Ecological site F043CY607OR
Cool Moist Conifer Foothills and Mountains (PIPO-PSME/SYAL)

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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 Engelman 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/common snowberry - CPS524 (modal)
Ponderosa pine/elk sedge - CPG222
Ponderosa pine/pinegrass - CPG221
Douglas-fir/elk sedge - CDG111
Douglas-fir/mountain snowberry - CDS625

Plant Assoc. of Wallowa-Snake Province (R6 E 255-86)
Ponderosa pine/common snowberry - CPS522 (modal)
Douglas-fir/mountain snowberry - CDS623
Ponderosa pine/spiraea - CPS523

United States National Vegetation Classification (2008)
Alliance (A3446) Central Rocky Mountain Ponderosa Pine/Shrub Woodland and Association

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)
Northern Rocky Mountain Ponderosa Pine Woodland and Savanna, CES306.030e

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 ponderosa pine, which is occasionally codominant with Douglas-fir (Pseudostuga menziesii). The herbaceous layer is dominated by grasses such as elk sedge (Carex geyeri), pinegrass (Calamagrostis rubescens) and forbs such as strawberry (Fragaria spp.), and heartleaf arnica (Arnica cordifolia). Unlike ponderosa forests nearby on droughtier soils, this site often hosts a characteristic shrub component of snowberry (Symphoricarpus spp.), with minor amounts of other low shrubs including creeping Oregon grape (Berberis repens). Forested sites at higher elevations and with greater proportions of volcanic ash, experience higher soil moisture retention which facilitates understory regeneration of grand fir (*Abies grandis*) and greater composition and productivity of Douglas-fir. 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. Frequent fire, as well as bark beetles, was historically a critical element of the disturbance regime of this site, acting to thin crowded understories and allow fire resistant mature ponderosa and Douglas-fir trees 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

F043CY608OR	**Cool Dry Conifer Foothills and Mountains (PIPO/FEID-PSSPS)** Occupying adjacent soils with somewhat shallower depth to a restrictive layer and droughty properties
F043CY605OR	**Cool Moist Conifer Mountains and Plateaus (PSME-PIPO/CARU)** Occupying adjacent somewhat deeper soils with greater soil moisture retention

Similar sites

F043CY608OR	**Cool Dry Conifer Foothills and Mountains (PIPO/FEID-PSSPS)** Lower available water content, somewhat shallower soils, higher coarse fragment content, andic soil properties less common
F043CY605OR	**Cool Moist Conifer Mountains and Plateaus (PSME-PIPO/CARU)** Somewhat deeper soils, cooler climate, fewer dry days (45-60)
F043CY609OR	**Warm Dry Conifer Foothills and Mountains (PIPO-PSME/SYAL/CAGE)** Occupying lower elevations

Table 1. Dominant plant species

Tree	(1) *Pinus ponderosa* (2) *Pseudotsuga menziesii*
Shrub	(1) *Symphoricarpos albus*
Herbaceous	Not specified

Physiographic features

This site occurs on forested backslopes, shoulders and summits of foothills and mountain slopes. This site occurs on all aspects with slopes typically ranging from 5-50%. Elevations are typically between 4,000 to 5,200 (1,225 to 1,600 m) but may range from 3,400 to 6,000 (1,025 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	4,000–5,200 ft
Slope	5–50%
Ponding depth	0 in
Water table depth	100 in
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	3,400–6,000 ft
Slope	0–70%
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 17 - 25 inches (430 - 635 mm) but can range from 15 to 29 inches (380 - 735 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 30 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)	30-120 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	17-25 in
Frost-free period (average)	70 days
Freeze-free period (average)	
Precipitation total (average)	19 in

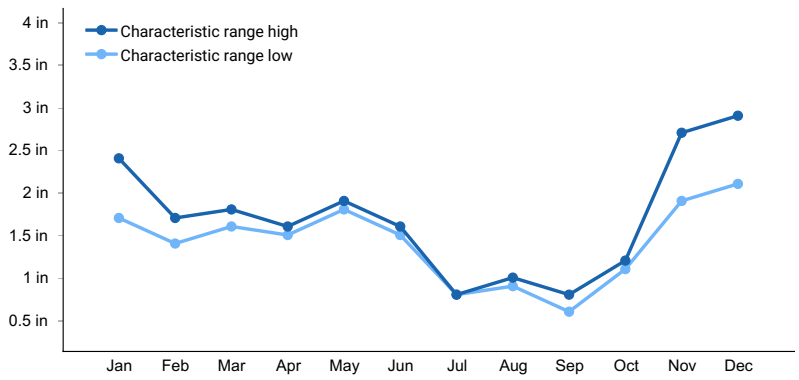


Figure 1. Monthly precipitation range

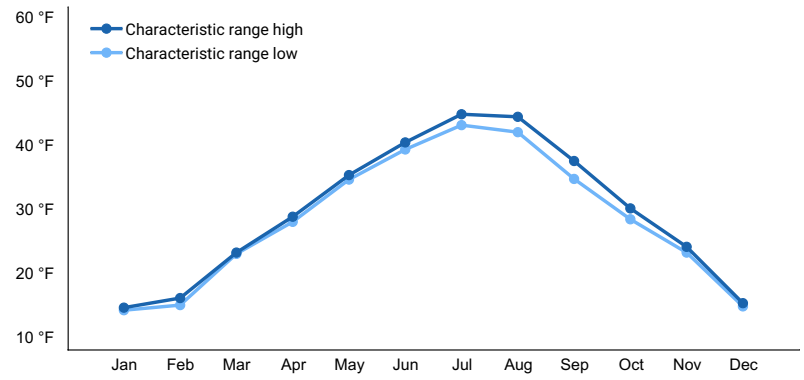


Figure 2. Monthly minimum temperature range

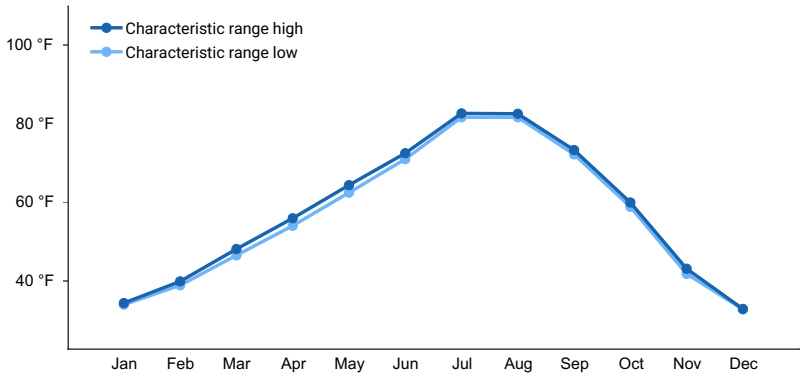


Figure 3. Monthly maximum temperature range

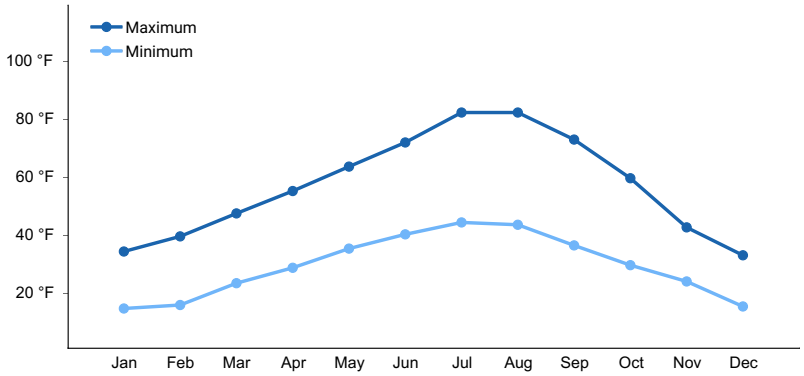


Figure 4. Monthly average minimum and maximum temperature

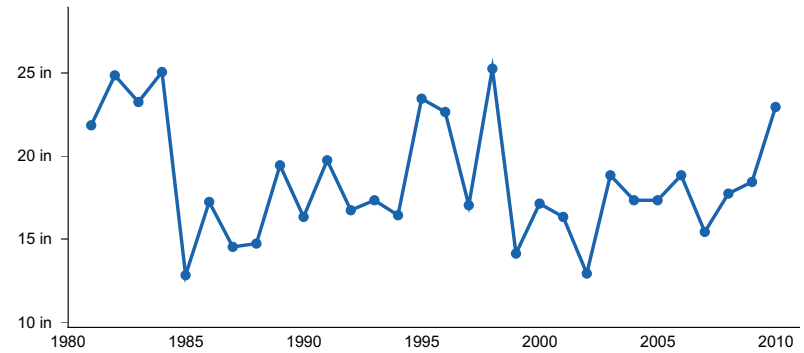


Figure 5. Annual precipitation pattern

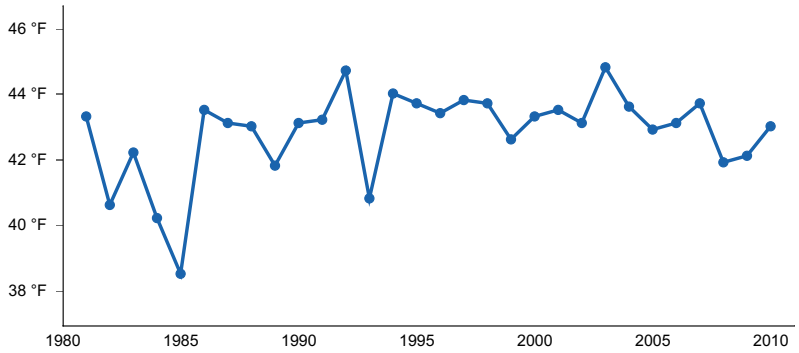


Figure 6. Annual average temperature pattern

Climate stations used

- (1) AUSTIN 3 S [USC00350356], Prairie City, OR
- (2) MASON DAM [USC00355258], Baker 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 moderately deep (but range from shallow to very deep). Surface textures are varied with subsurface coarse fragment content ranging from gravelly to extremely gravelly or stony. The family particle size class is typically loamy-skeletal but may vary. These soils are typically derived from basalt colluvium and residuum and commonly have some influence of volcanic ash throughout or in the upper part, yet lack a deep ash cap in the surface horizon. These are well drained soils, typified by an average representative available water capacity ranging from 1.2 – 2.0 in the 0 – 10 inch depth. See Fivebeaver, Klicker, and Humarel for modal series concepts.

Table 5. Representative soil features

Parent material	(1) Colluvium–volcanic and sedimentary rock (2) Residuum–volcanic and sedimentary rock (3) Volcanic ash–volcanic rock
Surface texture	(1) Ashy silt loam (2) Ashy sandy loam (3) Silt loam (4) Gravelly silt loam (5) Stony silt loam
Family particle size	(1) Clayey-skeletal (2) Fine (3) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderately slow to moderately rapid
Depth to restrictive layer	20–40 in
Soil depth	20–40 in
Surface fragment cover <=3"	0–45%
Surface fragment cover >3"	0–45%
Available water capacity (0-10in)	1.2–2 in
Soil reaction (1:1 water) (0-40in)	5.6–7.3

Subsurface fragment volume <=3" (4-60in)	0–35%
Subsurface fragment volume >3" (4-60in)	0–30%

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 association that defines this ecological site group concept is the widespread Ponderosa pine/Common snowberry association (PIPO/SYAL as described in Johnson and Clausnitzer 1992, and Johnson and Simon 1987). Additional closely related plant associations include Ponderosa pine/Elk sedge and Douglas-fir/Elk sedge. Within MLRA 43c in Oregon, these communities exist toward the moist end of the climate range supporting ponderosa pine forests and the warm and dry end of the climate range supporting Douglas-fir forests. As such, productivity is higher than other ponderosa pine forests in these mountains. This site group corresponds to the USFS potential vegetation group “Dry Upland Forest” and plant association group “Warm Dry Upland Forest”.

In its reference phase, these mature forests would been dominated by an overstory of large ponderosa pine, occasionally codominant with Douglas-fir, and a shrub/grass understory. Common shrubs include common snowberry, rose (Rosa spp.) birchleaf spiraea (*Spiraea betulifolia*), and creeping Oregon grape. Common members of the herbaceous component include pinegrass, elk sedge, Idaho fescue, heartleaf arnica, strawberry, common yarrow (*Achillea millefolium*) and lupine (Lupinus sp.). Douglas-fir is often found codominant with ponderosa pine on steeper slopes across varied aspects whereas ponderosa pine dominates across flat to steep slopes on primarily east to south facing aspects. Grand fir (*Abies grandis*) may be found occasionally in the understory of these forests in protected microsites where cooler temperatures and greater soil moisture are found.

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 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. Douglas-fir is also tolerant of fire at maturity, with very thick bark and a deep rooting habit. With longer time between fire, increased development of understory fuels such as young pine, Douglas-fir, occasional grand fir 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 trees 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 plants, such as elk sedge, pinegrass and snowberry, 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.

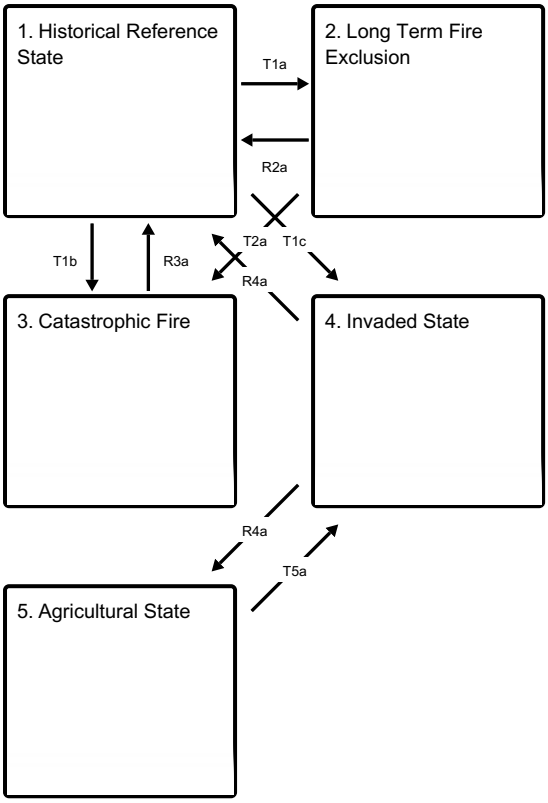
As a forested site with a productive herbaceous component in the understory, much of these forests were historically subject to livestock grazing, especially cattle and sheep. Prolonged historical use by these ungulates may have altered the composition of understory herbaceous and shrub communities. A decrease in palatable perennial grasses such as Idaho fescue and pinegrass may have paralleled increases in forbs such as lupine 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. In many cases, significant infill of young trees (especially those with greater shade tolerance such as Douglas-fir and grand fir) has occurred due to the factors stated above. In this forest type across the western US, fire regimes are considered to have experienced "moderate" to "high" departure from historical conditions (Natureserve 2020).

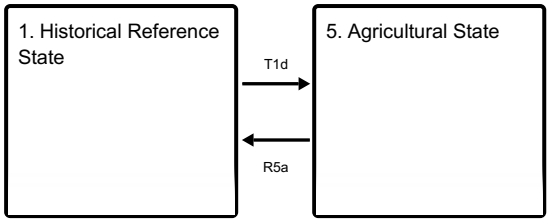
The state and transition model below represents a generalized and simplified version of forest change in response to major disturbance types in this ecological site. It does not attempt to model the potential effects of climate change on ecosystem function or process. Emerging evidence is suggesting 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. 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 - Introduced range grass or exotic grass invasion

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 stand replacing fire event

R3a - Conifer planting

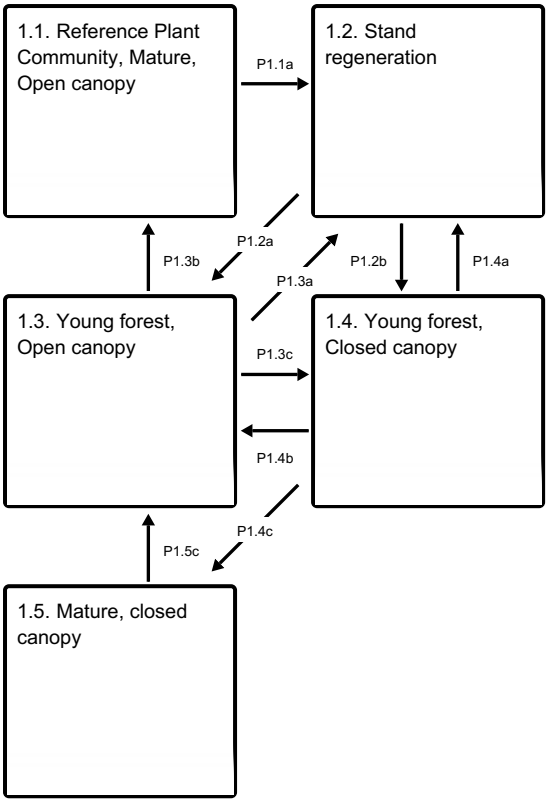
R4a - Practices that promote the reestablishment of native understory species

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

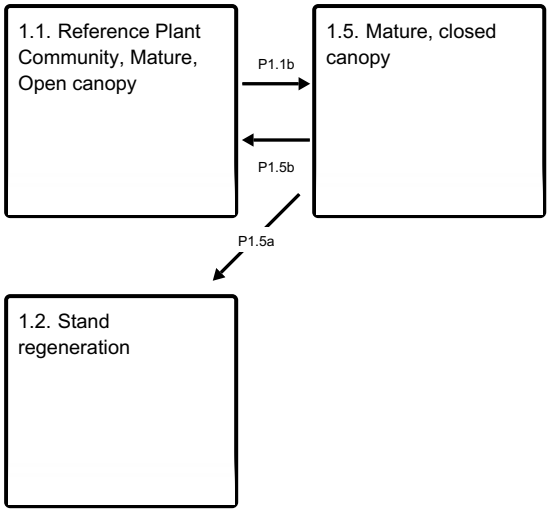
R5a - Practices that promote the reestablishment of native understory species

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

Mature 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 and occasionally Douglas-fir. In comparison to Douglas-fir, ponderosa pine reaches reproductive maturity at an earlier age and is more tolerant of fire when young. For this reason, with increasing fire return intervals or on fire protected aspects, Douglas-fir will become a more important component of the canopy. 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.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- common snowberry (*Symphoricarpos albus*), shrub
- rose (*Rosa*), shrub
- creeping barberry (*Mahonia repens*), shrub
- Geyer's sedge (*Carex geyeri*), grass
- Idaho fescue (*Festuca idahoensis*), grass
- pinegrass (*Calamagrostis rubescens*), 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 with occasional codominance of Douglas-fir on more fire protected microsites or areas with increased soil moisture.

Community 1.2
Stand regeneration

Conifer 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. Douglas-fir may depend on the establishment of ponderosa pine to create favorable conditions for germination.

Community 1.3
Young forest, Open canopy

Young to intermediate aged stand with open canopy conditions. At this stage, maturing Ponderosa pine and Douglas – fir 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 and Douglas-fir 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 whereas Douglas-fir is somewhat more shade tolerant.

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 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 sand 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 and Douglas-fir 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

- Douglas-fir (*Pseudotsuga menziesii*), tree
- grand fir (*Abies grandis*), tree
- ponderosa pine (*Pinus ponderosa*), tree
- common snowberry (*Symphoricarpos albus*), shrub
- rose (*Rosa*), shrub
- creeping barberry (*Mahonia repens*), shrub
- Geyer's sedge (*Carex geyeri*), grass
- Idaho fescue (*Festuca idahoensis*), grass
- pinegrass (*Calamagrostis rubescens*), 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

- common snowberry (*Symphoricarpos albus*), shrub
- spirea (*Spiraea*), shrub
- rose (*Rosa*), shrub
- creeping barberry (*Mahonia repens*), shrub
- Geyer's sedge (*Carex geyeri*), grass
- pinegrass (*Calamagrostis rubescens*), grass
- 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
- Douglas-fir (*Pseudotsuga menziesii*), tree
- common snowberry (*Symphoricarpos albus*), shrub
- creeping barberry (*Mahonia repens*), shrub
- rose (*Rosa*), shrub
- 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*), 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, un-stocked 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 references 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 references 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

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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	05/06/2024
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:**

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

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5. **Number of gullies and erosion associated with gullies:**

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6. **Extent of wind scoured, blowouts and/or depositional areas:**

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7. **Amount of litter movement (describe size and distance expected to travel):**

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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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):**

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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:**