USDA Natural Resources Conservation Service

Ecological site F004AB202OR
Dune 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: G205 Vancouverian Dry Coastal and Lowland Beach Pine Forest and Woodland-Sand Dune Woodland Alliance; G751 North Pacific Western Hemlock-Sitka Spruce-Western Redcedar Seasonal Rainforest Group-Stabilized Dune Forest Alliance
Ecological Systems of Washington State community type: North Pacific Maritime Coastal Sand Dune and Strand

Plant associations of the Oregon Dunes National Recreation Area: Shore Pine-Sitka Spruce/Evergreen Huckleberry Forest; Sitka Spruce/Evergreen Huckleberry Forest

Ecological site concept

This ecological site is on the western coastline of the Pacific Northwest, from southern Washington through central Oregon. It is inland from the coastal beaches and foredunes. Forests develop on mature, stabilized dunes in areas where tree species are able to root and become established. The soils that support this site formed in eolian sand or mixed alluvium. They generally are weakly developed and have limited available water capacity due to the sandy texture.
The maritime climate is characterized by cool, moist summers and cool, wet winters. The mean annual precipitation is 60 to 110 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 dominant vegetation is tolerant of heavy winds, a high seasonal water table, wind desiccation, low nutrient availability, and salt spray. The most common species include Sitka spruce (*Picea sitchensis*), shore pine (*Pinus contorta* var. contorta), evergreen huckleberry (*Vaccinium ovatum*), salal (*Gaultheria shallon*), kinnikinnick (*Arctostaphylos uva-ursi*), California wax myrtle (*Morella californica*), Pacific rhododendron (*Rhododendron macrophyllum*), brackenfern (*Pteridium aquilinum*), false lily of the valley (*Maianthemum dilatatum*), and western swordfern (*Polystichum munitum*).
The most common natural disturbance is strong windstorms. Infrequent wildfires and storm tidal surges may occur.

Table 1. Dominant plant species

Tree	(1) *Picea sitchensis* (2) *Pinus contorta var. contorta*
Shrub	(1) *Gaultheria shallon* (2) *Vaccinium ovatum*
Herbaceous	(1) *Pteridium aquilinum*

Physiographic features

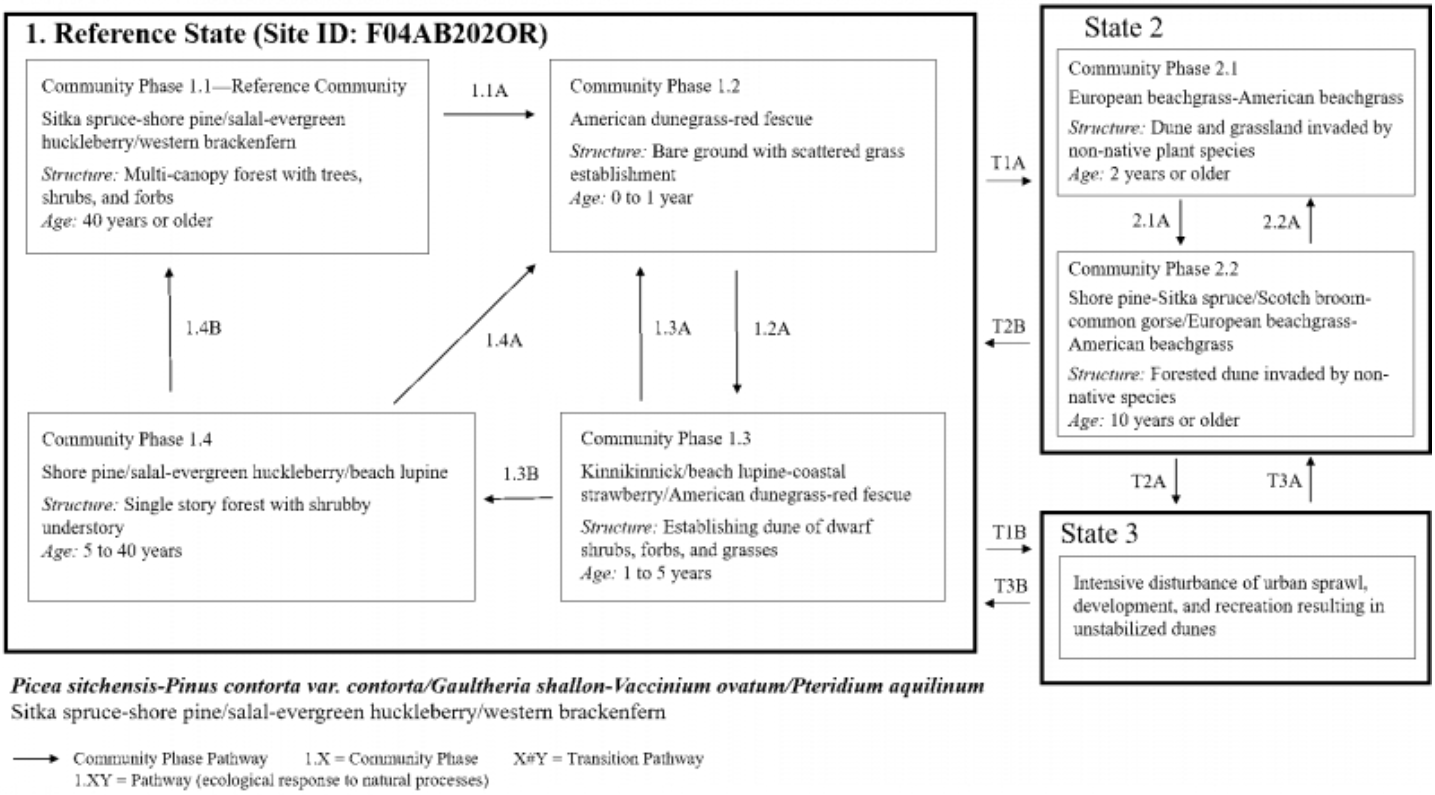
Climatic features

Influencing water features

Soil features

Ecological dynamics

State and transition model



State 1
Reference

Community 1.1
Sitka Spruce, Shore Pine, Salal, Evergreen Huckleberry, and Western Brackenfern

Structure: Multi-canopy forest with trees, shrubs, and forbs The reference community is a stabilized dune forest that consists primarily of trees and shrubs. Forbs and grasses commonly are sparse as a result of the dense canopy and salt spray. Mosses and lichens play an important role in this ecosystem by forming a thin, fragile mat on the soil surface, which helps to stabilize the soil. The most common tree species are Sitka spruce (*Picea sitchensis*) and shore pine (*Pinus contorta* var. contorta), but western hemlock (*Tsuga heterophylla*), western redcedar (*Thuja plicata*), and Douglas-fir (*Pseudotsuga menziesii*) may be present on very old, stabilized dunes. The most common shrubs are evergreen huckleberry (*Vaccinium ovatum*), salal (*Gaultheria shallon*), kinnikinnick (*Arctostaphylos uva-ursi*), California wax myrtle (*Morella californica*), and Pacific rhododendron (*Rhododendron macrophyllum*). Pacific rhododendron may be the dominant shrub in the understory of some stands. Herbaceous understory is sparse, but common species are brackenfern (*Pteridium aquilinum*), false lily of the valley (*Maianthemum dilatatum*), and western swordfern (*Polystichum munitum*). The reference community is subject to frequent salt spray, wind pruning, and windthrow. As a result, a large amount of coarse woody debris is present. This site represents a lack of major disturbance or unnatural modifications.

Community 1.2
American Dunegrass and Red Fescue

Structure: Bare ground with scattered grass establishment Community phase 1.2 represents a forested dune that has been affected by a major disturbance and is at the initiation phase of regeneration. The vegetation is emerging American dunegrass (*Leymus mollis* spp. mollis) and red fescue (*Festuca rubra*), and the cover is patchy. The unstable dune is highly susceptible to wind erosion, trampling, and drought. Minimizing disturbance (natural and unnatural) is important for the vegetative recovery of the site. Monitoring for establishment of non-native species, primarily European beachgrass (*Ammophila arenaria*), is imperative for a successful native dune plant community.

Community 1.3
Kinnikinnick, Beach Lupine, Coastal Strawberry, American Dunegrass and Red Fescue

Structure: Establishing dune of dwarf shrubs, forbs and grasses Community phase 1.3 represents a dune that is quickly stabilizing and has a higher diversity of plant life. Forbs begin to establish as the American dunegrass stabilizes, creating a well-established mats. Low-growing ericaceous shrubs such as kinnikinnick (*Arctostaphylos uva-ursi*) may establish during this phase and increase the stability of the dune. Depending on the seed source and site conditions, these shrubs may be entirely absent in some areas. Forbs such as seashore lupine (*Lupinus littoralis*), beach strawberry, (*Fragaria chiloensis*), and seashore false bindweed (*Calystegia soldanella*) may be intermixed. Red fescue (*Festuca rubra*) may be in the grass community.

Community 1.4
Shore Pine, Salal, Evergreen Huckleberry, and Beach Lupine

Structure: Single story forest with shrubby understory Community phase 1.4 represents a forested dune that is stabilizing with conifer establishment. Shore pine commonly is the first conifer to establish; however, depending on the seed source, Sitka spruce may be dominant in some areas. Shrubs such as salal, evergreen huckleberry, Pacific rhododendron, and California wax myrtle will begin to mature. In some areas, Pacific rhododendron may be the only shrub in the understory. As the canopy cover increases, forbs and grasses will diminish.

Pathway 1.1A
Community 1.1 to 1.2

This pathway represents a major disturbance such as a massive tidal surge, an excessively damaging windstorm, wildfire, or extended drought that removes most, if not all, of the existing vegetation.

Pathway 1.2A
Community 1.2 to 1.3

This pathway represents a transition toward dune stabilization as a result of increased plant diversity and cover.

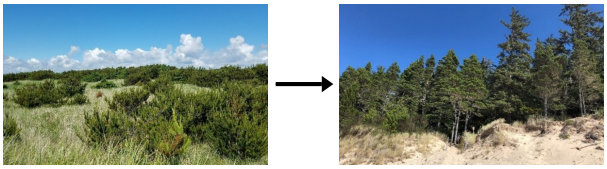
Pathway 1.3A
Community 1.3 to 1.2

This pathway represents a major disturbance such as a massive tidal surge, an excessively damaging windstorm, wildfire, or extended drought that removes most, if not all, of the existing vegetation.

Pathway 1.3B
Community 1.3 to 1.4

This pathway represents a transition toward dune stabilization as a result of increased plant diversity and cover.

Pathway 1.4B
Community 1.4 to 1.1



Shore Pine, Salal, Evergreen Huckleberry, and Beach Lupine

Sitka Spruce, Shore Pine, Salal, Evergreen Huckleberry, and Western Brackenfern

This pathway represents a transition toward dune stabilization as a result of increasing plant diversity and cover.

Pathway 1.4A
Community 1.4 to 1.2

This pathway represents a major disturbance from a massive tidal surge, an excessively damaging windstorm, wildfire, or extended drought that removes most, if not all, of the existing vegetation.

State 2
Disturbed

Community 2.1
European Beachgrass and American Beachgrass

Structure: Dune and grassland invaded by non-native plant species Community phase 2.1 represents a disturbed, unstable dune that is susceptible to invasion by non-native species. European beachgrass (*Ammophila arenaria*) is an exotic grass that has been used to stabilize dunes. It is highly successful at building thick mats very rapidly, and it tolerates salt spray, wind erosion, and excessive drought. American beachgrass (*Ammophila breviligulata*) was planted along the Long Beach peninsula, and it has spread throughout the coastal zone (Roccio, 2015). A small remnant community of American dunegrass, seashore lupine, and coastal strawberry may be present. Other common non-native species include little hairgrass (*Aira caryophyllea*) and hairy cat's ear (*Hypochaeris radicata*).

Community 2.2
Shore Pine, Sitka Spruce, Scotch Broom, Common Gorse, European Beachgrass American Beachgrass

Structure: Forested dune invaded by non-native species Community phase 2.2 represents a forested dune that has been susceptible to non-native species. Tree species such as shore pine and Sitka spruce are still dominant in the conifer canopy; however, the understory plant community has been altered significantly. Scotch broom (*Cytisus scoparius*) and common gorse (*Ulex europaeus*) are exotic shrubs that can spread widely across landscapes. Depending on site-specific dynamics and seed sources, the prevalence of Scotch broom, common gorse, Sitka spruce, and shore pine may be limited to one major shrub and tree species in an area. A small remnant community of salal, evergreen huckleberry, kinnikinnick, Pacific rhododendron, western brackenfern, western swordfern, and false lily of the valley may be present.

Pathway 2.1A
Community 2.1 to 2.2

This pathway represents growth over time with increased non-native plant establishment.

Pathway 2.2A
Community 2.2 to 2.1

This pathway represents a major disturbance from a massive tidal surge, an excessively damaging windstorm, wildfire, or extended drought that removes most, if not all, of the existing vegetation.

State 3
Developed

This state represents a full departure from the native reference state as a result of human-caused disturbances. Off-road vehicle use, residential development, and roadway construction will increase the susceptibility to non-native species, restrict the movement of sand (necessary for healthy dunes), and reduce habitat.

Transition T1A
State 1 to 2

This pathway represents a major disturbance from a massive tidal surge, an excessively damaging windstorm, wildfire, or extended drought that removes most, if not all, of the existing vegetation. It also represents a transition from a native plant community to a non-native, invaded plant community. Non-native seed disbursement is introduced (intentionally or unintentionally), which changes the reference community.

Transition T1B
State 1 to 3

This pathway represents human-influenced disturbance from urban sprawl or other development or from excessive use of recreational off-road vehicles. The stabilized dunes and habitat are diminished or completely lost.

Transition T2B
State 2 to 1

This pathway represents efforts to restore the native plant community. It is extraordinarily difficult to successfully remove Scotch broom, common gorse, European beachgrass, and American beachgrass once established. Native seed sources and extensive management and mitigation of brush and non-native species are needed to restore the community.

Transition T2A
State 2 to 3

This pathway represents human-influenced disturbance from urban sprawl or other development or from excessive use of recreational off-road vehicles. The stabilized dunes and habitat are diminished or completely lost.

Transition T3B
State 3 to 1

This pathway represents restoration of the native plant community and removal of man-made structures. Native seed sources and extensive management and mitigation of brush and non-native species are needed to restore the community.

Transition T3A
State 3 to 2

This pathway represents removal of man-made structures. Non-native seed disbursement is introduced (intentionally or unintentionally), which changes the reference community.

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):**

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:**