

Ecological site AX001X01X410

Low Cryic Udic Forest

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

Low Cryic Udic Forest sites occur on less stable landscape positions on glacial valley walls, ridges, mountain tops, and colluvial aprons in lower elevation areas within the cryic temperature zone. These sites are located on the windward side of the Olympic Mountains where precipitation is abundant. Relatively high slope gradients limit water infiltration on these sites, generating runoff to more stable Low Cryic Udic Moist Forests, Wet Subalpine Meadows, and Cryic Aquic Shrublands. As a result, Low Cryic Udic Forest sites characteristically favor the growth and production of moist mesophytic understory species, such as Cascade azalea (*Rhododendron albiflorum*). Low Cryic Udic Forest sites are characterized by a dense overstory of mountain hemlock (*Tsuga mertensiana*) and Pacific silver fir (*Abies amabilis*), accompanied by an understory shrub community of thinleaf huckleberry (*Vaccinium membranaceum*), locally known as black huckleberry, and Cascade azalea. The most common herbaceous layer species are strawberryleaf raspberry (*Rubus pedatus*) and roughfruit berry (*Rubus lasiococcus*). Bride's bonnet (*Clintonia uniflora*), white avalanche-lily (*Erythronium montanum*), Sitka valerian (*Valeriana sitchensis*), and twinflower (*Linnaea borealis*) are other common forbs on this site. Low Cryic Udic Forest sites are readily differentiated from Frigid Udic Forest sites by the low abundance of western hemlock (*Tsuga heterophylla*). If western hemlock is present on a Low Cryic Udic Forest site, it will generally be limited to regenerating patches. High Cryic Udic Forest sites are differentiated from Low Cryic Udic Forest sites by the presence of subalpine fir (*Abies lasiocarpa*). Subalpine fir is generally absent on Low Cryic Udic sites but may occasionally be present in low abundance at the upper elevation range of the site.

Associated sites

AX001X01X306	Cryic Aquic Subalpine Wet Meadow Cryic Aquic Subalpine Wet Meadows may be found in depressions and seeps adjacent to or surrounded by Low Cryic Udic Forest sites. Cryic Aquic Subalpine Wet Meadow sites are frequently ponded and lack tree cover.
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AX001X01X411	Low Cryic Udic Moist Forest Low Cryic Udic Moist Forest sites may be found downslope of Low Cryic Udic Forest sites. Low Cryic Udic Moist Forest sites may capture run-on water and have higher productivity.
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Similar sites

AX001X01X406	Frigid Udic Forest Frigid Udic Forest sites occur at lower elevations and are lack mountain hemlock (<i>Tsuga mertensiana</i>).
AX001X01X413	High Cryic Udic Forest High Cryic Udic Forest sites occur at higher elevations and support subalpine fir (<i>Abies lasiocarpa</i>).
AX001X01X412	Low Cryic Udic Dry Forest Low Cryic Udic Dry Forest sites occur in the rain shadow of the Olympic mountains and on steep or exposed aspects. Low Cryic Udic Dry Forests can be distinguished by common beargrass (<i>Xerophyllum tenax</i>) and pipsissewa (<i>Chimaphila umbellata</i>) in the reference community.

Table 1. Dominant plant species

Tree	(1) <i>Tsuga mertensiana</i> (2) <i>Abies amabilis</i>
Shrub	(1) <i>Vaccinium membranaceum</i> (2) <i>Rhododendron albiflorum</i>
Herbaceous	(1) <i>Rubus pedatus</i> (2) <i>Rubus lasiococcus</i>

Legacy ID

F001XA410WA

Physiographic features

This site primarily occurs on glacial valley walls, ridges, mountain tops, and colluvial aprons on mountains and mountain valleys. These upland forest sites are strongly influenced by slope gradients. Low Cryic Udic Forest sites are found on less stable slope positions and generate run-off that is collected by more stable sites downslope.

Table 2. Representative physiographic features

Landforms	(1) Mountains (2) Mountain valleys or canyons (3) Glacial-valley wall (4) Colluvial apron (5) Ridge
Flooding frequency	None
Ponding frequency	None
Elevation	900 – 1,300 m
Slope	20 – 100 %
Water table depth	150 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

This site occurs in a cryic 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)	60-90 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	2,490-3,510 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 cryic soil temperature regime and the udic soil moisture regime. Mountmystery soils are very deep, formed from colluvium from metasedimentary rock, and occur on colluvial aprons and glacial valley walls. Mountfromme-cool soils are shallow, formed from residuum, and occur on structural benches. Elklick soils are moderately deep, formed from residuum or colluvium from metasedimentary rock, and occur on glacial valley walls. They are all well-drained, have a high or very high saturated hydraulic conductivity, and have a rock fragment content of 35 percent or more in the control section. They have no major limiting factors

to plant growth. 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 (2) Colluvium – metasedimentary rock
Surface texture	(1) Silt loam (2) Gravelly silt loam (3) Very gravelly silt loam (4) Loam
Drainage class	Well drained
Soil depth	30 – 150 cm
Surface fragment cover <=3"	0 – 10 %
Surface fragment cover >3"	Not specified
Available water capacity (0-101.6cm)	3.3 – 12.95 cm
Soil reaction (1:1 water) (0-25.4cm)	4.5 – 5.5
Subsurface fragment volume <=3" (0-50.8cm)	10 – 50 %
Subsurface fragment volume >3" (0-50.8cm)	0 – 20 %

Ecological dynamics

Frequent, small-scale disturbance from windthrow events create a mosaic fabric of early-seral patches within late-seral communities. Windthrow events create small canopy gaps that provide favorable conditions for shrubs and semi-shade tolerant forb species. Eventually, trees will regenerate and close canopy gaps. Dominant conifers on this site are susceptible to a variety of root and butt rot fungi. Wood decay fungi exacerbate mature trees' vulnerability to windthrow events.

Infrequent, large-scale disturbances may occur in the form of stand-replacing wildfires, cataclysmic wind events, or large mass movement events. The fire regime of the western half of the Olympic peninsula is characterized by high-intensity, stand replacing fires with a long

return interval – greater than 100 years (Agee, 1987). Though infrequent, wildfires have a profound influence on the composition of these forests. Douglas-fir is a shade-intolerant species and generally requires a stand-replacing wildfire to clear canopy for successful recruitment and regeneration. In the absence of large-scale disturbance, more shade-tolerant western hemlock (*Tsuga heterophylla*), mountain hemlock, and pacific silver fir regenerate successfully and gradually succeed Douglas-fir. The longevity of Douglas-fir preserves evidence of historical high-intensity fire events.

High force windstorms are a major source of large-scale disturbance in these forests. These blowdown events may occasionally be stand replacing. In contrast to intense wildfires, windstorm events do not remove any organic matter from the system. Accumulations of woody debris shade the forest floor from light. Because of this, conditions in the aftermath of catastrophic windstorm events often tend to favor shade tolerant species in their aftermath (Van Pelt, 2007). If advanced tree regeneration is occurring at the time of disturbance, established tree recruits may be released from competition to rapidly regenerate the stand.

Large mass-movement events also provide conditions for the initiation of primary succession. Landslides are a significant source of disturbance, owing to the steep terrain and sedimentary geology of the park. (Gavin, 2014). As with stand-replacing wildfires, bare patches created by landslides favor establishment of shade intolerant Douglas-fir recruits (Geertsema & Pojar, 2007).

Changes in disturbance frequency or intensity through human alteration of the natural fire regime and a changing climate may promote shifts in community structure and function. For example, fire suppression efforts will likely shift communities further towards a shade-tolerant pacific silver fir and western hemlock dominated seral stage. (Reed, 2010) Alternatively, increased fire frequency in some areas due to human activity may encourage Douglas-fir recruitment and establishment. (Gavin, 2015)

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 (%)
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Table 6. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 7. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 8. Community 1.4 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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Table 9. Community 1.5 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
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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.oregonstate.edu>, visited October 2023.

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

Rocheftort, 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>.

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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	10/11/2026
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:
