USDA Natural Resources
Conservation Service

Ecological site AX001X01X411
Low Cryic Udic Moist Forest

Last updated: 5/15/2025
Accessed: 02/10/2026

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 Moist Forest sites occur on stable landscape positions on glacial valley walls in lower elevation areas within the cryic temperature zone. These sites receive additional run-on moisture from adjacent sites with higher slope gradients, increasing the effective precipitation on site.

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 oval-leaf huckleberry (Vaccinium ovalifolium). 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 Moist Forest sites. Cryic Aquic Subalpine Wet Meadow sites are frequently ponded and lack tree cover.
AX001X01X410	**Low Cryic Udic Forest** Low Cryic Udic Forest sites may be found upslope of Low Cryic Udic Moist Forest sites and frequently generate run-off moisture that is captured by Low Cryic Udic Moist Forest sites.
AX001X01X412	**Low Cryic Udic Dry Forest** Low Cryic Udic Dry Forest sites may be found upslope of Low Cryic Udic Moist Forest sites and frequently generate run-off moisture that is captured by Low Cryic Udic Moist Forest sites.

Similar sites

AX001X01X407	**Frigid Udic Moist Forest** Frigid Udic Moist Forest sites occur at lower elevations and lack mountain hemlock (Tsuga mertensiana).
AX001X01X414	**High Cryic Udic Moist Forest** High Cryic Udic Moist Forest sites occur at higher elevations and are indicated by the presence of subalpine fir (Abies lasiocarpa).

Table 1. Dominant plant species

Tree	(1) *Tsuga mertensiana* (2) *Abies amabilis*
Shrub	(1) *Vaccinium membranaceum* (2) *Vaccinium ovalifolium*
Herbaceous	(1) *Erythronium montanum* (2) *Rubus pedatus*

Legacy ID

F001XA411WA

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 gradient. Low Cryic Udic Moist Forest sites are typically found on intermediate slopes between less stable Low Cryic Udic Dry Forest sites and more stable Cryic Udic Wet Subalpine Meadow or Cryic Aquic Subalpine Wet Meadow sites. Low Cryic Udic Moist Forest sites receive a moderate amount of additional moisture via run-on.

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	25–65%
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)	2,489-3,505 mm

Influencing water features

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

Soil features

The soils that support this mapunit occur in the cryic soil temperature regime and the udic soil moisture regime. Ignarcreek soils are very deep, well drained, formed from colluvium from metasedimentary rock, and occur on glacial valley walls. They are subject to intense weathering and therefore are strongly developed. Saturated hydraulic conductivity is high or very high throughout. These soils have a rock fragment content of 35 percent or greater in the control section. Most soils contain a thin organic layer that protects the soil from wind and water erosion. These soils 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) Colluvium–metasedimentary rock
Surface texture	(1) Gravelly silt loam (2) Gravelly loam
Drainage class	Well drained
Soil depth	150 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	8.13–12.19 cm
Soil reaction (1:1 water) (0-25.4cm)	3.5–5.5

Subsurface fragment volume <=3" (0-50.8cm)	10–55%
Subsurface fragment volume >3" (0-50.8cm)	0–20%

Ecological dynamics

Frequent, small-scale disturbances 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 of 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 mountain hemlock (*Tsuga mertensiana*), and Pacific silver fir regenerate successfully and gradually succeed Douglas-fir. The longevity of Douglas-fir preserves evidence of historical high-intensity fire events.

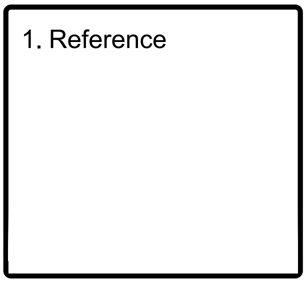
High-force windstorms are a major source of large-scale disturbance in these forests. These blowdown events may occasionally be stand-replacing. In contrast to intense wildfires, windstorm events do not remove any organic matter from the system. Accumulations of woody debris shade the forest floor from 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 the establishment of shade-intolerant Douglas-fir recruits (Geertsema and Pojar, 2007).

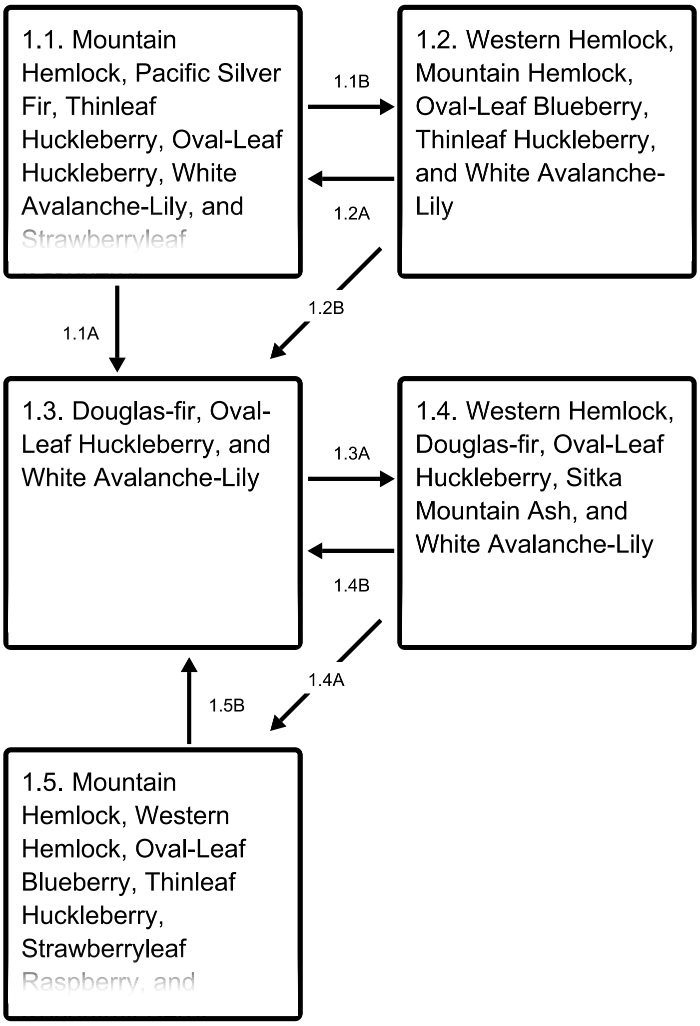
Changes in disturbance frequency or intensity through human alteration of the natural fire regime and a changing climate may promote shifts in community structure and function. For example, fire suppression efforts will likely shift communities further towards a shade-tolerant Pacific silver fir and mountain 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

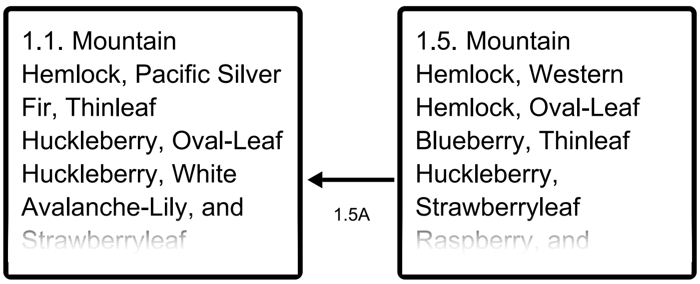
Ecosystem states



State 1 submodel, plant communities



Communities 1 and 5 (additional pathways)



1.1B - Minor disturbance

1.1A - High-intensity disturbance

1.2A - Time without disturbance

1.2B - High-intensity disturbance

1.3A - Time without disturbance

1.4B - High-intensity disturbance

1.4A - Time without disturbance

1.5A - Time without disturbance

1.5B - High-intensity disturbance

State 1
Reference

The Reference state is comprised of five communities in varying stages of regeneration following either small-scale or large-scale disturbance.

Dominant plant species

- mountain hemlock (*Tsuga mertensiana*), tree
- Pacific silver fir (*Abies amabilis*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- western hemlock (*Tsuga heterophylla*), tree
- thinleaf huckleberry (*Vaccinium membranaceum*), shrub
- oval-leaf blueberry (*Vaccinium ovalifolium*), shrub
- Sitka mountain ash (*Sorbus sitchensis var. sitchensis*), shrub
- rusty menziesia (*Menziesia ferruginea*), shrub
- white avalanche-lily (*Erythronium montanum*), other herbaceous
- strawberryleaf raspberry (*Rubus pedatus*), other herbaceous
- roughfruit berry (*Rubus lasiococcus*), other herbaceous
- twinflower (*Linnaea borealis*), other herbaceous
- bride's bonnet (*Clintonia uniflora*), other herbaceous

Community 1.1
Mountain Hemlock, Pacific Silver Fir, Thinleaf Huckleberry, Oval-Leaf Huckleberry, White Avalanche-Lily, and Strawberryleaf Raspberry

Structure: Multistory with small gap dynamics Mountain hemlock and Pacific silver fir are the dominant overstory species in the reference community. The dense reference encourages continual regeneration of the extremely shade-tolerant dominant conifer species. Common understory species include thinleaf huckleberry, oval-leaf huckleberry, strawberryleaf raspberry, white avalanche-lily, bride's bonnet (*Clintonia uniflora*), and twinflower (*Linnaea borealis*). High vertical stratification in the canopy and the presence of small gaps favors an abundant understory.

Community 1.2
Western Hemlock, Mountain Hemlock, Oval-Leaf Blueberry, Thinleaf Huckleberry, and White Avalanche-Lily

Structure: Mosaic of overstory and openings in varying states of regeneration This community is initiated in the wake of small-scale disturbance which creates small canopy openings. Pacific silver fir and mountain hemlock recruits will eventually establish in the canopy openings and regenerate the canopy. This community may be identified by higher than reference understory productivity. In the localized absence of a dense tree canopy, understory species are released from sunlight limitation.

Community 1.3
Douglas-fir, Oval-Leaf Huckleberry, and White Avalanche-Lily

Structure: Open forest with shrubby regeneration and snags This early seral-stage community occurs in the aftermath of a stand-replacing disturbance. Nearly all trees are removed from the site. In the case of high-intensity fire, few large fire-resistant trees may remain. Shade-intolerant Douglas-fir germinates and establishes in the absence of canopy cover post-disturbance. Shrubs and forbs are often able to outcompete tree saplings for several years post-disturbance.

Community 1.4
Western Hemlock, Douglas-fir, Oval-Leaf Huckleberry, Sitka Mountain Ash, and White Avalanche-Lily

Structure: Dense single-story As a discrete canopy layer is formed by maturing Douglas-fir, western hemlock will establish on the site. Shade-tolerant conifers readily germinate under the dense canopy.

Community 1.5
Mountain Hemlock, Western Hemlock, Oval-Leaf Blueberry, Thinleaf Huckleberry, Strawberryleaf Raspberry, and Roughfruit Berry

Structure: Dense single stratum canopy with diminished understory Additional time without major disturbance allows mountain hemlock to regenerate and gradually replace western hemlock. Understory diversity increases as additional time passes. Understory productivity is limited by high canopy density. Individual tree mortality and small-scale disturbance events will promote vertical stratification and create canopy gaps that favor increased understory productivity.

Pathway 1.1B
Community 1.1 to 1.2

Minor disturbances, often caused by individual tree mortality, create small gaps in the forest canopy.

Pathway 1.1A
Community 1.1 to 1.3

Stand-replacing disturbances such as high-intensity fires, catastrophic windstorms, and mass-movement events open the forest and lead to the stand initiation phase of development.

Pathway 1.2A
Community 1.2 to 1.1

Time without disturbance allows regeneration, growth, and progression to a later seral stage.

Pathway 1.2B
Community 1.2 to 1.3

Stand-replacing disturbances such as high-intensity fires, catastrophic windstorms, and mass-movement events open the forest and lead to the stand initiation phase of development.

Pathway 1.3A
Community 1.3 to 1.4

Time without disturbance allows regeneration, growth, and progression to a later seral stage.

Pathway 1.4B
Community 1.4 to 1.3

Stand-replacing disturbances such as high-intensity fires, catastrophic windstorms, and mass-movement events open the forest and lead to the stand initiation phase of development.

Pathway 1.4A
Community 1.4 to 1.5

Time without disturbance allows regeneration, growth, and progression to a later seral stage.

Pathway 1.5A
Community 1.5 to 1.1

Time without disturbance allows continued tree regeneration and growth.

Pathway 1.5B
Community 1.5 to 1.3

Stand-replacing disturbances such as high-intensity fires, catastrophic windstorms, and mass-movement events open the forest and lead to the stand initiation phase of development.

Additional community tables

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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	02/10/2026
Approved by	Grant Petersen
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:

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

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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:**
