USDA Natural Resources
Conservation Service

Ecological site AX001X01X415
High Cryic Udic Dry Forest

Last updated: 5/15/2025
Accessed: 04/08/2026

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

High Cryic Udic Dry Forest sites occur on less stable landscape positions on valley walls, bedrock benches, bedrock knobs, fluve basins, and slides in high elevation areas within the cryic temperature zone. These sites are typically located on the leeward side of the Olympic Mountains where precipitation is relatively low. Relatively high slope gradients limit water infiltration on these sites, generating runoff to more stable High Cryic Udic Moist Forests, Wet Subalpine Meadows, and Cryic Aquic Shrublands.

High Cryic Udic Dry Forest sites are characterized by a subalpine fir (*Abies lasiocarpa*) and lodgepole pine (*Pinus contorta*) canopy, accompanied by an understory shrub and subshrub community of common juniper (Juniperus communis), and Oregon boxleaf (Paxistima myrsinites). The most common herbaceous layer species are broadleaf lupine (Lupinus latifolius), Cascade desertparsley (Lomatium martindalei), sidebells wintergreen (*Orthilia secunda*).

High Cryic Udic Dry Forest sites are readily differentiated from Low Cryic Udic Dry Forest sites by presence of the subalpine fir (*Abies lasiocarpa*).

Associated sites

AX001X01X414	**High Cryic Udic Moist Forest** High Cryic Udic Moist Forest sites may be found downslope of High Cryic Udic Dry Forest sites. High Cryic Udic Moist Forest sites may capture run-on water and have higher productivity.
AX001X01X306	**Cryic Aquic Subalpine Wet Meadow** Cryic Aquic Subalpine Wet Meadows may be found in depressions and seeps adjacent to or surrounded by High Cryic Udic Dry Forest sites. Cryic Aquic Subalpine Wet Meadow sites are frequently ponded and lack tree cover.

Similar sites

AX001X01X412	**Low Cryic Udic Dry Forest** Low Cryic Udic Dry Forest sites are found at lower elevations and lack subalpine fir (Abies lasiocarpa).
AX001X01X413	**High Cryic Udic Forest** High Cryic Udic Forests are typically located on the windward side of the Olympic mountains and on protected aspects. These sites receive higher effective precipitation and production is significantly higher than on High Cryic Udic Dry Forest sites. High Cryic Udic Forest sites lack lodgepole pine (Pinus contorta) and common juniper (Juniperus communis).

Table 1. Dominant plant species

Tree	(1) *Abies lasiocarpa* (2) *Pinus contorta*
Shrub	(1) *Juniperus communis* (2) *Paxistima myrsinites*

Herbaceous	(1) *Lupinus latifolius* (2) *Lomatium martindalei*

Legacy ID

F001XA415WA

Physiographic features

This site primarily occurs on valley walls, bedrock benches, bedrock knobs, fluve basins, and slides on mountains. High Cryic Udic Dry Forest sites are strongly influenced by high slope gradients. Since these sites are typically found on the least stable forested slopes they lose a significant amount of water to run-off.

Table 2. Representative physiographic features

Landforms	(1) Mountains (2) Glacial-valley wall (3) Bench (4) Knob (5) Slide
Flooding frequency	None
Ponding frequency	None
Elevation	1,400–1,900 m
Slope	15–100%
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)	30-60 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	1,753-2,489 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. They are well-drained, formed from residuum or colluvium from metasedimentary rock, and occur on glacial valley walls, structural benches, and ridges. Mountfromme-cold, dry soils are shallow, Marmotlake is moderately deep, and Grandpass is very deep. Saturated hydraulic conductivity is high or very high throughout, and rock fragment content is 35 percent or more in the control section. These soils occur primarily in the rain shadow of the Olympic Peninsula, so they are drier than their counterparts on the west side. Less available water in these soils is the primary limiting factor 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) Very gravelly loam (3) Loam (4) Gravelly sandy loam
Drainage class	Well drained
Soil depth	51–152 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	3.3–13.72 cm
Soil reaction (1:1 water) (0-25.4cm)	4.5–5.5
Subsurface fragment volume <=3" (0-50.8cm)	0–50%
Subsurface fragment volume >3" (0-50.8cm)	0–20%

Ecological dynamics

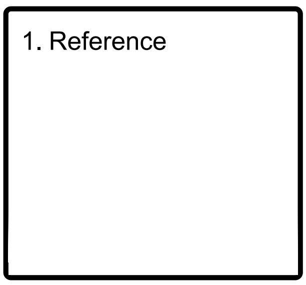
Frequent, small-scale disturbances from windthrow events create a mosaic fabric of early-seral patches within late-seral communities. Windthrow events create small canopy gaps that provide favorable conditions for limited Douglas-fir regeneration and increased understory productivity. Eventually, subalpine fir (*Abies lasiocarpa*) and lodgepole pine (*Pinus contorta*) will regenerate and become dominant.

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). Strong coastal winds produce intense blow-down disturbance events more frequently than fires occur. Wildfires and severe blowdown create conditions favorable for the establishment of early seral tree species. Douglas-fir (*Pseudotsuga menziesii*) and whitebark pine (*Pinus albicaulis*) regeneration is favored by stand-replacing disturbance. In the absence of large-scale disturbance, more slow-growing and shade-tolerant subalpine fir and lodgepole pine will regenerate successfully and gradually succeed Douglas-fir. White pine blister rust (Cronartium ribicola) is a deadly fungal pathogen of whitebark pine and generally causes widespread mortality of whitebark pine trees on these sites before they reach maturity. The longevity of Douglas-fir may preserve evidence of historical high-intensity disturbance events.

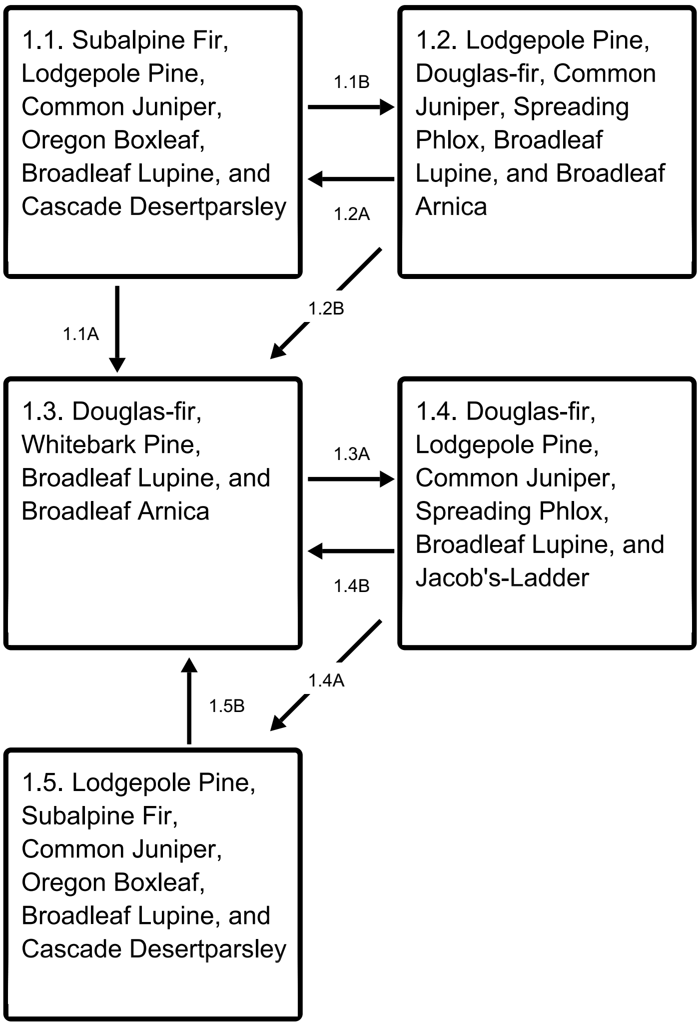
Large mass-movement events also provide conditions for the initiation of primary succession. Landslides are a significant source of disturbance, owing to the steep terrain and sedimentary geology of the park. (Gavin, 2014). As with stand-replacing wildfires, bare patches created by landslides favor the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

State and transition model

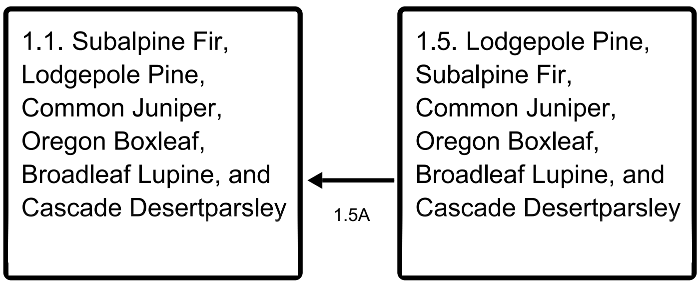
Ecosystem states



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.

Community 1.1
Subalpine Fir, Lodgepole Pine, Common Juniper, Oregon Boxleaf, Broadleaf Lupine, and Cascade Desertparsley

Structure: Multistory with small gap dynamics Subalpine fir and lodgepole pine are the dominant overstory species in the reference community. Reference community conifers are shade-tolerant and may regenerate continually in the understory. Common understory species include common juniper, Oregon boxleaf, broadleaf lupine, Cascade desertparsley, sidebells wintergreen (*Orthilia secunda*), Cascade azalea (*Rhododendron albiflorum*), and Sitka valerian (*Valeriana sitchensis*).

Dominant plant species

- subalpine fir (*Abies lasiocarpa*), tree
- lodgepole pine (*Pinus contorta*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- whitebark pine (*Pinus albicaulis*), tree
- common juniper (*Juniperus communis*), shrub
- Oregon boxleaf (*Paxistima myrsinites*), shrub
- Cascade azalea (*Rhododendron albiflorum*), shrub
- broadleaf lupine (*Lupinus latifolius*), other herbaceous
- cascade desertparsley (*Lomatium martindalei*), other herbaceous
- broadleaf arnica (*Arnica latifolia*), other herbaceous
- sidebells wintergreen (*Orthilia secunda*), other herbaceous
- Sitka valerian (*Valeriana sitchensis*), other herbaceous

Community 1.2
Lodgepole Pine, Douglas-fir, Common Juniper, Spreading Phlox, Broadleaf Lupine, and Broadleaf Arnica

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. Douglas-fir may recruit to canopy gaps before subalpine fir can establish. This community may be identified by higher than reference understory productivity.

Community 1.3
Douglas-fir, Whitebark Pine, Broadleaf Lupine, and Broadleaf Arnica

Structure: open forest with shrubby regeneration and snags This early seral 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.

Douglas-fir and whitebark pine readily germinate and establish post-disturbance. Shrubs and forbs are often able to outcompete tree saplings for several years post-disturbance. Juvenile whitebark pine will generally be killed by white pine blister rust in this community phase.

Community 1.4
Douglas-fir, Lodgepole Pine, Common Juniper, Spreading Phlox, Broadleaf Lupine, and Jacob's-Ladder

Structure: shrubby meadow with sparse tree establishment With additional time post-disturbance lodgepole pine will recruit to the site. Whitebark pine will be largely removed from the site in this community. Snags of dead trees and a few uninfected trees may be found.

Community 1.5
Lodgepole Pine, Subalpine Fir, Common Juniper, Oregon Boxleaf, Broadleaf Lupine, and Cascade Desertparsley

Structure: single story with diminished understory Additional time without major disturbance allows slow-growing and shade-tolerant tree species to gradually replace Douglas-fir. Lodgepole pine, subalpine fir, and Alaska cedar generally dominate in this community. Understory productivity may be limited by locally 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	04/08/2026
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:

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:**