USDA Natural Resources
Conservation Service

Ecological site AX001X01X405
Mesic Udic Dry Shallow Outcrop

Last updated: 5/15/2025
Accessed: 04/12/2026

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

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	35–100%
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)	991-1,397 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	25–51 cm
Surface fragment cover <=3"	0–5%
Surface fragment cover >3"	0%
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)	15–50%
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

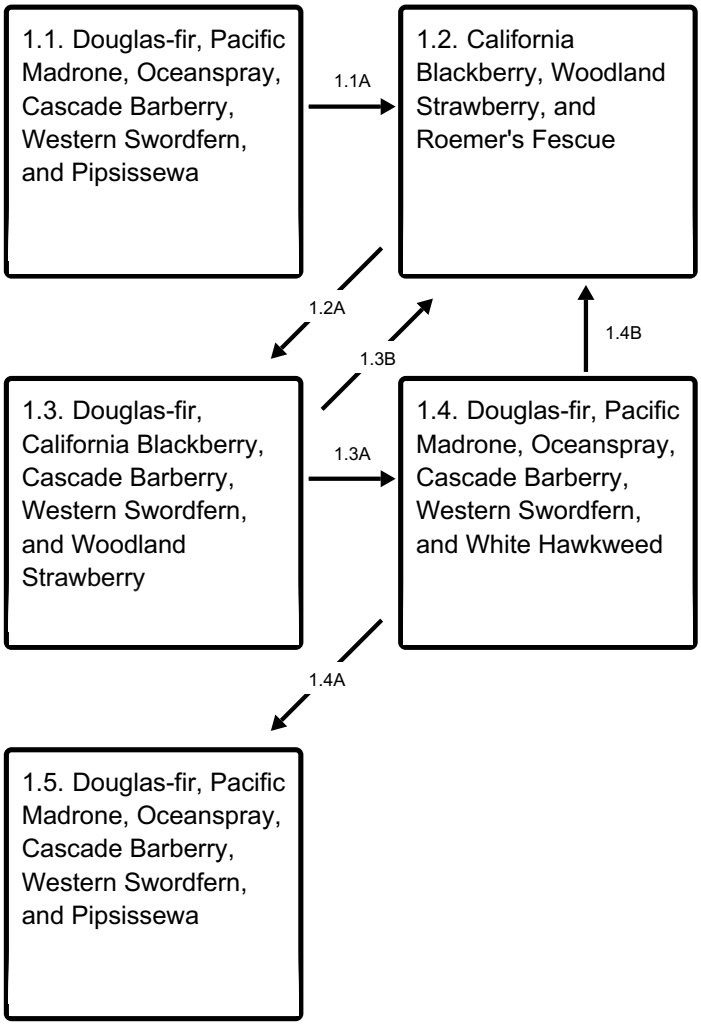
especially vulnerable to blowdown since it is susceptible to a variety of root and butt rot fungi. High-intensity Pacific frontal windstorms may cause high tree mortality and have a stand-replacing effect (Van Pelt, 2007). Mass movement generated from upslope sites can cause significant plant mortality 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

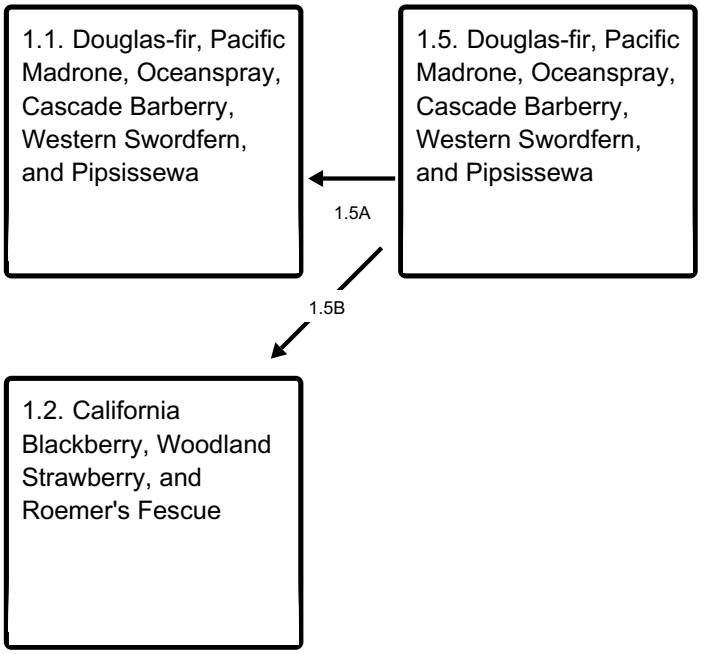
Ecosystem states

1. Reference

State 1 submodel, plant communities



Communities 1, 5 and 2 (additional pathways)



1.1A - High-intensity disturbance

1.2A - Time without disturbance

1.3B - 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 disturbance. Mesic Udic Dry Shallow Outcrop sites are dominated by evergreen trees, with a relatively sparse shrub and forb understory.

Dominant plant species

- Douglas-fir (*Pseudotsuga menziesii*), tree
- Pacific madrone (*Arbutus menziesii*), tree
- oceanspray (*Holodiscus discolor*), shrub
- Cascade barberry (*Mahonia nervosa*), shrub
- California blackberry (*Rubus ursinus*), shrub
- Roemer's fescue (*Festuca idahoensis ssp. roemeri*), grass
- western swordfern (*Polystichum munitum*), other herbaceous
- pipsissewa (*Chimaphila umbellata*), other herbaceous
- white hawkweed (*Hieracium albiflorum*), other herbaceous
- woodland strawberry (*Fragaria vesca*), other herbaceous

Community 1.1
Douglas-fir, Pacific Madrone, Oceanspray, Cascade Barberry, Western Swordfern, and Pipsissewa

Structure: Multistory with small gap dynamics Douglas-fir and Pacific madrone are the dominant overstory species in the reference community. These dominant tree species may continually regenerate depending on the availability of canopy gaps. Common understory species include oceanspray, dwarf rose (*Rosa gymnocarpa*), twinflower (*Linnaea borealis*), western swordfern, and pipsissewa. Cascade barberry is typically highly abundant on this site. Salal (*Gaultheria shallon*) may be present in low abundance. Bigleaf maple (*Acer macrophyllum*) may be present as a subdominant tree species. High vertical stratification in the canopy and the presence of small gaps favor an abundant understory.

Community 1.2
California Blackberry, Woodland Strawberry, and Roemer's Fescue

Structure: Mosaic of overstory and openings in varying states of regeneration This community is an early seral stage, occurring after a stand-replacing disturbance. Nearly all trees have been removed. In the case of high-intensity fire, few large fire-resistant trees may remain. Douglas-fir has thick, corky bark and mature individuals may be able to survive some fire events. Dwarf shrubs, forbs, and grasses are the first to establish on the site following disturbance. If soils are very shallow and available water capacity is too low to support trees, further progression towards a forested community phase might not be possible. If enough soil develops or accumulates to allow for tree establishment then the site may progress to later seral stages.

Community 1.3
Douglas-fir, California Blackberry, Cascade Barberry, Western Swordfern, and Woodland Strawberry

Structure: Shrubby single story with scattered understory of trees, shrubs, forbs, and grasses Douglas-fir can establish and grow quickly in the years following a stand-replacing disturbance. As time progresses, additional understory species regenerate and diversify. Roemer’s fescue may still be present on the site but is limited to forest gaps and microsites unsuitable for shrubs and forbs. Pacific madrone is slower to establish and grow than Douglas-fir following disturbance.

Community 1.4
Douglas-fir, Pacific Madrone, Oceanspray, Cascade Barberry, Western Swordfern, and White Hawkweed

Structure: Forest with a mix of shrubs, forbs, grasses, and tree regeneration in the understory Slow growing Pacific madrone will become subdominant or codominant to Douglas-fir within a few decades of disturbance. The shrub and forb layers continue to

develop. Oceanspray is typically found on the site in this phase. Oceanspray may not be the most abundant shrub species, but its presence is a good indicator of a dry udic site.

Community 1.5
Douglas-fir, Pacific Madrone, Oceanspray, Cascade Barberry, Western Swordfern, and Pipsissewa

Structure: Dense single stratum canopy with diminished understory With additional time passing after disturbance, the species composition of the understory begins to resemble the reference community, however understory productivity is generally diminished due to low canopy stratification and relatively dense tree growth, limiting sunlight density at the forest floor. Additional time will be required for the stand to develop vertical stratification. Individual tree mortality will promote age class diversity and create small canopy gap dynamics.

Pathway 1.1A
Community 1.1 to 1.2

Stand-replacing disturbances such as high-intensity fire, 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 1.3

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

Pathway 1.3B
Community 1.3 to 1.2

Stand-replacing disturbances such as high-intensity fire, 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 1.2

Stand-replacing disturbances such as high-intensity fire, 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 regeneration, growth, and progression to the reference community. Individual tree mortality gradually leads to a varied-age stand.

Pathway 1.5B
Community 1.5 to 1.2

Stand-replacing disturbances such as high-intensity fire, 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	04/12/2026
Approved by	Grant Petersen
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

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

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

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

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

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

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

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

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

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

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

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

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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:**

17. **Perennial plant reproductive capability:**