USDA Natural Resources Conservation Service

Ecological site F004AB403WA Coastal Upland Cool 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 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 Red Cedar Seasonal Rainforest; A3608 Sitka Spruce-Salmonberry Mesic Forest Alliance
Ecological Systems of Washington State community type: North Pacific Seasonal Sitka Spruce Forest
Sitka spruce/swordfern; Sitka spruce/salmonberry-salal

Ecological site concept

This ecological site is on the western coastline of the Pacific Northwest, from southern Washington through central Oregon. It is on coastal hills, mountains, and headlands at an elevation of 30 to 1,800 feet. Slopes are 20 to 100 percent.
The maritime climate is characterized by cool, moist summers and cool, wet winters. The mean annual precipitation is 70 to 130 inches. Coastal fog provides supplemental moisture in summer. Snowfall is rare, and it is not persistent when it occurs. The mean annual air temperatures is 48 to 52 degrees F. The mild temperatures and long growing season result in highly productive forestland.
The soils that support this ecological site 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.
This forest ecological site is supported by soils that have a wide range in physical properties. The soils are in the udic temperature regime and isomesic moisture regime. This climate is characterized by low potential evapotranspiration during the growing season; therefore, plants are not drought stressed. The soils have a high to low water-holding capacity, and the main soil properties that affect water-holding capacity are depth and texture.
As a result of the unique abiotic conditions, this ecological site is considered one of the most productive forests in the world (Franklin, 1973). The most common overstory species are Sitka spruce (Picea sitchensis) and western hemlock (Tsuga heterophylla). Stands may also include Douglas-fir (Pseudotsuga menziesii) and western redcedar (Thuja plicata). Red alder (Alnus rubra) may be common in forest openings. Regeneration of red alder is limited by canopy cover, and it commonly is in gaps where sunlight is most available. Common understory species include salmonberry (Rubus spectabilis), evergreen huckleberry (Vaccinium ovatum), red huckleberry (Vaccinium parvifolium), salal (Gaultheria shallon), western swordfern (Polystichum munitum), and false lily of the valley (Maianthemum dilatatum).
The most common natural disturbance on this ecological site is windthrow following large storms, which creates pockets of forest openings. Although wildfires are uncommon, the site is susceptible to catastrophic crown fires that are stand replacing (Taylor, 1990). The natural fire regime for Sitka spruce and western hemlock is 150 to 400 years (Griffith, 1992).

Table 1. Dominant plant species

Tree	(1) *Picea sitchensis* (2) *Tsuga heterophylla*
Shrub	(1) *Gaultheria shallon* (2) *Rubus spectabilis*
Herbaceous	(1) *Polystichum munitum* (2) *Maianthemum dilatatum*

Physiographic features

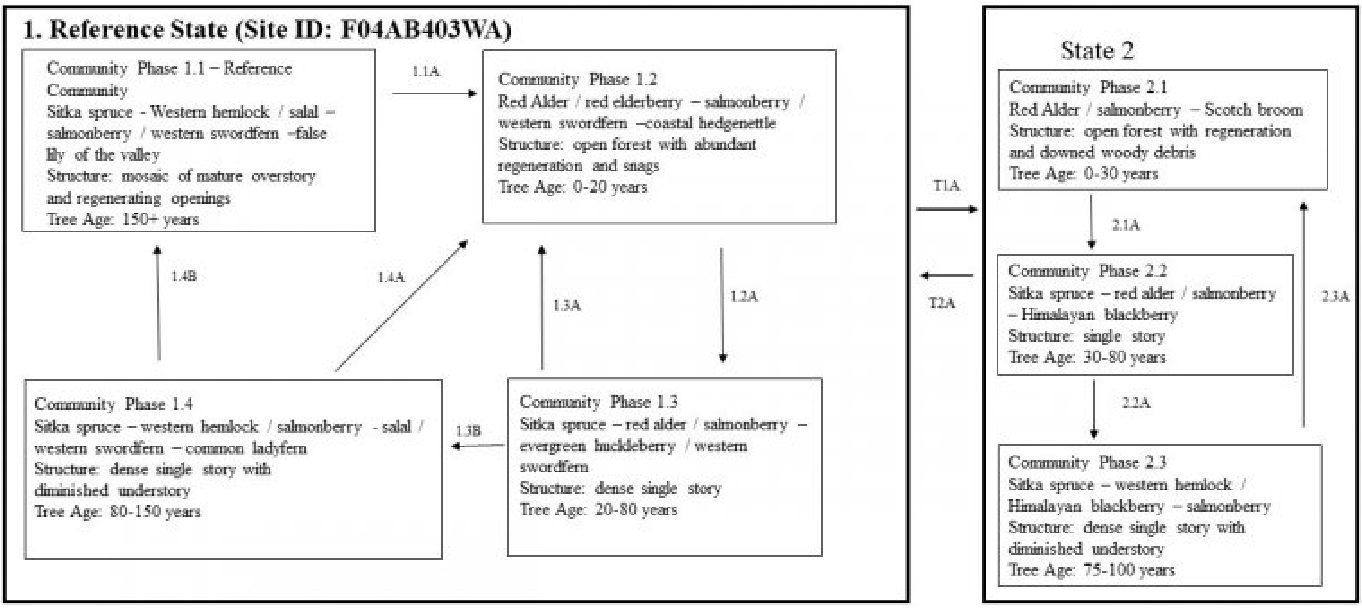
Climatic features

Influencing water features

Soil features

Ecological dynamics

State and transition model



Picea sitchensis - Tsuga heterophylla / Gaultheria shallon – Rubus spectabilis / Polystichum munitum – Maianthemum dilatatum
Sitka spruce - western hemlock / salal– salmonberry / western swordfern – false lily of the valley

Community Phase Pathway 1.X = Community Phase X#Y = Transition Pathway
1.XY = Pathway (ecological response to natural processes)
T.XY = Pathway (ecological response to forest management influenced by invasive species)

State 1
Reference State

Community 1.1
Sitka spruce-western hemlock/salal-salmonberry/western swordfern-false lily of the valley

Structure: Mosaic of mature overstory and regenerating openings Sitka spruce and western hemlock are the most common overstory species in the reference community. Douglas-fir and western redcedar likely are present; however, minimal Douglas-fir regeneration occurs in a closed canopy forest and it is entirely absent in some areas. The dense canopy created by the multiple age groups of trees may block most of the sunlight from the forest floor, which leads to sparse understory in some areas. Gaps in the mid canopy and overstory allow sunlight to reach the ground, and a majority of the understory plants establish in these gaps. The gaps also allow red alder to regenerate, and mature stands of red alder may be throughout this community. The understory tends to be more continuous in areas where there is no mid canopy. Common understory shrub species include evergreen huckleberry, red huckleberry, salal, thimbleberry (*Rubus parviflorus*), salmonberry, trailing blackberry (*Rubus ursinus*), and red elderberry (*Sambucus racemosa*). The herbaceous cover commonly is diverse, and it includes western swordfern, common ladyfern (*Athyrium filix-femina*), deer fern (*Blechnum spicant*), coastal hedgenettle (*Stachys chamissonis*), and Oregon oxalis (*Oxalis oregana*). Species such as slough sedge (*Carex obnupta*) 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/red elderberry-salmonberry/western swordfern-coastal hedgenettle

Structure: Open forest with abundant regeneration and snags 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, mass movement, or a major insect or disease infestation. Nearly all trees are absent, but some fire-resistant trees may survive in the overstory. Standing, decaying snags are prevalent. Vegetative regeneration occurs quickly following disturbance. The understory is dominantly early seral tree, shrub, and forb species such as red alder, thimbleberry, red elderberry, salmonberry, and coastal hedgenettle. Salmonberry can regenerate and grow to an average of 1 foot within the first 5 years following disturbance (Hemstrom, 1986). Red alder has several competitive advantages and can establish quickly as compared to conifers. It can sprout and establish in full sunlight and fixes nitrogen, which provide an early competitive advantage (Villarin, 2009). Seeds of deciduous species are light and can be transported long distances by wind and water, which allows for rapid recolonization. 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 establish within 3 to 10 years.

Community 1.3
Sitka spruce-red alder/salmonberry-evergreen huckleberry/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 the disturbance. After a moderate or severe fire, shrubs likely will outcompete tree seedlings. Red alder, red huckleberry, evergreen huckleberry, western swordfern, coastal hedgenettle, and salmonberry may be abundant in the understory if sunlight is sufficient (Bailey, 1968). Red alder will begin to die 40 to 70 years following disturbance and more light will penetrate the newly nitrogen-rich soil (Naiman, 2009). As a result, conifer regeneration becomes more prevalent in this community phase. Seed sources for tree species are the surrounding undisturbed forested areas. The combination of the new seedlings and survivors of the disturbance results in a mixed stand that could include Sitka spruce, Douglas-fir, western hemlock, and western redcedar (Franklin, 1973). Sitka spruce is vulnerable to outbreaks of white pine weevil during this community phase.

Community 1.4
Sitka spruce-western hemlock/salmonberry-salal/western swordfern-common ladyfern

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 is increased. Sitka spruce and western hemlock are dominant in the overstory canopy; however, more shade-intolerant species such as Douglas-fir and western redcedar may be present. Canopy closure is nearly 100 percent, which leads to diminished shrubs and forbs. Some understory species better adapted to at least partial shade will begin to increase. 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-western hemlock/salal-salmonberry/western swordfern-false lily of the valley

Red alder/red elderberry-salmonberry/western swordfern-coastal hedgenettle

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

Pathway 1.2A
Community 1.2 to 1.3

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

Pathway 1.3A
Community 1.3 to 1.2

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

Pathway 1.3B
Community 1.3 to 1.4

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

Pathway 1.4B
Community 1.4 to 1.1

Sitka spruce-western hemlock/salmonberry-salal/western swordfern-common ladyfern

Sitka spruce-western hemlock/salal-salmonberry/western swordfern-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-western hemlock/salmonberry-salal/western swordfern-common ladyfern

Red alder/red elderberry-salmonberry/western swordfern-coastal hedgenettle

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 State

Community 2.1
Red alder/salmonberry-Scotch broom

Structure: Open forest with regeneration and downed woody debris Community phase 2.1 represents a recently disturbed forest that is naturally regenerating. Following large-scale disturbances, logging slash and large woody debris commonly are prolific. This inhibits establishment of vegetation under natural conditions. Areas that are not replanted immediately (1 to 3 years) following timber harvesting or a large-scale disturbance may become vulnerable to infestation by invasive species. Typically, commercially managed forests will be replanted following a disturbance. 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. Plant community composition typically is homogenous and even aged. Scotch broom (*Cytisus scoparius*), tansy ragwort (*Senecio jacobaea*), and foxglove (Agalinis spp.) commonly are dominant after logging disturbance.

Community 2.2
Sitka spruce-red alder/salmonberry-Himalayan blackberry

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, which 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). The vegetation in areas that have been replanted commonly is dense and even aged, and the understory species are sparse in areas that have a high percentage of canopy cover. Salmonberry is a common understory species, but invasive species increase in prominence. Scotch broom and Himalayan blackberry (*Rubus armeniacus*) can greatly impact the shrubby understory and outcompete native species. Management techniques such as pre-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/Himalayan blackberry-salmonberry

Structure: Dense single story with diminished understory Community phase 2.3 represents a maturing forest that has increased plant diversity. Western hemlock can regenerate under dense, shrubby canopies. It will begin to establish in the overstory canopy along with Sitka spruce. Invasive species will inhibit the overall health and structure of the forest, creating an ecosystem in which Sitka spruce is susceptible to devastation from white pine weevil. The dense, shrubby understory is susceptible to wildfires. Commercial logging operations commonly take place during this phase as trees reach economical maturity in size and volume. As a result of the typical harvest sequence, an old-growth stand commonly is not achieved and Sitka spruce remains the most prevalent overstory tree. It is presumed that without timber management during this phase, an old-growth Sitka spruce and western hemlock stand 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 logging activities that lead to the stand initiation phase of forest development.

Transition T1A
State 1 to 2

This pathway represents a major disturbance that has removed most of the overstory. Large-scale disturbances may increase the vulnerability 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.

Additional community tables

Other references

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Approval

Kirt Walstad, 5/07/2024

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):**

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:**