

Ecological site F043CY608OR

Cool Dry Conifer Foothills and Mountains (PIPO/FEID-PSSPS)

Last updated: 9/08/2023
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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): 043C–Blue and Seven Devils Mountains

This MLRA covers the Blue and Seven Devils Mountains of Oregon, Washington and Idaho. The area is characterized by thrust and block-faulted mountains and deep canyons composed of sedimentary, metasedimentary, and volcanic rocks. Elevations range from 1,300 to 9,800 feet (395 to 2,990 meters). The climate is characterized by cold, wet winters and cool, dry summers. Annual precipitation, mostly in the form of snow, averages 12 to 43 inches (305 to 1,090 millimeters) yet ranges as high as 82 inches (2,085 millimeters) at upper elevations. Soil temperature regimes are predominately Frigid to Cryic and soil moisture regimes are predominately Xeric to Udic. Mollisols and Andisols are the dominant soil orders. Ecologically, forests dominate but shrub and grass communities may occur on south aspects and lower elevations as well as in alpine meadow environments. Forest composition follows moisture, temperature and elevational gradients and typically ranges from ponderosa pine and Douglas-fir plant associations at lower elevations, grand fir at middle elevations and subalpine fir and Engelmann spruce at upper elevations. Historical fire regimes associated with these forest types range from frequent surface fires in ponderosa pine - Douglas Fir forest types to mixed and stand replacing fire regimes in grand fir and subalpine fir types. A large percentage of the MLRA is federally owned and managed by the U.S. Forest Service for multiple uses.

Classification relationships

Plant Assoc. of Blue and Ochoco Mountains (R6 E TP-036-92)

Ponderosa pine/bluebunch wheatgrass - CPG111 (modal)

Ponderosa pine/Idaho fescue - CPG112 (modal)

Ponderosa pine/bitterbrush/Idaho fescue-bluebunch wheatgrass - CPS226

Ponderosa pine/mountain big sagebrush/Idaho fescue-bluebunch wheatgrass - CPS131

Ponderosa pine/mountain mahogany/Idaho fescue-bluebunch wheatgrass - CPS234

Ponderosa pine/mountain mahogany/Wheeler bluegrass - CPS233

Ponderosa pine/mountain snowberry - CPS525

Plant Assoc. of Wallowa-Snake Province (R6 E 255-86)

Ponderosa pine/bitterbrush-bluebunch wheatgrass - CPS231

Ponderosa pine/bluebunch wheatgrass - CPG132

Ponderosa pine/Idaho fescue - CPG131

USDA Forest Service Ecological Sub-region

M332 "Blue Mountains"

LANDFIRE BpS model 0710531

Northern Rocky Mountain Ponderosa Pine Woodland and Savanna – Mesic

Natureserve Terrestrial Ecological System (2020)

Ecological site concept

This site represents a commonly occurring ponderosa pine (*Pinus ponderosa*) site in the foothills of the Blue, Ochoco and Wallowa mountains of Oregon. The overstory is composed of almost exclusively ponderosa pine and the understory is dominated by grasses such as Idaho fescue (*Festuca idahoensis*), and bluebunch wheatgrass (*Pseudoregnaria spicata*). Western juniper (*Juniperus occidentalis*) may be occasionally present as well as antelope bitterbrush (*Purshia tridentata*). This site exists toward the lower moisture threshold of forested communities in these mountains and as such often transitions into shrublands, woodlands and grasslands. These may be grasslands dominated by Idaho fescue and bluebunch wheatgrass shrublands dominated by big sagebrush (*Artemesia tridentata*) and antelope bitterbrush, woodlands dominated by western juniper (*Juniperus occidentalis*) and mixed woodlands dominated by juniper with occasional ponderosa pine. Forested sites on adjacent protected aspects and with ashier soils with few coarse fragments, experience higher soil moisture retention facilitating higher productivity of ponderosa pine, higher shrub cover and occasional components of Douglas-fir (*Pseudotsuga menziesii*). The soil moisture regime of this site is xeric and the soil temperature regime is frigid. Disturbance was historically influenced by a fire regime characterized by relatively frequent surface fires. These frequent fires, as well as bark beetles, were historically a critical element of the disturbance regime of this site, acting to thin crowded understories and allow fire resistant ponderosa stands to attain an open, savanna-like forest structure.

This is a provisional ecological site that groups characteristics at a broad scale with little to no field verification and is subject to extensive review and revision before final approval. All data herein was developed using existing information and literature and should be considered provisional and contingent upon field validation prior to use in conservation planning.

Associated sites

F043CY607OR	Cool Moist Conifer Foothills and Mountains (PIPO-PSME/SYAL) Occupying adjacent soils with somewhat deeper depth to a restrictive layer and higher moisture retention
F043CY609OR	Warm Dry Conifer Foothills and Mountains (PIPO-PSME/SYAL/CAGE) Downslope positions with warmer soil climates
R043CY808OR	Claypan (ARAR8/FEID-PSSPS) Adjacent scablands with very shallow soils

Similar sites

F043CY607OR	Cool Moist Conifer Foothills and Mountains (PIPO-PSME/SYAL) Higher available water content, somewhat deeper soils, lower coarse fragment content, andic soil properties more common
F043CY609OR	Warm Dry Conifer Foothills and Mountains (PIPO-PSME/SYAL/CAGE) Downslope positions with warmer soil climates, mesic soil temperature regime

Table 1. Dominant plant species

Tree	(1) <i>Pinus ponderosa</i>
Shrub	Not specified
Herbaceous	(1) <i>Festuca idahoensis</i> (2) <i>Pseudoroegneria spicata</i>

Physiographic features

This site occurs on forested backslopes and summits of foothill and mountain slopes. This site typically occurs on south and east aspects with slopes typically ranging from 7.5 - 45%. Elevations are typically between 4,000 to 5,200 (1,225 to 1,575 m) but may range from 3,300 to 6,000 (1,000 to 1,825 m). This site does not experience flooding or ponding and no water table is present within the upper two meters of soil.

Table 2. Representative physiographic features

Landforms	(1) Mountains > Mountain slope (2) Foothills > Hillside or mountainside
Flooding frequency	None
Ponding frequency	None
Elevation	4,000–5,275 ft
Slope	8–45%
Ponding depth	0 in
Water table depth	100 in
Aspect	E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	3,300–6,000 ft
Slope	0–65%
Ponding depth	Not specified
Water table depth	Not specified

Climatic features

This site experiences an intermountain climate with cool, wet winters and warm, dry summers. Mean annual precipitation is typically 16 - 23 inches (405 - 585 mm) but can range from 14 to 26 inches (355 - 660 mm). Mean annual temperatures are typically 43°F (6°C) but range from 39 - 45 °F (3 - 7°C). The soil temperature regime is Frigid and the soil moisture regime is Xeric typically experiencing 60 – 90 dry days per year. Frost free days average 40 to 120 per year. Climate graphs are populated from the closest available weather station and are included to represent general trends rather than representative values.

Table 4. Representative climatic features

Frost-free period (characteristic range)	40-120 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	16-23 in
Frost-free period (average)	70 days
Freeze-free period (average)	
Precipitation total (average)	18 in

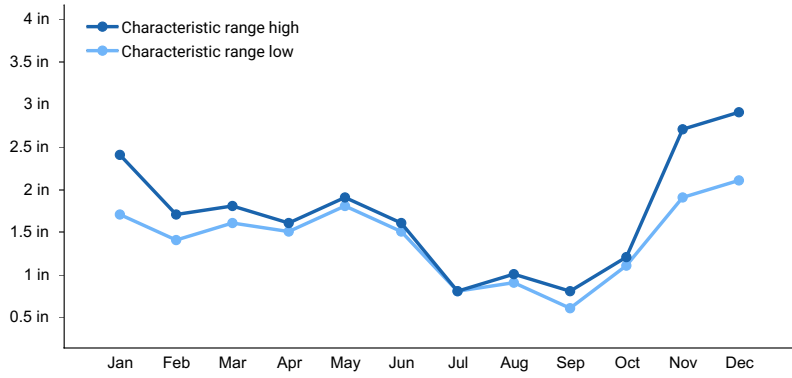


Figure 1. Monthly precipitation range

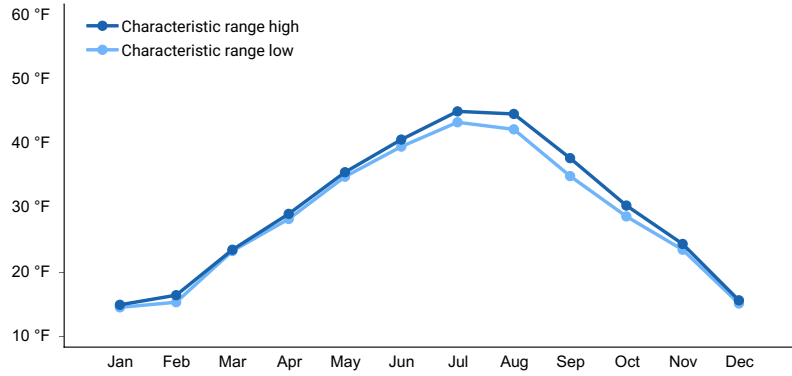


Figure 2. Monthly minimum temperature range

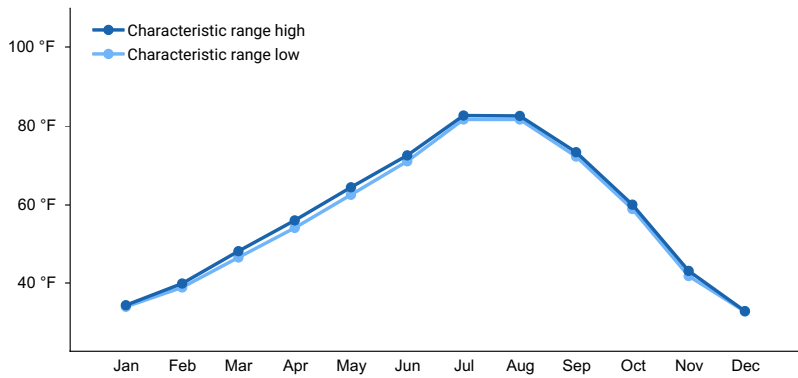


Figure 3. Monthly maximum temperature range

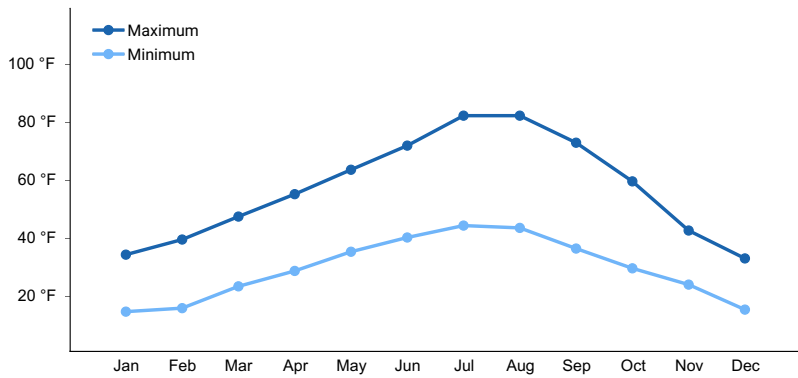


Figure 4. Monthly average minimum and maximum temperature

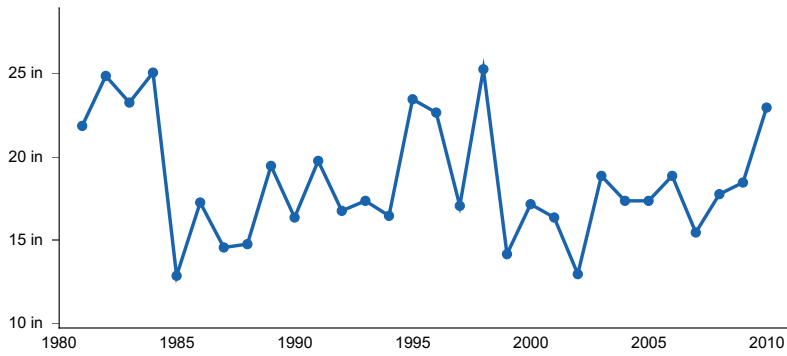


Figure 5. Annual precipitation pattern

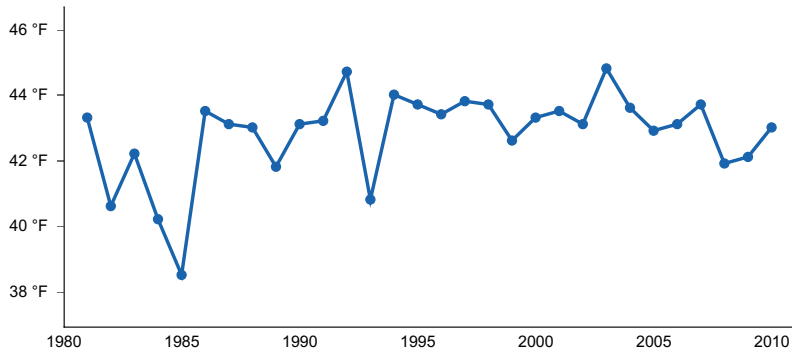


Figure 6. Annual average temperature pattern

Climate stations used

- (1) MASON DAM [USC00355258], Baker City, OR
- (2) AUSTIN 3 S [USC00350356], Prairie City, OR

Influencing water features

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

Soil features

Soils on this site are typically shallow to moderately deep (but range to very deep). Surface textures are varied but typically range from very gravelly ashy silt loam to very gravelly ashy sandy loam. Subsurface coarse fragment content typically ranging from very gravelly to extremely gravelly or stony. The family particle size is typically loamy-skeletal but vary. These soils are typically derived from basalt colluvium and residuum and other volcanic rock and commonly have some influence of volcanic ash throughout yet lack a deep ash cap in the surface horizon. These are well drained, droughty soils, typified by an average representative available water capacity of 0.5 - 1.2 in the 0 – 10 inch depth. See Fivebit and Gaib for modal series concepts.

Table 5. Representative soil features

Parent material	(1) Colluvium–volcanic rock (2) Residuum–volcanic rock (3) Volcanic ash–volcanic rock
Surface texture	(1) Very gravelly sandy loam (2) Very gravelly silt loam
Family particle size	(1) Loamy-skeletal (2) Clayey-skeletal (3) Fine
Drainage class	Well drained
Permeability class	Slow to moderate

Depth to restrictive layer	10–40 in
Soil depth	10–40 in
Surface fragment cover ≤3"	0–45%
Surface fragment cover >3"	0–45%
Available water capacity (0-10in)	0.5–1.2 in
Soil reaction (1:1 water) (0-40in)	5.6–7.3
Subsurface fragment volume ≤3" (4-60in)	5–50%
Subsurface fragment volume >3" (4-60in)	5–35%

Table 6. Representative soil features (actual values)

Drainage class	Not specified
Permeability class	Not specified
Depth to restrictive layer	10–80 in
Soil depth	10–80 in
Surface fragment cover ≤3"	Not specified
Surface fragment cover >3"	Not specified
Available water capacity (0-10in)	Not specified
Soil reaction (1:1 water) (0-40in)	Not specified
Subsurface fragment volume ≤3" (4-60in)	Not specified
Subsurface fragment volume >3" (4-60in)	Not specified

Ecological dynamics

The modal plant associations that define this site concept are the widespread Ponderosa pine / Idaho Fescue and Ponderosa pine / Bluebunch wheatgrass associations (PIPO/FEID and PIPO/PSSP as described in Johnson and Clausnitzer 1992, and Johnson and Simon 1987). These communities exist toward the warm and dry end of the ponderosa pine forests of MLRA 43c in Oregon. As such, productivity is lower than other ponderosa pine forests in these mountains. In its reference phase, these mature ponderosa forests would have included a perennial grass component of Idaho fescue and bluebunch wheatgrass, with bluebunch wheatgrass and cover of bare ground increasing on soils with greater surface coarse fragments. Other herbaceous species include Sandberg bluegrass (*Poa secunda*), squirreltail (*Elymus elymoides*), common yarrow (*Achillea millefolium*) and tailcup lupine (*Lupinus caudatus*). This site concept also includes less locally common ponderosa pine communities that include components of shrub and tree species adapted to droughty soils and exposures such as antelope bitterbrush, western juniper and big sagebrush. These species are especially common on the southernmost extent of this site and less common in locations further north where exposure to Columbia river weather patterns instead favors minor components of shrubs such as rose (*Rosa* sp.) and snowberry (*Symphoricarpos* sp.). Mountain mahogany (*Cercocarpus ledifolius*) may also occur in this plant community on upper slope positions and ridgetops with rocky soils.

Ponderosa pine forests were historically subject to frequent surface fires primarily ignited by lightning strikes and Native American cultural burning practices. These fires would have likely occurred at less than 35 year intervals and approximated Landfire fire regime group 1 (0-35 year frequency, surface severity). These low intensity fires would

have decreased the density of young regenerating understory conifers which are less tolerant of fire when young and may otherwise act as ladder fuels to ignite crown fires and lead to stand replacing events. Overtime, frequent low intensity fires, as well as occasional mixed severity fires, would have favored the development of mature, uneven-aged ponderosa pine stands with open canopies. Mixed severity fires, where direct overstory mortality was patchy, were less common than surface fires, and true stand replacement fires were rare. Fire-resistant ponderosa is well-adapted to these conditions, developing increasing fire resistance with age by growing thick bark and self-thinning lower limbs. With longer time between fire, increased development of understory fuels such as young pine, juniper and down wood, along with the development of a closed canopy, can promote an increased frequency of stand replacing fires and insect outbreaks. In addition to direct impacts of wildfire, disturbance factors that resulted in the death of mature pine included injury from lightning strikes, wind events, weather extremes, and the collective influence of various damage agents such as bark beetles, pine engraver, mistletoe, and other adapted insects and diseases associated with injury or competitive stressors.

Understory species in these forests were adapted to respond to this fire driven disturbance regime. Many cool season perennial grasses, such as bluebunch wheatgrass, would resprout from crowns following fire. Understory forbs, such as common yarrow, may resprout from rhizomes while others, such as lupine, can effectively respond to post fire conditions that may delay the reestablishment of other species, such as low soil nutrient levels, by fixing their own nitrogen.

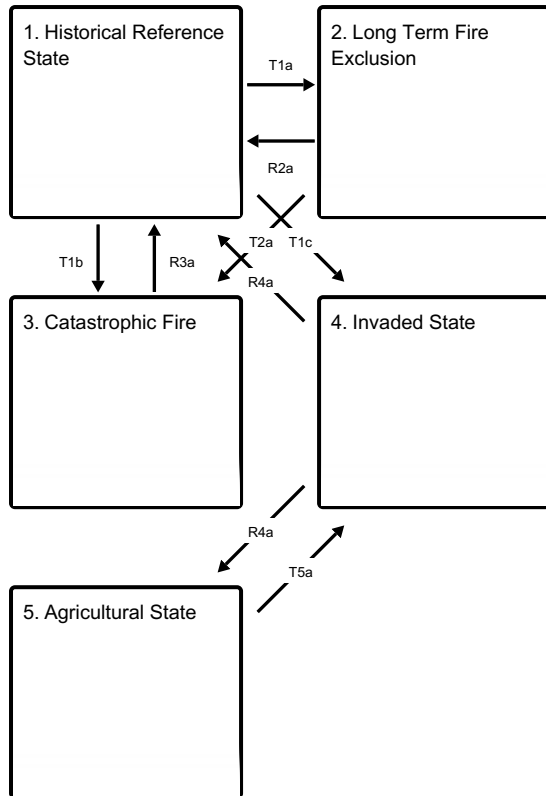
As a forested site with a grass dominated understory, much of these forests were historically subject to livestock grazing, especially cattle and sheep. Prolonged historical use by these ungulates may have altered the composition of understory herbaceous and shrub communities. A decrease in palatable shrubs such as bitterbrush, and perennial grasses such as Idaho fescue may have paralleled increases in forbs such as lupin and yarrow and exotic annual grasses such as cheatgrass (*Bromus tectorum*), Medusahead rye (*Taeniatherum caput-medusae*), and North Africa grass (*Ventenata dubia*). Increases in exotic grasses have been associated with other impacts as well, including off highway vehicle use and proximity to human development. At high levels, the impacts of these invasions on nutrient cycling, wildlife habitat and fire cycles may be severe.

Current stand conditions in this ecological site do not, in most instances, conform to the historic range of variability (as represented by the reference state below) in terms of the expected frequency and severity of future wildfire events. Since the arrival of Euro-American settlers to the region in the late 1880's, the character and function of these forests have changed. Logging, grazing, conversion to other uses, and fire exclusion have impacted the natural processes of this fire-dependent ecosystem. Depending on the severity and degree of impact, alternative states (which function outside of the parameters of the reference state), have developed. Within this forest type across the Blue Mountains, fire regimes are considered to have experienced "high" departure from historical conditions (Natureserve 2020).

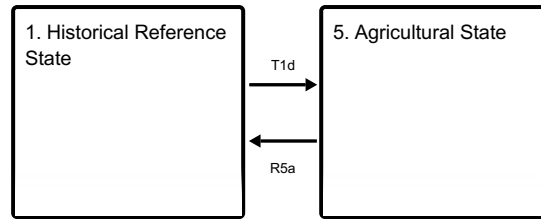
The state and transition model below represents a generalized and simplified version of forest change in response to major disturbance types in this ecological site. It does not attempt to model the potential effects of climate change on ecosystem function or process. Emerging evidence is suggesting 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, this may include the possibility of regeneration failure following wildfire disturbance (Halofsky et al. 2020). As evidence increases, this model will likely undergo alterations and updates to reflect our emerging understanding.

State and transition model

Ecosystem states



States 1 and 5 (additional transitions)



T1a - Long term fire exclusion (50-100+) years

T1b - Widespread catastrophic stand replacing fire event

T1c - Invasion of introduced cool season grasses or exotic annual grass

T1d - Site converted to annual cropland or pasture/hayland

R2a - Restoration practices that reduce excessive fuel loads and reduce overstory crown bulk density

T2a - Widespread catastrophic fire occurs

R3a - Conifer planting

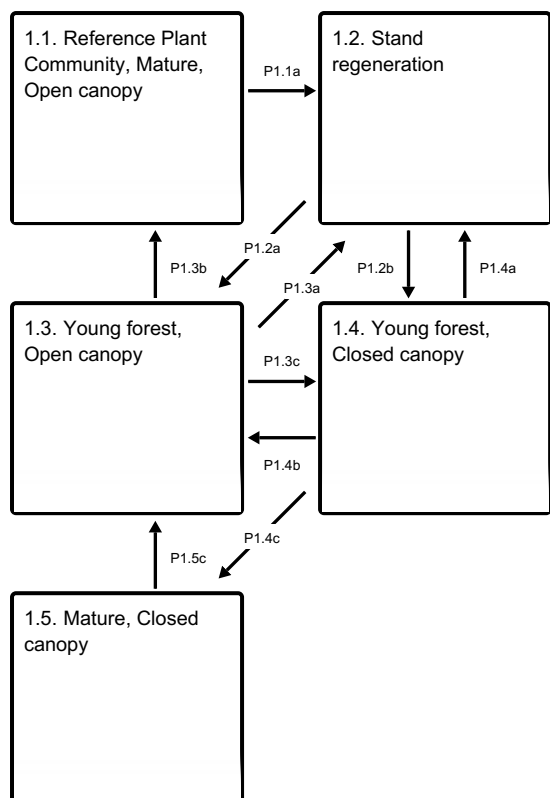
R4a - Practices that promote the reestablishment of native understory species

R4a - Practices are applied which reduce or eliminate unwanted weeds and invasive species

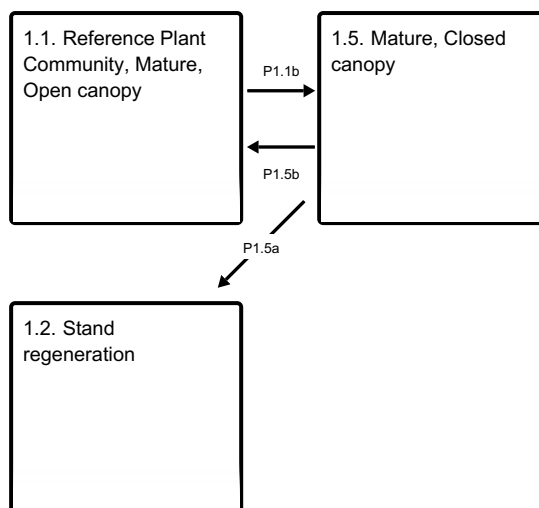
R5a - Practices that promote the reestablishment of native understory species

T5a - Poor management or abandonment leads to weed invasion

State 1 submodel, plant communities



Communities 1, 5 and 2 (additional pathways)



State 1

Historical Reference State

Ponderosa pine forests of this type tended to be heterogeneous and spatially complex. The primary disturbance regime that maintained this ecological site in the historical context was frequent low intensity surface fire and less frequent mixed severity fire., which resulted in multiple age and size classes of ponderosa pine. A wide array of wildlife species benefited from the edge effects created by the spatial intersections within the larger landscape, and by naturally occurring snags and large woody debris. Across the overall landscape stand structure was expressed by a combination of patch openings, clumpy (dense or overstocked) tree groups, and as well-spaced mature overstory trees encompassing larger stand groups. These mosaic patterns could occur over the landscapes in a scale of upwards of tens of thousands of acres. Disturbances from fire and other biotic and abiotic sources impacted much smaller areas within the larger landscape, on the order of thousands of acres. Following a disturbance occurrence that eliminated or significantly reduced much of the established Ponderosa pine within the forest stand, the key to re-establishing and sustaining the reference state was dependent on the successful recruitment of Ponderosa pine seedlings from adjacent sources, from soil banked viable seed, or from remnant surviving seed trees. Larger sized patches and impacted areas approaching landscape level scales, isolated from seed sources and devoid of remnant Ponderosa pine of any size class, tend to revert to long term grass/shrub conditions.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- Idaho fescue (*Festuca idahoensis*), grass
- bluebunch wheatgrass (*Pseudoroegneria spicata* ssp. *spicata*), grass

Community 1.1

Reference Plant Community, Mature, Open canopy

This mature forest is the dominant representation of the pre-European historic reference state which is sustained by plant adaptations to naturally occurring and frequent non-lethal fires that removed understory regeneration and fuels. It is typically un-even aged stand with an open overstory dominated by mature ponderosa pine.

Community 1.2

Stand regeneration

Pine seedlings/saplings establish in small-size patch openings created from disturbance events (fire and disease or insect outbreaks, occurring in both endemic or epidemic outbreaks) that reduced or eliminated portions of the overstory canopy layer. Seedling recruitment commonly comes from seed production in the years following the event, but also from viable banked seed that was on the ground before the disturbance occurred or from surviving regeneration that pre-dated the disturbance. Favorable weather conditions are necessary for seedlings to establish and develop. Limitations of seed dispersion distance from seed trees (these are heavy seeds) seriously hinder Ponderosa pine re-establishment in larger patch sizes. Mixed severity fire may maintain the stand in this phase. The process of seedling establishment is once again dependent on sporadic cone production, coupled with favorable weather.

Community 1.3

Young forest, Open canopy

Young to intermediate aged stand with open canopy conditions. At this stage, maturing Ponderosa pine are well suited to survive low intensity surface fire. Surface and mixed fires will facilitate a beneficial “thinning” effect in dense stocking conditions (i.e., some trees succumb to the fire while others survive) maintaining the stand in this phase. Reoccurring surface fire near the middle and later stages of this phase can provide beneficial self-pruning of the lower limbs of individual trees, which reduces the subsequent ladder fuel risk for those trees. Ponderosa pine seedlings will become established underneath overstory Ponderosa pine canopy layers, but their development and successional pathway will be impacted by the competition and shade relationships of the overstory stand. Ponderosa pine is a shade intolerant tree species meaning that the tree species is best adapted to growing in open sites or very low levels of overstory shade.

Community 1.4

Young forest, Closed canopy

Young stand with closed canopy conditions, uncommon in reference conditions. The canopy will begin to close and understory early seral shrub cover, if present, begins to decline as tree canopy cover approaches 50%. The stand will often will exhibit clumpy attributes, and increased intraspecific stand stress will occur as the stand ages, which is the beginning of the stem exclusion phase of stand development. Without fire, to open the stand up to conditions similar to 1.3, this phase is at risk of converting to the long-term fire exclusion state 2 as fuels increase. The risk of a transition to alternative state 3 due to a stand replacing fire is also increased.

Community 1.5

Mature, Closed canopy

This is a mature, closed canopy stand, uncommon in reference conditions. Persistent snags and the development of down wood is high. Beneath the dominant and co-dominant overstory layer, a limited expression of younger cohorts of Ponderosa pine can exist. The threat of mountain pine beetle increases, and individual trees within the canopy are at greater risk of insect and disease mortality which in turn create gaps in the overstory. Without fire to open the stand to conditions similar to 1.3 or 1.4, this phase is at risk of converting to the long-term fire exclusion state 2 as fuels increase. The risk of a transition to alternative state 3 due to a stand replacing fire is also increased.

Pathway P1.1a

Community 1.1 to 1.2

Fine scale patch openings develop from disturbance events. Causes of overstory mortality include mixed severity and localized stand replacement fire events, and from single tree to cluster mortality of mature pine trees that have succumbed to incidences such as beetle kill, mistletoe, windthrow, and storm damage.

Pathway P1.1b

Community 1.1 to 1.5

With time and the absence of major disturbance events, the stand develops into a mature, closed canopy structure.

Pathway P1.2a
Community 1.2 to 1.3

Low severity fire regime maintained for an extended period which allows more mature trees to resist or escape fire and develop into older age classes.

Pathway P1.2b
Community 1.2 to 1.4

Fire cycles missed which allows the continued development of young trees in dense, unthinned stands.

Pathway P1.3b
Community 1.3 to 1.1

A fire regime characterized by frequent, low severity fire allows the stand to develop to the mature phase. Stands have thinned as size classes increased, primarily from the natural exclusion processes as well as from stress induced bark beetle mortality and fire.

Pathway P1.3a
Community 1.3 to 1.2

Fires occur which are severe enough to eliminate most of all Ponderosa pine size classes, and again sets back the development of the site to the regeneration phase.

Pathway P1.3c
Community 1.3 to 1.4

Fire cycles missed allowing understory infill of younger trees to progress and increase stand density.

Pathway P1.4a
Community 1.4 to 1.2

Fires occur which are severe enough to eliminate most of all Ponderosa pine size classes, and again sets back the development of the site to the regeneration phase.

Pathway P1.4b
Community 1.4 to 1.3

Mixed severity fire occurs eliminating some of the overstory and opening the canopy.

Pathway P1.4c
Community 1.4 to 1.5

Low severity fire regime maintained for ~150 years which allows many trees to mature into the overstory maintaining a closed canopy.

Pathway P1.5b
Community 1.5 to 1.1

Insects/disease, such as bark beetles, remove portions of the overstory, opening the canopy to mature open canopy conditions resembling 1.1.

Pathway P1.5a
Community 1.5 to 1.2

A fire event severe enough to eliminate the majority of the overstory, or less severe mixed severity fires which creates random patch openings, occurs. The stand or impacted patch areas within the overall stand are set back to

the conditions in plant community phase 1.2, in which necessary seed source/seed establishment components must be present in order to achieve adequate Ponderosa pine regeneration.

Pathway P1.5c Community 1.5 to 1.3

Insects/disease, such as bark beetles, remove portions of the overstory, opening the canopy. Mixed and low severity fire may also thin the stand into the 1.3 phase.

State 2 Long Term Fire Exclusion

Conditions favorable to the development of this alternative state began to occur within the Reference State around the turn of the twentieth century. The impacts of fire exclusion, a management goal of post-European settlers, has allowed many stands to progress without the natural occurrence of fire, especially frequently occurring and beneficial fire episodes. Fire suppression has shifted the age expression and density of the younger stands, and changed the composition of understory vegetation, leading to reduced spatial variation. Fuel levels and fuel stratum layers have increased, shifting the fire regime/condition class toward a greater likelihood of stand replacement fire episodes.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- antelope bitterbrush (*Purshia tridentata*), shrub
- Idaho fescue (*Festuca idahoensis*), grass
- bluebunch wheatgrass (*Pseudoroegneria spicata* ssp. *spicata*), grass

State 3 Catastrophic Fire

This state represents conditions immediately following a catastrophic wildfire event. Long term detrimental impacts to wildlife, hydrology and soil quality occur immediately due to the abnormally high intensity of the catastrophic burn. Microbial populations, organic matter levels, nitrogen cycling and other structural elements of the native soil resources are negatively impacted. The number of wildlife snags will usually increase in the short term following the fire. Recolonization of the site by conifers will depend greatly on distance to seed sources as most on site seed will be eliminated.

Dominant plant species

- antelope bitterbrush (*Purshia tridentata*), shrub
- greenleaf manzanita (*Arctostaphylos patula*), shrub
- Idaho fescue (*Festuca idahoensis*), grass
- bluebunch wheatgrass (*Pseudoroegneria spicata* ssp. *spicata*), grass
- common yarrow (*Achillea millefolium*), other herbaceous
- lupine (*Lupinus*), other herbaceous

State 4 Invaded State

This state has developed with the introduction and invasion of introduced grasses and noxious weeds. In this site, cheatgrass (*Bromus tectorum*), Medusahead rye (*Taeniatherum caput-medusae*), and North Africa grass (*Ventenata dubia*) may invade the stand. These conditions are more likely to develop on areas which were near developed farm and pasture lands, road and trail networks and other converted lands.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- North Africa grass (*Ventenata dubia*), grass
- medusahead (*Taeniatherum caput-medusae*), grass

- cheatgrass (*Bromus tectorum*), grass

State 5

Agricultural State

This state follows a very intensive or total harvest of the mature overstory, followed by stump removal and the elimination of all other native forest vegetation. Cultivation follows. In this state virtually all the natural forest functions were eliminated by the converted use to agricultural lands (including annually tilled crops as well as hay and pasture production).

Dominant plant species

- orchardgrass (*Dactylis glomerata*), grass

Transition T1a

State 1 to 2

Long term fire exclusion (50-100+) years (resulting in Alternative State 2).

Transition T1b

State 1 to 3

A widespread catastrophic stand replacing fire event occurs as a natural (but rare) event in the reference state. Ponderosa pine and Douglas-fir are virtually eliminated across all age/size classes, leading to a long-term deficiency of seed source to re-establishment Ponderosa pine (resulting in Alternative State 3).

Transition T1c

State 1 to 4

Introduced cool season grasses invading sites near homesteads, pastureland, and other converted land. This includes exotic annual grass invasion of improperly grazed sites, as well as other excessive disturbance(s) of the native vegetation (resulting in Alternative State 4).

Transition T1d

State 1 to 5

Site converted to annual cropland or pasture/hayland (leading to Alternative State 5).

Restoration pathway R2a

State 2 to 1

Restoration practices that reduce excessive fuel loads and reduce overstory crown bulk density, as well as treatment of overstocked clumpy areas, may help to simulate historical stand densities. Tree planting in larger, unstocked areas where Ponderosa pine and other native seed sources are absent, as well as the introduction of prescribed burning, can contribute to increased resiliency and a return to natural ecologic integrity.

Transition T2a

State 2 to 3

Widespread catastrophic fire occurs, similar to that of T1B, but the intensity and impact of the wildfire event is much greater in scope due to the unnatural buildup of fuels in Alternative State 2 (resulting in Alternative State 3).

Restoration pathway R3a

State 3 to 1

Ponderosa pine and Douglas-fir are planted due to the widespread lack of adequate seed source or surviving trees of any size or age class. Natural recovery will be extremely long without tree planning efforts, up to many 100's of

years as conifers would have to slowly re-establish parameter areas and then migrate inwards by natural reproduction under favorable circumstances. It is possible that persistent brush or grass/brush cover may exist for years if un-planted. Soil integrity may be slow to respond to pre-fire levels, especially considering increases in hydrophobicity, reductions in organic matter and potential for erosion immediately following fire.

Restoration pathway R4a State 4 to 1

Practices that promote the reestablishment of native understory species, for example tree and/or native grass planting in properly prepared seedbed conditions, have the potential to restore some of the function of native Ponderosa pine and Douglas-fir communities in this ecological site. Complete restoration to reference conditions, however, is unlikely and rather a transition to a “current potential state” with improved ecological processes yet still including some degree of invasive species is more likely.

Restoration pathway R4a State 4 to 5

Practices are applied which reduce or eliminate unwanted weeds and invasive species, followed by the application of sound agronomic practices or by applying pasture/hayland management. Returns to Alternative State 5, and not to the Reference State.

Restoration pathway R5a State 5 to 1

Practices that promote the reestablishment of native understory species, for example tree and/or native grass planting in properly prepared seedbed conditions, have the potential to restore some of the function of native Ponderosa pine and Douglas-fir communities in this ecological site. Complete restoration to reference conditions, however, is unlikely and rather a transition to a “current potential state” with improved ecological processes yet still including some degree of invasive species is more likely.

Transition T5a State 5 to 4

Poor management or abandonment leads to weed invasion, often with noxious species (resulting in Alternative State 4).

Additional community tables

References

. Fire Effects Information System. <http://www.fs.fed.us/database/feis/>.

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

Other references

Agee, J.K., 1993. Fire Ecology of Pacific Northwest Forests. Inland Press, Washington, DC.

Arno, S. (2000). Fire in western forest ecosystems (chapter 5). In: J.K Brown and J.K. Smith (editors), pp. 97-120, Wildland fire in ecosystems: effects of fire on flora. USDA Forest Service, General Technical Report RMRS-GTR-42-vol 2.

Churchhill, Derek J.; Carnwath, Gunnar C.; Larson, Andrew J.; Jeronimo, Sean A. 2017. Historical forest structure, composition and spatial pattern in dry conifer forests of the western Blue Mountains, Oregon. Gen. Tech. Rep. PNW-GTR-956. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 93 p.

- Crane, M. F.; Fischer, William C. 1986. Fire ecology of the forest habitat types of central Idaho. Gen. Tech. Rep. INT-218. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 86 p.
- Fitzgerald, Stephen A. 2005. Fire Ecology of Ponderosa Pine and the Rebuilding of Fire-Resilient Ponderosa Pine Ecosystems (pg. 197-225). In "Proceedings of the Symposium on Ponderosa Pine: Issues, Trends, and Management", Gen. Tech. Rep. PSW-GTR-198. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture. 281 p.
- Graham, Russell T.; Jain, Theresa B. 2005. Ponderosa Pine Ecosystems (pg. 1-32). In "Proceedings of the Symposium on Ponderosa Pine: Issues, Trends, and Management", Gen. Tech. Rep. PSW-GTR-198. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture. 281 p.
- Hall, Frederick C.; Bryant, Larry; Clausnitzer, Rod (and others). 1995. Definitions and Codes of Seral Status and Structure of Vegetation. General Technical Report PNW-GTR-363. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. 39 p.
- Halofsky, J.E., Peterson, D.L. & Harvey, B.J. Changing wildfire, changing forests: the effects of climate change on fire regimes and vegetation in the Pacific Northwest, USA. *fire ecol* 16, 4 (2020). <https://doi.org/10.1186/s42408-019-0062-8>
- Johnson, CG, Jr.; Simon, Steven A. 1987. Plant Association of the Walla-Snake Province, Wallowa-Whitman National Forest. R6-ECOL-TP-225A-86. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region, Wallow-Whitman National Forest. 400 p.
- Johnson, CG, Jr.; Clausnitzer, R.R. 1992. Plant Association of the Blue and Ochoco Mountains. Tech. Publ. R6-ERW-TP-036-92. Portland, OR; U.S. Department of Agriculture, Forest Service, Pacific Northwest Region, Wallow-Whitman National Forest. 164 p.
- Juran, Ashley G. 2017. Fire regimes of conifer forests in the Blue Mountains. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Missoula Fire Sciences Laboratory (Producer).
- LANDFIRE: LANDFIRE National Vegetation Dynamics Models. (2007, January – last update). BpS 10450 and 10531. [Homepage of the LANDFIRE Project, U.S. Department of Agriculture, Forest Service; U.S. Department of Interior], [Online]. Available [2007, February 8].
- Larson, A.J., Churchill, D.C., 2012. Tree spatial patterns in fire-frequent forests of western North America, including mechanisms of pattern formation and implications for designing fuel reduction and restoration treatments. *Forest Ecology and Management* 267, 74–92.
- McDonald, G. I.; Harvey, A. E.; Tonn, J. R. 2000. "Fire, Competition and Forest Pests: Landscape Treatment to Sustain Ecosystem Function", in Neuenschwander, Leon F.; Ryan, Kevin C., tech. eds. Proceedings from the Joint Fire Science Conference and Workshop: crossing the millennium: integrating spatial technologies and ecological principles for a new age in fire management; the Grove Hotel, Boise, Idaho, June 15-17, 1999. Moscow, Idaho: University of Idaho, 2000: 195-211.
- Miller, M. 2000. Chapter 2: Fire Autecology. In: Brown, J.K.; Smith, J.K., editors. *Wildland fire in ecosystems: effects of fire on flora*. Gen. Tech. Report RMRS-GTR-42- vol. 2. Ogden, UT: Rocky Mountain Research Station, Forest Service, U.S. Department of Agriculture. 257 p.
- NatureServe. 2020. "Terrestrial Ecological System: Northern Rocky Mountain Ponderosa Pine Woodland and Savanna." NatureServe, Arlington, Virginia. (Accessed: September 15, 2020).
- Powell, 1996 (rev 2012). A Stage is a Stage is a Stage ... Or Is It? White Paper F14-SO-WP-Silv-10. Pendleton, OR. U.S. Department of Agriculture, Forest Service, Umatilla National Forest. 14 p.
- Powell, D.C. 2006 (rev 2017). Seral Status for Tree Species of the Blue and Ochoco Mountains. Tech. Publ. F14-

SO-WP-SILV-58. Pendleton, OR. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region, Umatilla National Forest. 17 p.

Powell, D.C.; Johnson, C.G.; Crowe, E.A.; Wells, A.; Swanson, D.K. 2007. Potential vegetation hierarchy for the Blue Mountains section of northeastern Oregon, southeastern Washington, and west-central Idaho. Gen. Tech. Rep. PNW-GTR-709. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 87 p.

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Kurt Moffit - Initial PES grouping
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Approval

Kirt Walstad, 9/08/2023

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	04/25/2024
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:**
