Ecological site AX004A01X403
Udic Moist Forest

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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): 004A–Sitka Spruce Belt

This area consists of a long and narrow band of marine terraces, coastal estuaries, sand dunes, low relief hills, and mountain slopes that parallels the Pacific Ocean. This area is entirely within the Pacific Border Province of the Pacific Mountain System in Oregon and Washington. In Washington, this area ranges in elevation from sea level to a maximum of 1800 feet (550 meters) inland. The portion of this area in northern Washington consists primarily of glacial deposits, with some scattered young Tertiary sedimentary rocks. The climate is cool and moist, with minimal changes between seasons. Summer temperatures are moderated by the proximity of cool ocean water and fog. Sitka spruce forests are characteristic of this area. The average annual precipitation is 52 to 60 inches (1,320 to 1,525 millimeters) near the beach and can be as much as about 150 inches (3,800 millimeters) at the higher elevations along the inland edge of the MLRA. Most of the rainfall occurs during low-intensity, Pacific frontal storms. Precipitation is evenly distributed throughout fall, winter, and spring; summers are cool and dry. Snowfall accumulation is rare on the ocean side of this area, but some snowfall occurs along the eastern boundary. This area lies within the coastal fog belt zone, and heavy fogs are common in summer. Supplemental moisture is provided by fog condensation. Dominant soil orders in this MLRA are Andisols, Inceptisols, Spodosols, and Entisols.

Ecological site concept

Isomesic Udic Moist Forest sites occur on stable landscape positions on colluvial aprons in the isomesic fog belt. Runoff generated from less stable Isomesic Udic Forest sites accumulates on Isomesic Udic Moist Forest sites, resulting in increased available water. As a result, Isomesic Udic Moist Forest sites characteristically favor the growth and production of moist mesophytic understory species, such as salmonberry (Rubus spectabilis) and threeleaf foamflower (Tiarella trifoliata). Isomesic Udic Moist Forest sites are characterized by a dense overstory of western hemlock (Tsuga heterophylla) and Sitka spruce (Picea sitchensis), accompanied by an understory shrub community of salmonberry (Rubus spectabilis) and cascara buckthorn (Frangula purshiana). The herbaceous layer is dominated by common ladyfern (Athyrium filix-femina), western swordfern (Polystichum munitum), horsetail (Equisetum spp.), threeleaf foamflower (Tiarella trifoliata), redwood-sorrel (Oxalis oregana), water parsley (Oenanthe sarmentosa), and threepetal bedstraw (Galium trifidum). Western redcedar (Thuja plicata) is commonly present in the overstory.

Associated sites

AX001X01X200	**Temperate Wet Meadow** Temperate Wet Meadow sites may be found adjacent to or surrounded by Isomesic Udic Moist Forest sites. Temperate Wet Meadows occur on depressions and seeps. Temperate Wet Meadow sites lack tree cover.
AX004A01X404	**Isomesic Aquic Forest** Isomesic Aquic Forest sites may occur downslope or in mosaic with Isomesic Udic Moist Forest sites. Isomesic Aquic Forest sites occur on depressions and seeps and are subject to ponding.

AX004A01X401	**Isomesic Udic Forest** Isomesic Udic Forest sites may be found upslope of Isomesic Udic Moist Forest sites and frequently generate run-off moisture that is captured by Isomesic Udic Moist Forest sites.

Similar sites

AX001X01X402	**Mesic Udic Moist Forest** Mesic Udic Moist Forest sites occur at higher elevations and lack Sitka spruce (Picea sitchensis).
AX001X01X407	**Frigid Udic Moist Forest** Frigid Udic Moist Forest sites occur at much higher elevations and support Pacific silver-fir (Abies amabilis).

Table 1. Dominant plant species

Tree	(1) *Tsuga heterophylla* (2) *Picea sitchensis*
Shrub	(1) *Rubus spectabilis* (2) *Frangula purshiana*
Herbaceous	(1) *Athyrium filix-femina* (2) *Tiarella trifoliata*

Legacy ID

F004AA403WA

Physiographic features

This site primarily occurs on colluvial aprons on mountains. These upland forest sites are strongly influenced by slope gradient. Isomesic Udic Moist Forest sites typically are found on intermediate slopes between steeper Isomesic Udic Forests and the more stable Temperate Wet Meadow or Isomesic Aquic Forest sites. These sites receive a moderate amount of additional moisture due to their run-on slope position.

Table 2. Representative physiographic features

Landforms	(1) Mountains > Colluvial apron
Flooding frequency	None
Ponding frequency	None
Elevation	100 – 300 m
Slope	0 – 40 %

Water table depth	150 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

This site occurs in an isomesic temperature and udic moisture regime. Precipitation arrives mostly via low-intensity, Pacific frontal storms. Precipitation mostly falls as rain, but some snowfall occurs along the eastern boundary of the area. Precipitation is evenly distributed throughout the fall, winter, and spring, while summers are dry. Heavy fog is very common in the summer, contributing supplemental moisture. The frost-free period of this area is strongly tied to ocean proximity; the eastern edge of the area has a significantly shorter growing season than the western edge. There is relatively little seasonal variation in air temperature due to Pacific Ocean influence.

Table 3 Representative climatic features

Frost-free period (characteristic range)	180-240 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	2,010-3,000 mm

Influencing water features

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

Soil features

The soils are very deep, have very high or high Ksat throughout, and are well drained. The soils are formed colluvium derived from metasedimentary rock. The soil surface texture is Silt Loam. Clay content is eight to 17 percent throughout. The soil series for this ecological site is Jolleycreek. 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) Colluvium – metasedimentary rock
Surface texture	(1) Silt loam
Drainage class	Well drained
Soil depth	150 cm
Surface fragment cover <=3"	0 – 10 %
Surface fragment cover >3"	0 – 10 %

Available water capacity (0-101.6cm)	11.43 – 15.24 cm
Soil reaction (1:1 water) (0-25.4cm)	4.5 – 5.5
Subsurface fragment volume <=3" (0-50.8cm)	0 – 40 %
Subsurface fragment volume >3" (0-50.8cm)	0 – 10 %

Ecological dynamics

Frequent, small-scale disturbance from windthrow events create a mosaic fabric of early-seral patches within late-seral communities. Canopy gaps created by windthrow favor shade-intolerant understory species such as red alder (Alnus rubra) and red elderberry (Sambucus racemosa). 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. High force windstorms are a major source of large-scale disturbance in these forests. These blowdown events may be stand replacing and conditions tend to favor shade intolerant species in their aftermath (Van Pelt, 2007). The fire regime of this site is characterized by high-intensity, stand replacing fires with a long return interval – greater than 100 years (FEIS). Though infrequent, wildfires have a profound influence on the composition of these forests. Sitka spruce is a relatively shade-intolerant species and regenerates quickly in the aftermath of a stand-replacing wildfire. In the absence of large-scale disturbance, more shade-tolerant western hemlock regenerates successfully. Large mass-movement events also provide conditions favorable for early seral species. Landslides are a significant source of disturbance, owing to the steep terrain and sedimentary geology of the park. (Gavin, 2014).

Red alder (Alnus rubra) and Sitka spruce (Picea sitchensis) recruits regenerate in the aftermath of stand-replacing disturbance, accompanied by California blackberry (Rubus ursinus) and fireweed (Chamerion angustifolium). As Sitka spruce (Picea sitchensis) and red alder (Alnus rubra) grow and form a discrete canopy, the understory community diversifies. Shrub and forb layers develop, dominated by cascara buckthorn (Frangula purshiana), and salmonberry (Rubus spectabilis), and common ladyfern (Athyrium filix-femina) and threeleaf foamflower (Tiarella trifoliata) respectively. Canopy stratification will be encouraged by tree maturation, as well as by mortality induced by small-scale disturbances. Increased vertical stratification promotes diversity and abundance of shrubs and forbs, allowing a return to reference community conditions.

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.

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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	09/01/2026
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):**

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

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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:**

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17. **Perennial plant reproductive capability:**
