USDA Natural Resources Conservation Service

Ecological site F004AB405OR
Coastal Salt Spray Forest

Last updated: 1/23/2025
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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): 004A–Sitka Spruce Belt

This resource area is along the coast of the Pacific Ocean. It is characterized by a marine climate and coastal fog belt. The parent material is primarily glacial, marine, or alluvial sediment and some scattered areas of Tertiary sedimentary rock and organic deposits. Glacial deposits are dominant in the northern part of the MLRA in Washington; marine and alluvial deposits and eolian sand are dominant along the southern part of the Washington coast and extending into Oregon. The mean annual precipitation ranges from 52 to 60 inches near the beaches to more than 190 inches in the inland areas of the MLRA.
Andisols and Inceptisols are the dominant soil orders in the MLRA, but Spodosols, Entisols, and Histosols are also present. The soils are shallow to very deep and very poorly drained to somewhat excessively drained. They are on hilly marine terraces and drift plains; coastal uplands, hills, and foothills; flood plains; and coastal dunes, marshes, and estuaries.
The soil temperature regimes of MLRA 4A are moderated by the proximity to the Pacific Ocean, which eases the differences between the mean summer and winter temperatures. The seasonal differences in temperature are more pronounced in adjacent MLRAs further inland. Included in MLRA 4A are soils in cooler areas at higher elevations or on northerly aspects that have an isofrigid temperature regime.
The soil moisture regimes of MLRA 4A are typified by soils that do not have an extended dry period during normal years. Many of the soils further inland in MLRA 2 have a dry period in summer. Soils in low-lying areas and depressions of MLRA 4A are saturated in the rooting zone for extended periods due to a high water table or long or very long periods of flooding or ponding.

MLRA 4A Soil Temperature Regimes
Isomesic The mean annual soil temperature (measured at a depth of 20 inches) is 46 to 59 degrees F, and the difference between the mean winter and summer temperatures is less than 11 degrees. The seasonal soil temperatures and difference between the mean winter and summer temperatures are moderated by the proximity to the ocean and the effects of fog in summer.
Isofrigid The mean annual soil temperature (measured at a depth of 20 inches) is 32 degrees F to less than 46 degrees, and the difference between the mean winter and mean summer temperatures is less than 11 degrees. The seasonal soil temperatures and difference between the mean winter and summer temperatures are moderated by the proximity to the ocean and the effects of fog in summer. The temperatures are cooler than in surrounding lowlands because of the higher elevation and differences in slope and aspect.
MLRA 4A Soil Moisture Regimes
Udic The soil rooting zone is not dry in any part for more than 90 cumulative days in normal years. Soil moisture does not limit plant growth because of the fog in summer.
Aquic The soil is virtually free of dissolved oxygen due to saturation of the rooting zone. The soils are saturated for extended periods during the growing season and may be subject to long or very long periods of ponding and flooding.
Refer to Keys to Soil Taxonomy for complete definitions of the soil temperature and moisture regimes.

LRU notes

The Central Sitka Spruce Belt land resource unit (LRU B) of MLRA 4A is along the west coast of Washington and Oregon. The LRU extends from the Chehalis River in Washington to South Slough in Oregon, and it is bounded on the west by the Pacific Ocean. This area consists of sand dunes, flood plains, and marine terraces that extend a few miles east and are parallel to the Pacific Ocean, and it transitions to steeper and higher elevation ridges and mountainsides of the western slopes of the Coast Range in Oregon. Near the shore in coastal lowland areas, the parent material is dominantly eolian (wind-deposited) sand, alluvium, and marine sediment. Residuum, colluvium, and landslide deposits derived from sedimentary and basaltic sources are on the coastal foothills and mountains, and minor additions of recent alluvium are along the river valleys. Several major rivers carved steep, narrow valleys through the coastal mountains and foothills before entering broader coastal valleys. Subduction zones along the Pacific Coast may cause significant earthquakes and tsunamis, which would disrupt the ecological processes beyond what is described in this ecological site description.

Classification relationships

National vegetation classification: G751 North Pacific Western Hemlock-Sitka Spruce-Western Redcedar Seasonal Rainforest; A3608 Sitka Spruce-Salmonberry Mesic Forest Alliance
Ecological Systems of Washington State community type: North Pacific Seasonal Sitka Spruce Forest
Plant associations of the Oregon Dunes National Recreation Area: Sitka spruce/Salal-Salmonberry Forest (PISI/GASH-RUSP)
National Park Service association groups: Sitka spruce/False lily of the Valley Forest; Sitka spruce-(red alder)/Salmonberry/Swordfern Forest

Ecological site concept

This ecological site is on marine terraces of the western coastline of the Pacific Northwest, from southern Washington through central Oregon. The site is exposed to extremely high winds and salt spray. Elevation typically is 50 to 400 feet, and slope is 0 to 50 percent.
The maritime climate is characterized by cool, moist summers and cool, wet winters. The mean annual precipitation is 70 to 105 inches. Coastal fog provides supplemental moisture in summer. Snowfall is rare, and it is not persistent when it occurs. The mean annual air temperature is 48 to 52 degrees F.
The soils that support this ecological site are in the isomesic temperature regime and udic moisture regime. They generally formed in colluvium and residuum derived dominantly from volcanic, basaltic, or metasedimentary rock. Areas of soils that are shallow to bedrock or are skeletal and have a high content of rock fragments and areas of rock outcroppings are on the steeper slopes. These areas can be significant locally.
The soil parent material along the coast is exposed to a heightened weathering regime due to moderated temperatures and high precipitation. Enhanced weathering and organic matter from the dense vegetative cover have resulted in an accumulation of a particular suite of organic and metal oxide compounds, a process called andisolization. The level of andisolization varies within this ecological site, but Andisols and andic intergrades have been identified. A unique set of soil properties has developed as a result of andisolization, including an improved water-holding capacity, a high content of organic matter, and high phosphorous retention. This process is most typical in soils that formed in weathered volcanic ash, but a unique combination of climatic conditions and vegetation has resulted in these soil properties in coastal areas of the Pacific Northwest.
The most common overstory species is Sitka spruce (Picea sitchensis). Regeneration is limited by the canopy cover, and it commonly is in gaps where sunlight is most available. Red alder (Alnus rubra) may be dominant in the overstory in the gaps. Common understory species include salmonberry (Rubus spectabilis), salal (Gaultheria shallon), evergreen huckleberry (Vaccinium ovatum), western swordfern (Polystichum munitum), and false lily of the valley (Maianthemum dilatatum).
The most common natural disturbance on this site is windthrow following large coastal storms, which creates pockets of forest openings. Although wildfires are uncommon, the site is susceptible to catastrophic that are stand replacing (Taylor, 1990). Landslides may occur along the steep coastal hillslopes. Unnatural disturbances include grazing, urban sprawl, and establishment of non-native species.

Table 1. Dominant plant species

Tree	(1) *Picea sitchensis*

Shrub	(1) *Gaultheria shallon* (2) *Rubus spectabilis*
Herbaceous	(1) *Polystichum munitum* (2) *Maianthemum dilatatum*

Physiographic features

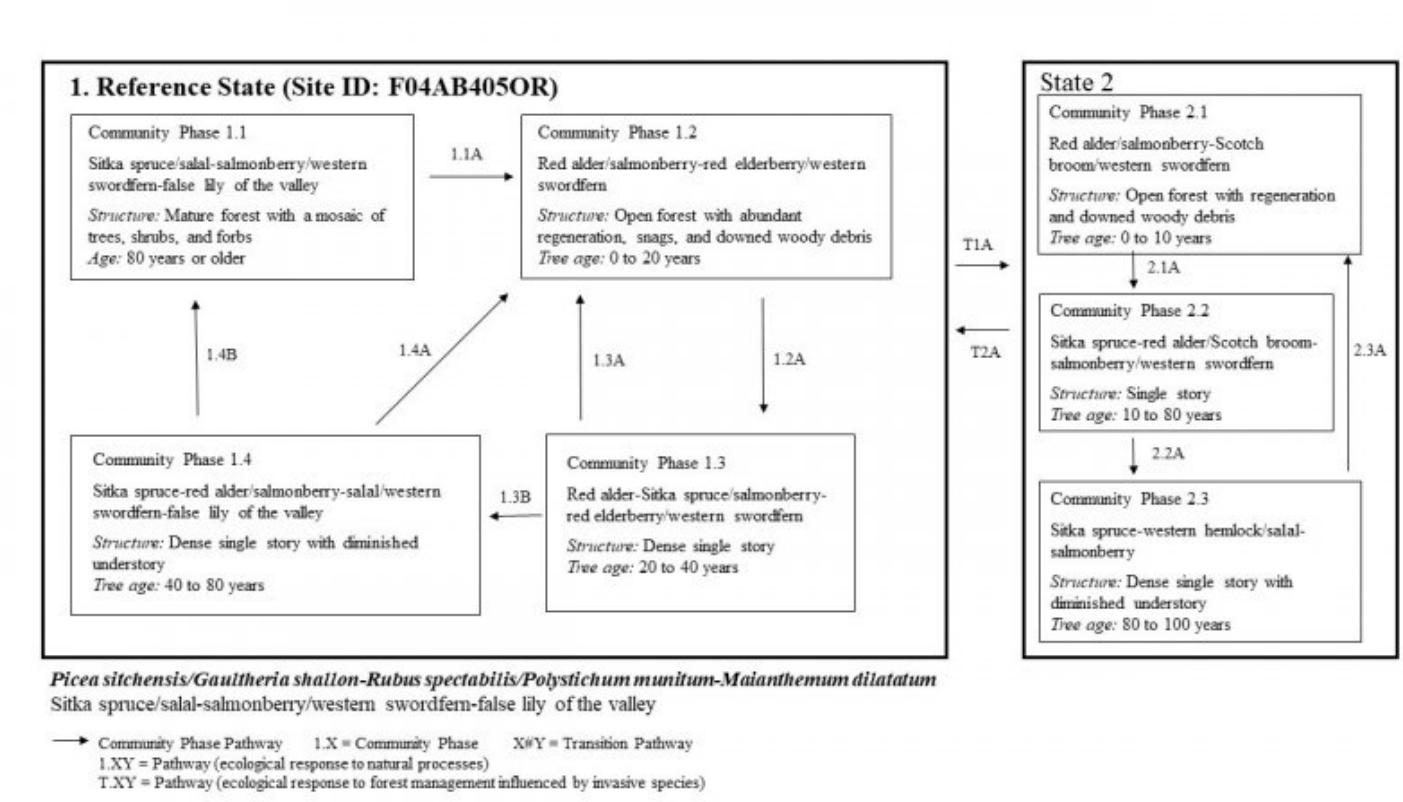
Climatic features

Influencing water features

Soil features

Ecological dynamics

State and transition model



State 1
Reference

Community 1.1
Sitka Spruce, Salal, Salmonberry, Western Swordfern, and False Lily of the Valley

Structure: Mature forest with a mosaic of trees, shrubs, and forbs Sitka spruce is the primary overstory tree, but western hemlock (*Tsuga heterophylla*), Douglas-fir (*Pseudotsuga menziesii*), shore pine (*Pinus contorta* var. contorta), and western redcedar (*Thuja plicata*) may be present. Sitka spruce is considered a seral tree species as compared to western hemlock, but several factors have contributed to its dominance in late successional forests (Taylor, 1990). Sitka spruce is highly tolerant of salt spray and grows well in mineral-rich soils that have low pH and high cation-exchange capacity. These factors tend to support the growth and regeneration of Sitka spruce in coastal ecosystems (Peterson, 1997). Gaps in the mid canopy and overstory allow sunlight to reach the ground; thus, a majority of the understory plants establish in these gaps. The dense canopy created by the multiple age groups of trees may block most of the sunlight from the forest floor, which leads to a sparse understory or lush herbaceous understory in some areas. Red alder may also be in the gaps and openings. Common understory species include salal, salmonberry, evergreen huckleberry, red elderberry (*Sambucus racemosa*), red huckleberry (*Vaccinium parvifolium*), rusty menziesia (*Menziesia ferruginea*), western swordfern, deer fern (*Blechnum spicant*), false lily of the valley, and Oregon oxalis (*Oxalis oregana*). Species such as slough sedge (*Carex obnupta*), coastal hedgenettle (*Stachys chamissonis*), common ladyfern (*Athyrium filix-femina*), and threepetal bedstraw (*Galium trifidum*) may be in depressions or microsites that have a high water table or are subject to intermittent ponding.

Community 1.2
Red Alder, Salmonberry, Red Elderberry, and Western Swordfern

Structure: Open forest with abundant regeneration, snags, and downed woody debris Community phase 1.2 is an early seral plant community that has been impacted by a stand-replacing disturbance such as a wildfire, a large-scale wind event, or mass movement. Few, if any, trees are in the overstory. Standing, decaying snags are prevalent. The understory is dominantly early seral tree, shrub, and forb species such as red alder, salmonberry, red elderberry, red huckleberry, and western swordfern. Some grasses will establish, but they will be replaced by shrubs over time. Depending on the severity of the disturbance, tree seedlings and saplings typically will establish within 3 to 10 years.

Community 1.3
Red Alder, Sitka Spruce, Salmonberry, Red Elderberry, and Western Swordfern

Structure: Dense single story Community phase 1.3 is an early seral forest in regeneration. Scattered remnant mature trees may be present. Species composition depends on the natural seed sources present and the intensity of disturbance. After a moderate or severe disturbance, shrubs likely will outcompete tree seedlings. Red alder, red huckleberry, red elderberry, evergreen huckleberry, western swordfern, and salmonberry may be abundant depending on the availability of sunlight. Seed sources for tree species are the surrounding undisturbed forested areas and survivors of the disturbance. This results in a mixed stand that could include Sitka spruce, red alder, Douglas-fir, shore pine, western hemlock, and western redcedar.

Community 1.4
Sitka Spruce, Red Alder, Salmonberry, Salal, Western Swordfern, and False Lily of the Valley

Structure: Dense single story with diminished understory Community phase 1.4 is a forest in the competitive exclusion stage. Scattered remnant mature trees may be present. Competition among individual trees for available water and nutrients increases. Sitka spruce is dominant in the overstory; however, more shade-intolerant species such as western hemlock, Douglas-fir, and western redcedar may be present. The canopy closure is nearly 100 percent; thus, the shrub and forb layers are diminished. Some understory species better adapted to at least partial shade will begin to increase in abundance. Over time, the forest will begin to self-thin due to the elevated competition.

Pathway 1.1A
Community 1.1 to 1.2

Sitka Spruce, Salal, Salmonberry, Western Swordfern, and False Lily of the Valley

Red Alder, Salmonberry, Red Elderberry, and Western Swordfern

This pathway represents a major stand-replacing disturbance such as a high-intensity fire, timber management, a large-scale wind event, a major insect infestation, or large mass movement that leads to the stand initiation phase of forest development.

Pathway 1.2A
Community 1.2 to 1.3

Red Alder, Salmonberry, Red Elderberry, and Western Swordfern

Red Alder, Sitka Spruce, Salmonberry, Red Elderberry, and Western Swordfern

This pathway represents growth over time with no further significant disturbance.

Pathway 1.3A
Community 1.3 to 1.2

Red Alder, Sitka Spruce, Salmonberry, Red Elderberry, and Western Swordfern

Red Alder, Salmonberry, Red Elderberry, and Western Swordfern

This pathway represents a major stand-replacing disturbance such as a high-intensity fire, timber management, a large-scale wind event, a major insect infestation, or large mass movement that leads to the stand initiation phase of forest development.

Pathway 1.3B
Community 1.3 to 1.4

Red Alder, Sitka Spruce, Salmonberry, Red Elderberry, and Western Swordfern

Sitka Spruce, Red Alder, Salmonberry, Salal, Western Swordfern, and False Lily of the Valley

This pathway represents growth over time with no further major disturbance.

Pathway 1.4B
Community 1.4 to 1.1

Sitka Spruce, Red Alder, Salmonberry, Salal, Western Swordfern, and False Lily of the Valley

Sitka Spruce, Salal, Salmonberry, Western Swordfern, and False Lily of the Valley

This pathway represents growth over time with no further major disturbance.

Pathway 1.4A
Community 1.4 to 1.2

Sitka Spruce, Red Alder, Salmonberry, Salal, Western Swordfern, and False Lily of the Valley

Red Alder, Salmonberry, Red Elderberry, and Western Swordfern

This pathway represents a major stand-replacing disturbance such as a high-intensity fire, timber management, a large-scale wind event, a major insect infestation, or large mass movement that leads to the stand initiation phase of forest development.

State 2
Disturbed

Community 2.1
Red Alder, Salmonberry, Scotch Broom, and Western Swordfern

Structure: Open forest with regeneration and downed woody debris Community phase 2.1 represents a recently disturbed forest that is naturally regenerating. Large woody debris commonly is prolific following large-scale disturbances. This inhibits the establishment of vegetation under natural conditions. Areas that are not replanted immediately (1 to 3 years) after timber harvesting or a large-scale disturbance may become vulnerable to infestation by invasive species. Typically, commercially managed forests will be replanted following disturbance. The species preference depends on site conditions and long-term economic decisions. Overall, species biodiversity is diminished in forests managed for short-rotation timber. Natural reforestation depends on available seed sources following disturbance. Early seral species such as red alder and salmonberry tend to regenerate quickly under abundant sunlight. The plant community composition typically is homogenous and even aged. Areas that are not replanted or actively managed are vulnerable to infestation by invasive species such as Scotch broom (*Cytisus scoparius*).

Community 2.2
Sitka Spruce, Red Alder, Scotch Broom, Salmonberry, and Western Swordfern

Structure: Single story Community phase 2.2 represents an even-aged, regenerating forest. Sitka spruce, western hemlock, shore pine, and Douglas-fir can regenerate quickly on nurse logs or in recently disturbed soils. A higher soil temperature favors seed germination of Sitka spruce; thus, it commonly is the first coniferous tree species to re-establish following logging (Peterson, 1997). Shade-intolerant red alder remains a large component in the overstory until it reaches maturity (Fonda, 1974). Vegetation in areas that have been replanted commonly is dense and even aged, and understory species are sparse in areas that have high percentage of canopy cover. Salmonberry, common gorse, and Scotch broom increase in prominence in areas that receive abundant sunlight. Management techniques such as pre-commercial or commercial thinning and mitigation of invasive species will accelerate the maturation and improve the health of the forest.

Community 2.3
Sitka Spruce, Western Hemlock, Salal, and Salmonberry

Structure: Dense single story with diminished understory Community phase 2.3 represents a maturing conifer forest that has increased species diversity. A shrubby understory of shade-tolerant species will develop; however, common gorse likely will remain in areas where there are openings in the canopy. The dense, shrubby understory is prone to wildfires. Commercial logging operations commonly take place during this phase as the trees reach economical maturity in size and volume. It is presumed that without timber management during this phase, an old-growth stand of Sitka spruce and western hemlock will develop.

Pathway 2.1A
Community 2.1 to 2.2

This pathway represents growth over time with no further major disturbance or active forest management.

Pathway 2.2A
Community 2.2 to 2.3

This pathway represents growth over time with no further major disturbance or active forest management.

Pathway 2.3A
Community 2.3 to 2.1

This pathway represents a major stand-replacing disturbance such as a high-intensity fire, a large-scale wind event, a major insect or disease infestation, large mass movement, or timber harvesting that leads to the stand initiation phase of forest development.

Transition T1A
State 1 to 2

This pathway represents a major disturbance that removes most of the overstory. Large-scale disturbances can increase the vulnerability of the site to infestation by invasive species if a seed source is nearby or introduced into the site. This type of disturbance will impact the natural feedbacks that maintained the reference state.

Transition T2A
State 2 to 1

This pathway represents intensive management to restore the historic plant community by creating a closed canopy with natural gaps that allow understory species to regenerate.

Additional community tables

Other references

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Approval

Kirt Walstad, 1/23/2025

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	05/07/2024
Approved by	Kirt Walstad
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):**

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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:**

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17. **Perennial plant reproductive capability:**
