Ecological site AX002X01X005
Puget Lowlands Moist Forest

Last updated: 12/09/2024
Accessed: 12/22/2024

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): 002X–Willamette and Puget Sound Valleys

The Willamette and Puget Sound Valleys Major Land Resource Area (MLRA 2) is in western parts of Washington and Oregon. It occupies a forearc basin between the Coast Ranges and the Cascade Mountain volcanic arc. The northern part contains Pleistocene drift, outwash, and lacustrine and glaciomarine deposits associated with continental glaciers. The southern part contains Late Pleistocene deposits from glacial outburst floods (Missoula Floods).

Climate is mild and moist, and the growing season is long. Mean annual precipitation ranges from 20 to 60 inches, received mostly in fall, winter, and spring. Summers are dry. The soil temperature regime is mesic, and the soil moisture regimes are xeric and aquic.

Most sites in this MLRA can support forested vegetation, but some were maintained as prairie, savanna, or woodland through cultural burning prior to Euro-American settlement. Puget Sound has a moderating effect on temperatures, and humidity can be higher in the northern part of the MLRA. Douglas-fir (Pseudotsuga menziesii) is widespread throughout. Oregon white oak (Quercus garryana) is common on uplands in the south and on warm, exposed or droughty sites in the north. Pacific madrone grows in areas close to saltwater. Western hemlock (Tsuga heterophylla) is codominant with Douglas-fir in the north. Flood plains typically contain Brayshaw black cottonwood (Populus balsamifera ssp. trichocarpa) and red alder (Alnus rubra). Oregon ash (Fraxinus latifolia) is typical of forested wetlands in the south.

Forestry, urban development, and cultivated agriculture are currently the most extensive land uses (USDA, Agriculture Handbook 296, 2022).

LRU notes

The Puget Sound Trough Lowlands Land Resource Unit (LRU) is bounded to the north by the Frasier River Valley at the international border with Canada and extends south to the Cowlitz River. To the west lie Puget Sound and the Strait of Juan De Fuca; to the east lie the foothills of the Cascade Range. The LRU is affected by the proximity of climate-moderating saltwater. Modest annual swings in temperature, winters that seldom experience freezing temperatures, adequate rainfall, and warm, dry summers support small-scale agriculture and forestry. This climate also supports the largest population and highest population density in the Northwest. Aside from isolated areas affected by local rain shadows and marine-influenced fog, the climate is consistent throughout the Puget Lowlands.

The LRU represents the furthest southern extent of repeated advances of continental glaciers in western Washington. Glacial drift is the predominant parent material. The LRU also includes intermittent areas of glacially modified, resistant bedrock and several alluvial systems. Volcanic ash is present but intermittent. Soil moisture varies considerably over short distances. This variability creates a mosaic of small plant communities. Soil drainage can be restricted by dense glaciomarine sediments or till. This restriction can create widespread areas of seasonal high water tables and ponding. In places, soils that developed in deep, unconsolidated, coarse-textured sandy drift

or in bedrock-restricted colluvium have low available water capacity. South-facing areas near shorelines and minor outwash plains are typically some of the drier areas in the LRU. Precipitation increases with elevation and distance from Puget Sound.

Classification relationships

Relationship to Other Established Classifications:

This site is related to plant associations PSME-ARME/VAOV, PSME-TSHE/RHMA-VAOV, PSME-TSHE/VAOV, and PSME-TSHE/VAOV/POMU in Chappell (2006).

Chappell, C.B. 2006. Upland plant associations of the Puget Trough ecoregion, Washington. Natural Heritage Rep. 2006-01. Washington Department of Natural Resources, Natural Heritage Program, Olympia, WA. https://file.dnr.wa.gov/publications/amp_nh_upland_puget.pdf (accessed 29 January 2021).

Ecological site concept

The soil moisture control section of this ecological site is dry for only 45 to 60 consecutive days a year. Most of the annual precipitation is received from October through April, primarily as rain. Plants that require moist, cool conditions without limitation from a high water table thrive in this community. The site is widespread in Puget Sound. The soils range from somewhat poorly drained to somewhat excessively drained. The extensive plant community is supported by the consistent climate, which is moderated by proximity to saltwater, and by the pervasive impact of continental glacial parent materials throughout Puget Sound. This ecological site is typically on bedrock hills, glacially modified hills, and glacial terraces. It is in areas of higher elevation in the Puget Lowlands, on aspects that are well protected from sun and wind exposure, and near the cooler areas bordering the Cascade or Coast Range foothills. The site is in zones that are frequently impacted by a foggy marine layer. During the mild winters, some areas receive intermittent snow due to higher elevation or proximity to MLRA 3 to the east or MLRA 1 to the west.

Associated sites

AX002X01X008	**Puget Lowlands Riparian Forest**
AX002X01X003	**Puget Lowlands Peat Wetlands**
AX002X01X007	**Puget Lowlands Wet Hemlock Forest**

Similar sites

F002XN903WA	**Western redcedar - Douglas-fir/salal/swordfern**
F002XN902WA	**Western hemlock - Douglas-fir/Cascade Oregongrape**
F002XN906WA	**Western hemlock-western redcedar/red huckleberry-salal/western swordfern**

Table 1. Dominant plant species

Tree	(1) *Tsuga heterophylla* (2) *Thuja plicata*
Shrub	(1) *Vaccinium parvifolium* (2) *Gaultheria shallon*
Herbaceous	(1) *Polystichum munitum*

Legacy ID

F002XA005WA

Physiographic features

This site is on slopes of bedrock hills, glacially modified hills, and glacial terraces.

Table 2. Representative physiographic features

Landforms	(1) Hill (2) Terrace--outwash or marine
Flooding frequency	None to rare
Elevation	91–305 m
Slope	5–30%
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Flooding frequency	Not specified
Elevation	30–610 m
Slope	0–90%

Climatic features

Mean annual air temperature: 48 to 52 degrees Fahrenheit

Table 4. Representative climatic features

Frost-free period (characteristic range)	160-220 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	889-2,032 mm

Influencing water features

This site is not influenced by water from a wetland or stream.

Soil features

Surface textures: Gravelly sandy loams, sandy loams, loams, and silt loams
Soil family textures: Sandy, fine-loamy, coarse-loamy, loamy-skeletal, and sandy-skeletal
Parent material: Glacial drift including outwash or till, colluvium, residuum are most typical; alluvium and some volcanic ash can occur
Soil depth: 20 to more than 60 inches. Lithic or densic contacts are possible restrictions
Soil drainage: Somewhat poorly drained to somewhat excessively drained. Moderately well drained and well drained are most common.
Available water capacity in the top 40 inches: 1.5 to 10 in/in
pH in water: 4.5 to 6.6
Soil is dry in all parts from 45 to 60 consecutive days.

Ecological dynamics

Western hemlock and western redcedar are the dominant trees. Douglas-fir grows in places, but it is not shade tolerant compared to western hemlock and western redcedar (*Thuja plicata*). Because it is such a long-lived species (800+ years), however, scattered individuals remain. Bigleaf maple (*Acer macrophyllum*) and red alder may also be present.

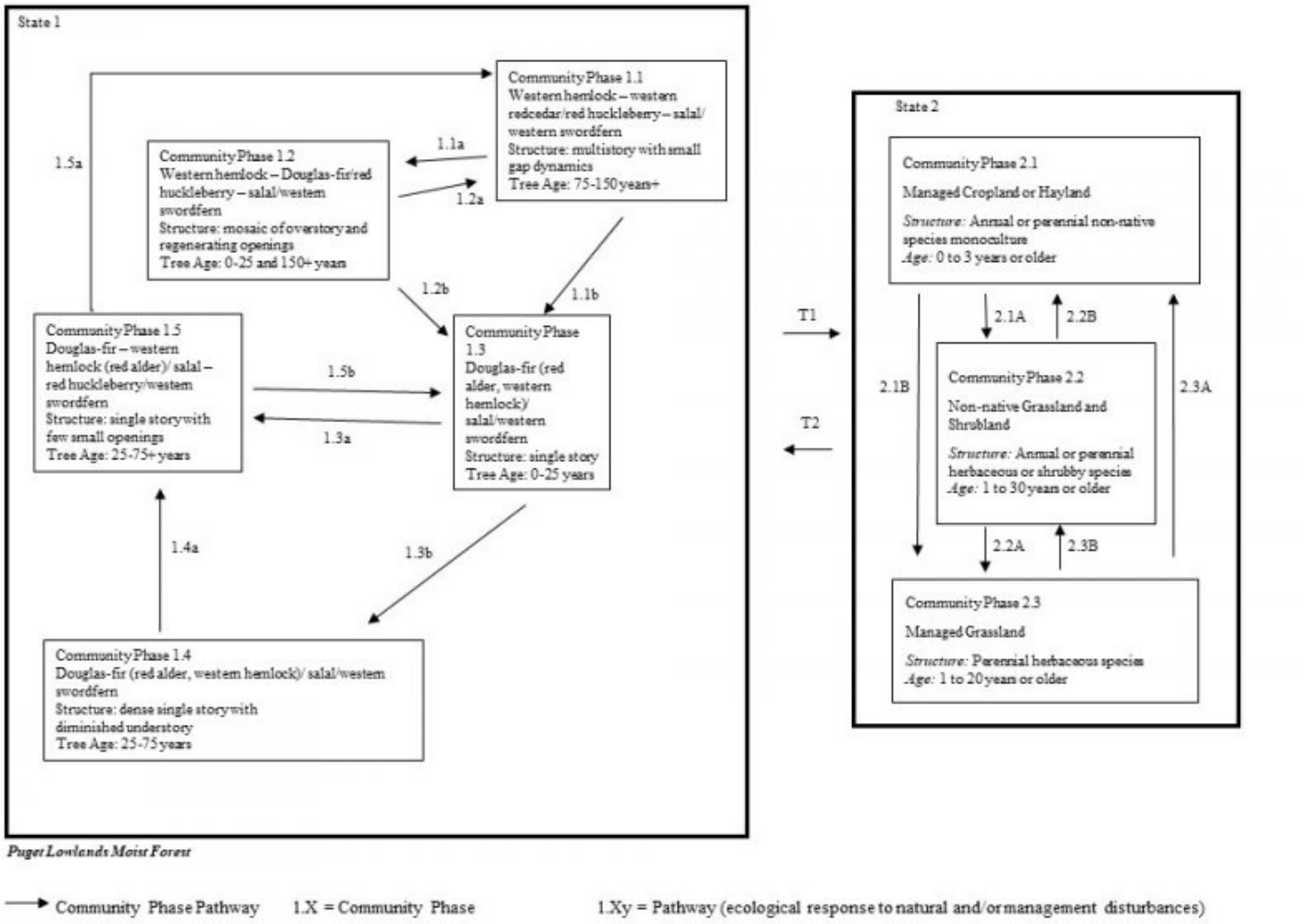
Most areas of this site have been harvested for timber since European settlement. Although the areas were typically burned after harvest, all of the various plant communities can have remnant mature trees. The historic fire regime had low frequency (150 to 300+ years) and moderate to high intensity. These fires would, in effect, be stand-replacing. Individual trees, however, would survive and provide a seed source. Western hemlock, which has thin bark and a shallow root system, is not able to tolerate fire. Western redcedar is only somewhat more tolerant.

Douglas-fir is well adapted to withstand fire; therefore, even moderate fire is likely to change the species composition.

Red alder is a common early-seral, fast growing species in this area. It commonly seeds-in on newly cleared land. This typically results in a nearly pure stand that includes a scattered number of Douglas-fir, redcedar, and hemlock. Red alder, however, is shade intolerant and cannot reproduce under its own canopy. It is also relatively short-lived. The stand starts to deteriorate after about 70 years. This deterioration releases the more shade-tolerant species that seeded in under the alder. The stand then progresses toward the reference community phase until the next disturbance.

If no red alder seed source is available, the initial stand is a mix of western hemlock, western redcedar and Douglas-fir. The most common natural disturbances in areas of this site are small pockets of wind-thrown or diseased overstory trees. All three of these species are susceptible to various rots, which weaken the roots and boles and cause breakage. The resulting openings in the canopy allow some sunlight to reach the forest floor, which benefits the commonly sparse understory. Openings are especially likely in mid-successional (75 to 150 year old) stands, which have very little height differentiation. Western swordfern (*Polystichum munitum*), red huckleberry (*Vaccinium parvifolium*), salal (*Gaultheria shallon*), trailing blackberry (*Rubus ursinus*), and Cascade barberry (*Mahonia nervosa*, known locally as Cascade Oregongrape) are common understory species in this ecological site.

State and transition model



State 1
Reference

Community 1.1

Western Hemlock, Western Redcedar, Red Huckleberry, Salal, and Western Swordfern

Structure: Multistory with small gap dynamics Western hemlock and western redcedar are the most common overstory species. Douglas-fir and bigleaf maple are also present. The dense canopy, which is created by multiple age groups of hemlocks, blocks most of the sunlight from the forest floor and leads to a sparse understory. The majority of the understory plants grow where gaps in the canopy allow sunlight to reach the ground. In areas where there is no mid-canopy of regenerating hemlocks, the understory is more continuous. The most common natural disturbance in areas of this community are the small gap dynamics following the death of one or two trees.

Dominant plant species

- western hemlock (*Tsuga heterophylla*), tree
- western redcedar (*Thuja plicata*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- bigleaf maple (*Acer macrophyllum*), tree
- red huckleberry (*Vaccinium parvifolium*), shrub
- salal (*Gaultheria shallon*), shrub
- California blackberry (*Rubus ursinus*), shrub
- Cascade barberry (*Mahonia nervosa*), shrub
- western swordfern (*Polystichum munitum*), other herbaceous

Community 1.2
Western Hemlock, Douglas-fir, Red Huckleberry, Salal, and Western Swordfern

Structure: Mosaic of mature overstory and regenerating openings This community phase retains some areas that resemble the reference community but also contains moderate sized (2–5 acres) openings. Historically, this spatial pattern would have been caused by low- to moderate-intensity fires or pockets of disease (such as annosum root rot or laminated root rot). Uneven-aged management techniques, such as group selection or shelterwood with reserves, can also create this plant community. Depending on the seed sources present, the patches may contain any of the previously mentioned overstory species. Some of the shrub species in the ecological site also respond well to increased sunlight and may delay or even prevent reforestation of the newly formed openings. Examples

include Cascade barberry (*Mahonia nervosa*, known locally as Cascade Oregongrape), salal, salmonberry (*Rubus spectabilis*), and red elderberry (*Sambucus racemosa*).

Dominant plant species

- western hemlock (*Tsuga heterophylla*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- western redcedar (*Thuja plicata*), tree
- Cascade barberry (*Mahonia nervosa*), shrub
- salal (*Gaultheria shallon*), shrub
- salmonberry (*Rubus spectabilis*), shrub
- red elderberry (*Sambucus racemosa*), shrub
- western swordfern (*Polystichum munitum*), other herbaceous

Community 1.3
Douglas-fir, Red Alder, Western Hemlock, and Salal

Structure: Single story/shrub This community consists of forestland in regeneration. Species composition depends on the natural seed sources present and the intensity of management. If this community results from a moderate to severe fire event, the possibility is good for shrubs to out-compete tree seedlings. Red huckleberry, salal, trailing blackberry, red elderberry, and salmonberry (which may have been only moderately abundant previously) all have the capability to rapidly recover and spread when top-killed, slowing successful regeneration. This would be less of an issue with intensive management. Historically, Douglas-fir has been preferred over red alder, western redcedar, or western hemlock on these sites. This has changed over time, so a managed stand could feature any of the species or a mixture of species.

Dominant plant species

- Douglas-fir (*Pseudotsuga menziesii*), tree
- red alder (*Alnus rubra*), tree
- western hemlock (*Tsuga heterophylla*), tree
- salmonberry (*Rubus spectabilis*), shrub
- red huckleberry (*Vaccinium parvifolium*), shrub
- salal (*Gaultheria shallon*), shrub
- California blackberry (*Rubus ursinus*), shrub
- red elderberry (*Sambucus racemosa*), shrub
- western swordfern (*Polystichum munitum*), other herbaceous

Community 1.4
Douglas-fir, Red Alder, Western Hemlock, Salal, and Western Swordfern

Structure: Dense single story with sparse understory This community consists of forest in the competitive exclusion stage. Because this community is indicative of no active management, competition among individual trees is increased for the available water and nutrients. Canopy closure is almost 100 percent, leading to a diminished understory. Over time, the forest begins to self-thin due to the elevated competition. Species composition depends on the original seed source(s) available. The forest can be single or mixed-species.

Dominant plant species

- Douglas-fir (*Pseudotsuga menziesii*), tree
- red alder (*Alnus rubra*), tree
- western hemlock (*Tsuga heterophylla*), tree
- red huckleberry (*Vaccinium parvifolium*), shrub
- salal (*Gaultheria shallon*), shrub
- western swordfern (*Polystichum munitum*), other herbaceous

Community 1.5
Douglas-fir, Western Hemlock Red Alder, Salal, Red Huckleberry, and Western Swordfern

Structure: Single story with scattered openings This community consists of maturing forest that is starting to differentiate vertically. Individual trees are dying (due to insects, disease, competition, or windthrow), allowing some sunlight to reach the forest floor. The sunlight allows for an increase in the understory as well as some overstory tree species regeneration. Cycling between Community Phases 1.3 and 1.5 while using even-aged management generates maximum wood fiber.

Dominant plant species

- Douglas-fir (*Pseudotsuga menziesii*), tree
- western hemlock (*Tsuga heterophylla*), tree
- western redcedar (*Thuja plicata*), tree
- red alder (*Alnus rubra*), tree
- salal (*Gaultheria shallon*), shrub
- western swordfern (*Polystichum munitum*), other herbaceous

Pathway 1.1A
Community 1.1 to 1.2

This pathway represents a large disturbance. Historically, a moderate-intensity fire or windstorm would have created this forest structure. Uneven-aged management techniques, such as group selection or shelterwood with reserves, can also lead to this community. Areas of regeneration range from 2 to 5 acres.

Pathway 1.1B
Community 1.1 to 1.3

This pathway represents a major disturbance, such as a high-intensity fire, large scale wind events, or clear-cutting followed by prescribed burning.

Pathway 1.2A
Community 1.2 to 1.1

This pathway represents growth over time with no further significant disturbance. The areas of regeneration pass through the typical stand phases—competitive exclusion, maturation, and understory reinitiation—until they resemble the old-growth structure of the reference community (1.1).

Pathway 1.2B
Community 1.2 to 1.3

This pathway represents either a high-intensity fire or a change to intensive management (block harvest, post-harvest burn). Both situations lead to the stand initiation phase of forest development.

Pathway 1.3B

Community 1.3 to 1.4

This pathway represents no further management, denoting only growth over time.

Pathway 1.3A
Community 1.3 to 1.5

This pathway represents growth over time with active management to maximize timber development. Precommercial thinning, commercial thinning, or both, combined with understory control, lower the stand density and decrease competition for water and nutrients.

Pathway 1.4A
Community 1.4 to 1.5

This pathway represents grow over time, with or without active management. Precommercial (or possibly commercial) thinning can decrease competition by removing a portion of the trees. Without management, intermediate and suppressed trees begin to die.

Pathway 1.5A
Community 1.5 to 1.1

Douglas-fir, Western Hemlock Red Alder, Salal, Red Huckleberry, and Western Swordfern

Western Hemlock, Western Redcedar, Red Huckleberry, Salal, and Western Swordfern

This pathway represents no further management. Continued growth over time and ongoing mortality lead to continued vertical diversification. The community begins to resemble the structure of the reference community but has small pockets of regeneration and a more diversified understory.

Pathway 1.5B
Community 1.5 to 1.3

This pathway represents intensive management focused on wood products. Clear-cutting, some type of site preparation, planting of preferred species, and timely thinning are the management steps.

State 2
Converted

Community 2.1
Managed Cropland or Hayland

Structure: Annual or perennial non-native species monoculture Community phase 2.1 can consist of a range of crops, including annually planted species, short-lived perennial species, and more permanent shrubby plants. Hay and grasses and legumes for silage are included in this community phase.

Community 2.2
Non-native Grassland and Shrubland

Structure: Annual or perennial herbaceous or shrubby species Community phase 2.2 is characterized by low-level agronomic or management activity, such as the addition of soil nutrients, intensive grazing management, regular mowing, or weed control. This plant community commonly consists dominantly of introduced weedy species. Areas that have extremely low fertility or are subject to heavy grazing pressure have a higher proportion of annual, stoloniferous, or rhizomatous species. Wetland areas commonly support dominantly non-native rhizomatous

grasses. The plant community may include remnants of introduced pasture species that commonly are seeded.

Community 2.3
Managed Grassland

Structure: Perennial herbaceous species Community phase 2.3 receives regular agronomic inputs. Examples include adding soil nutrients and other soil amendments, such as lime; implementing grazing management plans; mowing regularly; controlling weeds; and reseeding as needed. This plant community typically includes introduced perennial pasture and hay species that commonly are seeded. In areas of historic native grassland, mixtures of perennial and annual native species can be seeded and managed by appropriate agronomic and livestock management activities. This phase includes minor amounts of introduced species that commonly are in non-native grassland and shrubland communities (community phase 2.2).

Pathway 2.1A
Community 2.1 to 2.2

In the absence of agronomic and livestock management activities, seeds from surrounding weedy plant communities are transported to the site by wind, animals, or vehicle traffic, and the adapted species become established. Management activities include tilling; adding soil nutrients and other soil amendments, such as lime; mowing; burning; harvesting or chemically controlling vegetation; planting desirable herbaceous species; and implementing grazing management plans.

Pathway 2.1B
Community 2.1 to 2.3

This pathway represents agronomic and livestock management activities. Examples include tilling; adding soil nutrients and other soil amendments, such as lime; mowing; burning; harvesting or chemically controlling vegetation; planting desirable herbaceous species; and implementing grazing management plans.

Pathway 2.2B
Community 2.2 to 2.1

This pathway represents agronomic activities. Examples include tilling; adding soil nutrients and other soil amendments, such as lime; mowing; burning; harvesting or chemically controlling vegetation; and planting desirable crop species.

Pathway 2.2A
Community 2.2 to 2.3

This pathway represents agronomic and livestock management activities. Examples include tilling; adding soil nutrients and other soil amendments, such as lime; mowing; burning; harvesting or chemically controlling vegetation; planting desirable herbaceous species; and implementing grazing management plans.

Pathway 2.3A
Community 2.3 to 2.1

This pathway represents agronomic activities. Examples include tilling; adding soil nutrients and other soil amendments, such as lime; mowing; burning; harvesting or chemically controlling vegetation; and planting desirable crop species.

Pathway 2.3B
Community 2.3 to 2.2

In the absence of agronomic and livestock management activities, seeds from surrounding weedy plant communities are transported to the area by wind, floodwater, animals, or vehicle traffic, and the adapted species become established. Management activities include tilling; adding soil nutrients and other soil amendments, such as lime; mowing; burning; harvesting or chemically controlling vegetation; planting desirable herbaceous species;

and implementing grazing management plans.

Transition T1A
State 1 to 2

This transition represents a change in land use. Land management includes modifications to the hydrologic function to develop pasture and agriculture. Non-native seed disbursement is introduced (intentionally or unintentionally), which alters the reference community (1.1).

Transition T2A
State 2 to 1

This transition represents restoration of the natural hydrologic function and native plant habitat. Native seed sources and extensive management and mitigation of brush and invasive species are needed to restore the community.

Additional community tables

Other references

U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. 2019. Fire Effects Information System (FEIS). https://www.feis-crs.org/feis/ (accessed 8 January 2021).

Agee, J.K. 1993. Fire ecology of Pacific Northwest forests. Island Press. Covelo, CA. ISBN: 978-1559632300.

Perry, D.A. 1994. Forest ecosystems. The Johns Hopkins University Press. Baltimore, MD. ISBN: 0-8018-4760-5.

Contributors

Erik Dahlke
Marty Chaney
Stephanie Shoemaker

Approval

Kirt Walstad, 12/09/2024

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	12/09/2024
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:**