Subalpine Habitats on Mount St. Helens.” Ecology 68, no. 4 (1987).

Zhao, Yunpeng, Chengzhu Liu, Simin Wang, Yiyun Wang, Xiaoqing Liu, Wanqing Luo, and Xiaojuan Feng. “‘Triple Locks’ on Soil Organic Carbon Exerted by Sphagnum Acid in Wetlands.” Geochimica et Cosmochimica Acta 315 (December 2021): 24–37. https://doi.org/10.1016/j.gca.2021.09.028.

Contributors

Alec Haulotte
Erin Kreutz
Abigail Field
Max Ross
Erik Dahlke

Approval

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	09/24/2026
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

14. **Average percent litter cover (%) and depth (in):**

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

17. **Perennial plant reproductive capability:**