Ecological site R006XA216OR
Forested Shrubby Dunes 8-11 PZ

Last updated: 9/11/2023
Accessed: 05/20/2024

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): 006X–Cascade Mountains, Eastern Slope

Stretching from northern Washington to southern Oregon, MLRA6 encompasses the mountain slopes, foothills, elevated plateaus and valleys on the eastern slopes of the Cascade mountains. This MLRA is a transitional area between the Cascade Mountains to the west and the lower lying Columbia Basalt Plateau to the east. Situated in the rain shadow of the Cascade Crest, this MLRA receives less precipitation than portions of the cascades further west and greater precipitation than the basalt plateaus to the east. Geologically, the majority of the MLRA is dominated by Miocene volcanic rocks, while the northern portion is dominated by Pre-Cretaceous metamorphic rocks and the southern portion is blanketed with a thick mantle of ash and pumice from Mount Mazama. The soils in the MLRA dominantly have a mesic, frigid, or cryic soil temperature regime, a xeric soil moisture regime, and mixed or glassy mineralogy. They generally are moderately deep to very deep, well drained, and loamy or ashy. Biologically, the MLRA is dominated by coniferous forest, large expanses of which are dominated by ponderosa pine, Douglas-fir or lodgepole pine. Areas experiencing cooler and moister conditions include grand fir, white fir, and western larch while the highest elevations include pacific silver fir, subalpine fir and whitebark pine. Economically, timber harvest and recreation are important land uses in these forests. Historically, many of these forests would have experienced relatively frequent, low and mixed severity fire favoring the development of mature forests dominated by ponderosa pine or Douglas-fir. In the southern pumice plateau forests, less frequent, higher severity fire was common and promoted the growth of large expanses of lodgepole pine forests.

LRU notes

This unit is characterized by a landscape of basalt terraces, abandoned lakebeds and dunes where exceedingly dry ponderosa pine – western juniper forests occur. These forests are largely geographically confined to the Lost Forest Research Natural Area, and despite receiving less than 11 inches of annual precipitation, persist among a desert shrubland due to unique soil characteristics. Here, deep eolian deposits of ash and pumice increase water holding capacity relative to nearby soils. Geologically, these deposits are underlain by Pliocene basalt from the High Cascades volcanic province. Botanically, these forests share characteristics with other dry pine forests as well as the nearby shrub steppe. Common members include, antelope bitterbrush, big sagebrush, needle and thread, Indian ricegrass, creeping wildrye and granite prickly gilia. The climate of this unit is cool and very dry with a soil climate defined by a frigid temperature regime and an aridic moisture regime. The historical fire regime of this site is likely similar to other very dry ponderosa pine communities, with moderately frequent, low severity fire common.

Ecological site concept

This site represents a very dry western juniper (Juniperus occidentalis), ponderosa pine (Pinus ponderosa) woodland occurring upon dunes within the Lost Forest Research Natural Area at the northwestern edge of the Great Basin. Dislocated from other ponderosa pine sites at the Eastern foothills of the Cascades, the Lost Forest stands is in stark contrast to the surrounding sagebrush steppe landscape. Here deep eolian deposits of volcanic ash and pumice have created the conditions for ponderosa pine persistence despite receiving precipitation generally lower than is required for the species (Moir and Franklin 1974). The influence of ash in these soils

increases water holding capacity and bolsters site resilience during drought, facilitating the survival of ponderosa pine. Forested sites found on dune landforms occupy relatively little acreage in the Lost Forest. In contrast to other sites occupying dune landforms on the Lost Forest, this site is found at higher elevations and supports greater cover of ponderosa pine likely due to somewhat cooler temperatures and decreased evapotranspiration.

This is a provisional ecological site and is subject to extensive review and revision before final approval. All data herein should be considered provisional and contingent upon field validation prior to use in conservation planning.

Development of this site as a range site was based on field data collection completed in 1998 by the Burns ESI team. It was revised and updated with information regarding ecological dynamics in 2020.

Associated sites

R006XA213OR	**Pumice Terrace 8-10 PZ** adjacent forested terraces
R006XA217OR	**Very Shallow Pumice Terrace 8-11 PZ** adjacent very-shallow terraces
R006XA214OR	**Forested Pumice Dunes 8-11 PZ** lower elevation dunes with lower bitterbrush cover
R006XA212OR	**Forested Sandy Loam 8-11 PZ** Adjacent forested areas not on dune landforms

Similar sites

R006XA214OR	**Forested Pumice Dunes 8-11 PZ** Lower elevation, lower cover of ponderosa pine

Table 1. Dominant plant species

Tree	(1) *Juniperus occidentalis* (2) *Pinus ponderosa*
Shrub	(1) *Purshia tridentata*
Herbaceous	(1) *Achnatherum hymenoides* (2) *Hesperostipa comata ssp. comata*

Physiographic features

These sites are on dunes in Pleistocene lacustrine basins where eolian sands accumulate. Slopes are commonly 2 to 20 percent and elevations range from 4,400 to 4,750 feet (1,350 to 1,450 meters). This site occurs on all aspects. This site is not subject to ponding or flooding and no water table is present within the upper 100 inches of soil.

Table 2. Representative physiographic features

Landforms	(1) Basin > Dune
Flooding frequency	None
Ponding frequency	None
Elevation	1,341–1,448 m
Slope	2–20%
Ponding depth	0 cm
Water table depth	254 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Climatic features

This site is characterized by hot dry summers and cold wet winters. Precipitation, largely in the form of rain and snow, ranges from 8-11 inches, averaging 10 inches annually. Frost-free days range from 85 to 95 and the freeze-free period ranges from 120 to 135 days. The soil temperature regime is frigid and the soil moisture regime is aridic. The graphs below are populated from the closest available weather station to representative site locations and are provided to indicate general climate patterns.

Table 3. Representative climatic features

Frost-free period (characteristic range)	85-95 days
Freeze-free period (characteristic range)	120-135 days
Precipitation total (characteristic range)	203-279 mm
Frost-free period (average)	90 days
Freeze-free period (average)	125 days
Precipitation total (average)	254 mm

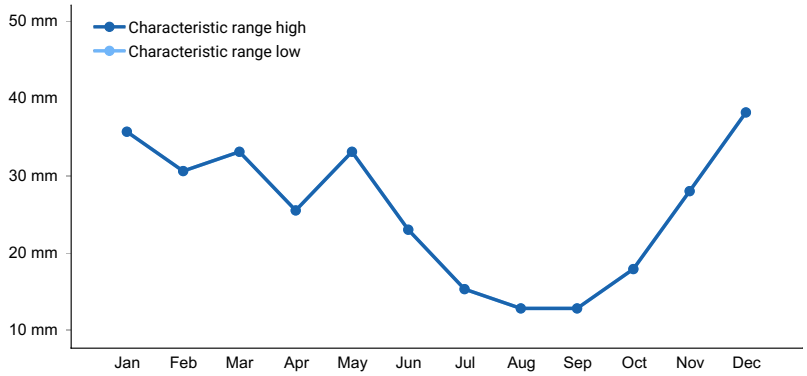


Figure 1. Monthly precipitation range

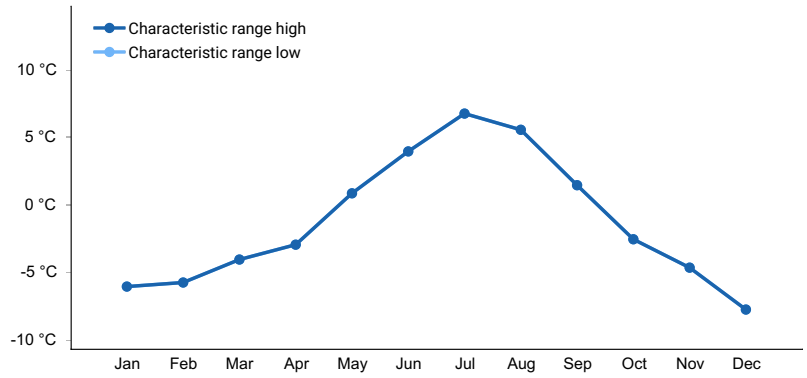


Figure 2. Monthly minimum temperature range

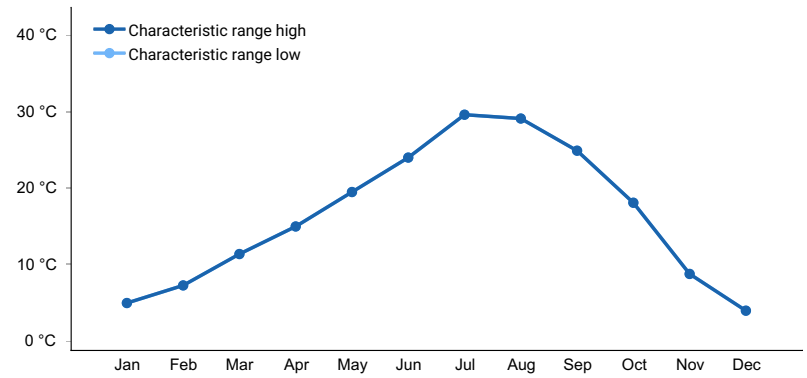


Figure 3. Monthly maximum temperature range

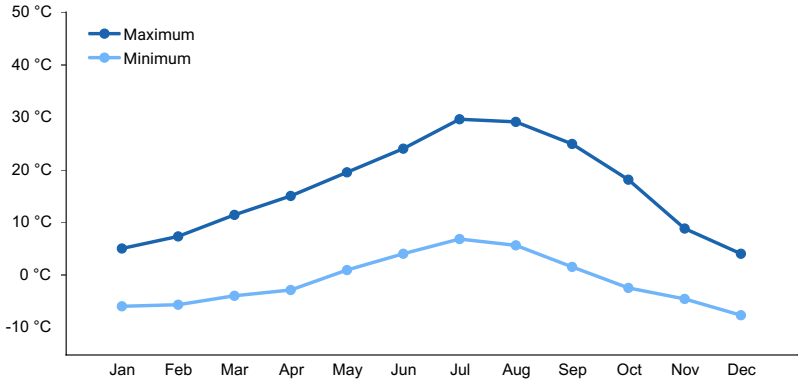


Figure 4. Monthly average minimum and maximum temperature

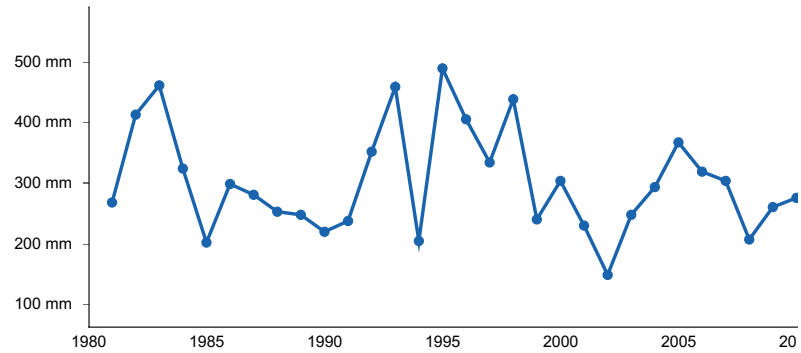


Figure 5. Annual precipitation pattern

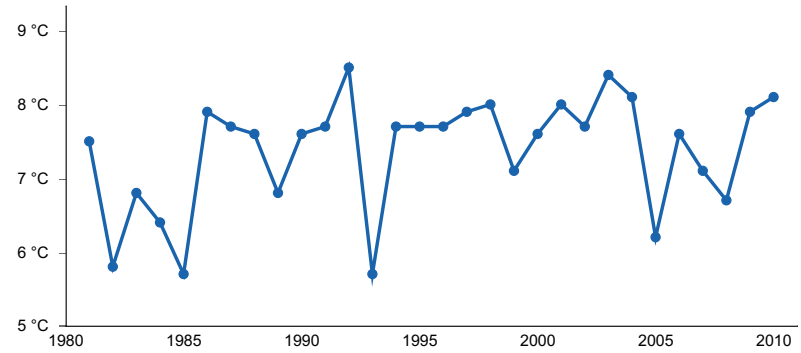


Figure 6. Annual average temperature pattern

Climate stations used

- (1) THE POPLARS [USC00358420], Silver Lake, OR

Influencing water features

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

Wetland description

N/A

Soil features

Soils on this site are typically deep to very deep, ashy loamy fine sands over sands. These soils were formed in eolian deposits of pumice and volcanic ash, allowing for increased water holding capacity and the ability to sustain ponderosa pine unlike adjacent desert shrub communities. These soils are excessively drained and have rapid to very rapid permeability. Soils on this site are classified into the Psamments subgroup, which are largely unconsolidated sand deposits with little soil development.

A representative soil component associated with this site:

Morehouse, 2 to 25% slopes

Table 4. Representative soil features

Parent material	(1) Eolian deposits–pumice (2) Volcanic ash
Surface texture	(1) Ashy loamy fine sand
Family particle size	(1) Ashy
Drainage class	Excessively drained
Permeability class	Rapid to very rapid
Depth to restrictive layer	152–203 cm
Soil depth	152–203 cm
Surface fragment cover <=3"	0–45%
Surface fragment cover >3"	0–45%
Available water capacity (0-101.6cm)	6.35–11.43 cm
Soil reaction (1:1 water) (0-101.6cm)	7.4–9
Subsurface fragment volume <=3" (10.2-152.4cm)	0–30%
Subsurface fragment volume >3" (10.2-152.4cm)	0–20%

Table 5. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	102–203 cm
Soil depth	102–203 cm
Surface fragment cover <=3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-101.6cm)	Not specified
Soil reaction (1:1 water) (0-101.6cm)	Not specified
Subsurface fragment volume <=3" (10.2-152.4cm)	Not specified
Subsurface fragment volume >3" (10.2-152.4cm)	Not specified

Ecological dynamics

Reference Plant community:

The Reference Plant Community is dominated by antelope bitterbrush, ponderosa pine, western juniper, Indian ricegrass (*Achnatherum hymenoides*) and needle and thread (*Hesperostipa comata*). While the ashy soils allow for the presence of ponderosa pine, the low precipitation requires that these species be adapted to dry site conditions. This site represents a somewhat rare scenario where ponderosa and juniper may persist in a codominant woodland

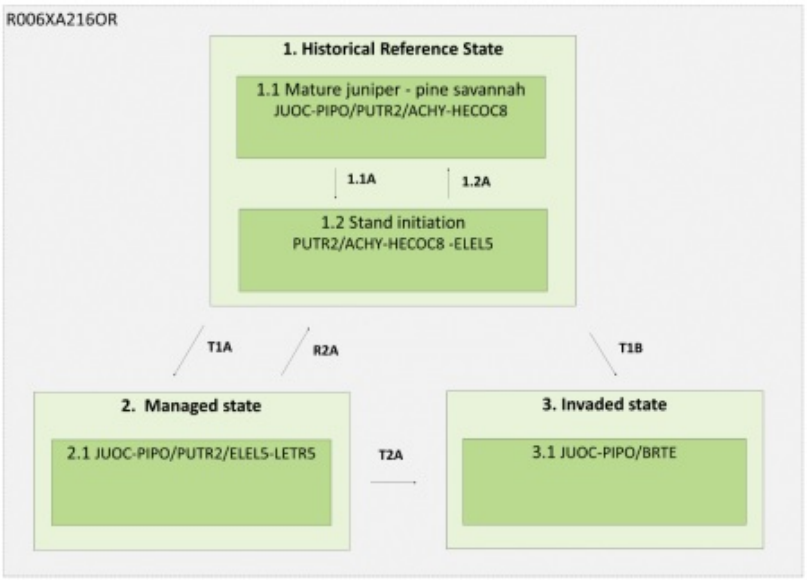
composition for an extended period, in part due to an infrequent fire rotation. These are generally open stands where moisture limitation may preclude dense, closed canopy conditions. A comprehensive forest health study of the Lost Forest was undertaken by the USFS in 2007. Researchers recorded an abundance of western juniper greater than 150 years old, with considerable numbers of younger trees that were less than 150 years old (40% and 60% of all trees recorded respectively) (Chadwick and Eglitis 2007). This suggests that this is a persistent juniper site, yet infill of younger trees may be greater than it was historically, possibly due to grazing practices and harvest of mature pine.

Disturbance:

A complex host of mortality agents and disturbance factors have been recorded for sites in the Lost Forest. Factors that have contributed to the mortality of juniper and pine in the past include the drought of the 1920s and 1930s, movement of dune landforms into forest stands, annosus root disease and windthrow (Chadwick and Eglitis 2007). Timber harvest in the 1940s and 1950s also removed mature ponderosa pine from primarily the most productive sites on the forest (Chadwick and Eglitis 2007). Other disturbances include livestock grazing which may have produced vegetation changes prior to its exclusion in 1968 and ongoing off road recreational activity (Moir et al. 1973). Grazing disturbance may alter the composition of the herbaceous layer and favor an increase in bottlebrush squirreltail (*Elymus elymoides*) and creeping wildrye at the expense of Indian ricegrass and needle and thread. Despite a high frequency of lightning strikes, research suggests that fire was likely not a common disturbance agent in this forest due to low fuel loads and continuity (Chadwick and Eglitis 2007). According to the best available knowledge of similar systems, the fire regime is likely comparable to other very dry ponderosa pine sites and influenced by the surrounding Wyoming big sage (Artemesia tridentata ssp. wyomingensis) plant communities (Landfire fire regime group 3: 35 to 100 plus year frequency, mixed severity) (Landfire 2007). This fire regime of this site is approximated by the landfire biophysical setting model 0710532 - Northern Rocky Mountain Ponderosa Pine Woodland and Savanna – Xeric. The resilience and resistance of this site to widespread invasions of exotic annual grasses is not known, however plant data collected to describe the reference state indicates a minimal cover of weed species present, indicating that this site may have the potential for widespread weed infestation.

Given that this site occupies a limited geographic area, little is known about the plant community dynamics over time, therefore the model below represents a generalized and simplified understanding of community response to disturbance. Emerging evidence is suggesting that climate change is leading to hotter and drier conditions in western forests that will increase fire frequency and extent and lengthen fire seasons (Halofsky et al. 2020). When combined with the interacting impacts of fire suppression, drought, and insect outbreaks, it is possible that this ecological system will experience unpredictable ecosystem shifts and additional alternative states. For warm and dry sites, these impacts may include the possibility of regeneration failure following wildfire disturbance (Halofsky et al. 2020). As our understanding of these systems evolves and this site is updated in future iterations, descriptions will include more thorough treatments of disturbance and ecological change.

State and transition model



Community Pathways

1.1A	High severity fire, severe windthrow, extreme drought or disease
1.2A	Time without severe fire

Transitions / Restoration Pathways

T1A	Prolonged improper grazing management
T1B	Catastrophic fire, prolonged improper grazing management
T2A	Continued improper grazing management, catastrophic fire
R2A	Extended rest from grazing, possible reseeding of native grasses

State 1
Historical Reference State

This is the Reference Plant Community given an unaltered disturbance regime.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- ponderosa pine (*Pinus ponderosa*), tree
- antelope bitterbrush (*Purshia tridentata*), shrub
- Indian ricegrass (*Achnatherum hymenoides*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass

Community 1.1
Mature juniper pine savannah: JUOC - PIPO/PUTR2/ACHY - HECOC8

The Reference Plant Community has an overstory dominated by a mature, open stand of western juniper and ponderosa pine with an herbaceous layer largely dominated by Thurber's needlegrass and Idaho fescue. Exotic annuals may be present in low numbers. Severe fire is relatively infrequent in this state and the community will be maintained by periodic mortality of young juniper and ponderosa pine caused by mixed severity fire, drought, insects, windthrow and disease (Chadwick and Eglitis 2007). Given the likelihood that this state, even in the best condition and highest potential, will almost always include at least some component of exotic species regardless of management inputs, this may also be referred to as the "current potential state". In this document, the term "reference state" is used synonymously with "current potential state" for the sake of simplicity.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	123	191	314
Shrub/Vine	56	78	135
Tree	28	45	73
Forb	17	22	39
Total	**224**	**336**	**561**

Community 1.2
Stand initiation: PUTR/ACHY - HECOC8 - ELEL5

Following severe fire, extreme drought, widespread disease outbreak or a severe incidence of windthrow, the overstory canopy may be lost. The community will be become dominated by perennial grasses with bitterbrush, young western juniper and ponderosa pine returning overtime.

Pathway 1.1A
Community 1.1 to 1.2

High severity fire, severe windthrow, extreme drought or disease

Pathway 1.1B
Community 1.2 to 1.1

Time without severe fire

State 2
Grazing Managed state

In this state, the site is being managed for livestock grazing. This may lead to altered plant community composition and production where plants adapted to grazing disturbance may increase while those sensitive to disturbance may decrease. Additionally, impacts to the abiotic conditions of the site may occur as soil is compacted due to hoof trampling or eroded due to an increase in bare ground.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- ponderosa pine (*Pinus ponderosa*), tree
- antelope bitterbrush (*Purshia tridentata*), shrub
- squirreltail (*Elymus elymoides*), grass
- beardless wildrye (*Leymus triticoides*), grass

Community 2.1
JUOC - PIPO/PUTR2/ELEL5 - LETR5

Following prolonged improper grazing management, native increaser species such as bottlebrush squirreltail and creeping wildrye may increase at the expense of the Reference Community dominant species, Indian ricegrass and needle and thread.

State 3
Invaded state

In this state much of the native herbaceous vegetation has been replaced by exotic annual grasses which at high levels may create positive feedbacks that alter fire regimes and promote prolonged invasion.

Dominant plant species

- western juniper (*Juniperus occidentalis*), tree
- ponderosa pine (*Pinus ponderosa*), tree
- cheatgrass (*Bromus tectorum*), grass

Community 3.1
Invaded state

Following continued mismanaged grazing, or catastrophic fire, where invasive annual grasses are already present on site, these grasses may increase while perennial grasses decline. Juniper, ponderosa pine and bitterbrush will temporarily decline with catastrophic fire, yet will return overtime. An abundance of annual grass will increase fine fuels and may increase fire frequency, creating a positive feedback that will encourage the maintenance of the site in this state.

Transition T1A
State 1 to 2

Prolonged improper grazing management

Transition T1B
State 1 to 3

Catastrophic fire, prolonged improper grazing management

Context dependence. Invasive species must be present onsite or within a sufficiently close distance for dispersal from nearby invaded sites

Restoration pathway R2A
State 2 to 1

Extended rest from grazing, possible reseeding of native grasses

Context dependence. Excessive grazing leading to a loss of species diversity or reproductive output or altering abiotic conditions by significantly compacting or eroding soil, for example, will not recover by rest alone and will require additional inputs

Transition T1B
State 2 to 3

Catastrophic fire, prolonged improper grazing management

Context dependence. Invasive species must be present onsite or within a sufficiently close distance for dispersal from nearby invaded sites

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Grass and Grasslike plants**			112–202	
	Indian ricegrass	achy	*Achnatherum hymenoides*	112–168	–
	needle and thread	hecoc8	*Hesperostipa comata ssp. comata*	28–56	–
	Idaho fescue	FEID	*Festuca idahoensis*	22–45	–
	beardless wildrye	letr5	*Leymus triticoides*	11–28	–
	squirreltail	elel5	*Elymus elymoides*	6–17	–
	sedge	carex	*Carex*	6–17	–
	Sandberg bluegrass	POSE	*Poa secunda*	6–11	–
2	**Other perennial grasses**			3–17	
Forb					
3	**Forbs**			6–11	
	milkvetch	astra	*Astragalus*	6–11	–
	granite prickly phlox	lipu11	*Linanthus pungens*	6–11	–
4	**Other perennial forbs**			3–17	
Shrub/Vine					
5	**Shrubs**			39–78	
	antelope bitterbrush	putr2	*Purshia tridentata*	56–112	–
	mountain big sagebrush	artrv	*Artemisia tridentata ssp. vaseyana*	6–11	–
6	**Other perennial shrubs**			6–17	
Tree					
7	**Trees**			22–50	
	western juniper	juoc	*Juniperus occidentalis*	28–56	–
	ponderosa pine	pipo	*Pinus ponderosa*	11–28	–

Inventory data references

Information presented here has been derived from NRCS data. Field observations from range trained personnel were also used. Other sources used as references include USDA NRCS Water and Climate Center, USDA NRCS National Range and Pasture Handbook, and USDA NRCS Soil Surveys from various counties.

References

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. 2021 (Date accessed). USDA PLANTS Database. http://plants.usda.gov.

Other references

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Contributors

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Andrew Neary - 2020/2021 PES update of draft site

Approval

Kirt Walstad, 9/11/2023

Acknowledgments

Development of this site as a range site was based on field data collection completed in 1998 by the Burns ESI team. It was revised and updated with information regarding ecological dynamics in 2020.

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	05/20/2024
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:**