USDA Natural Resources Conservation Service

Ecological site F043CY605OR
Cool Moist Conifer Mountains and Plateaus (PSME-PIPO/CARU)

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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

U.S. National Vegetation Classification Standard (NVCS)
Central Rocky Mountain Grand fir - Douglas-fir Forest & Woodland Alliance (A-3362)
Central Rocky Mountain Mesic Grand fir-Douglas-fir Forest Group (G211)

USDA Forest Service Ecological Sub-region
M332 “Blue Mountains”.

LANDFIRE BpS model 10450:
Northern Rocky Mountain Dry-Mesic Montane Mixed-Conifer Forest

Plant Assoc. Of Blue and Ochoco Mountains (R6 E TP-036-92)
Douglas-fir/big huckleberry - CDS821
Douglas-fir/common snowberry - CDS624 (modal)
Douglas-fir/ninebark - CDS711
Douglas-fir/oceanspray - CDS611
Douglas-fir/pinegrass - CDG112
Grand fir/birchleaf spirea - CWS322
Grand fir/elk sedge - CWG111
Grand fir/pinegrass - CWG113 (modal)
Lodgepole pine(grand fir)/pinegrass - CLG21

Plant Assoc. Of Wallowa-Snake Province (R6 E 255-86)
Douglas-fir/common snowberry - CDS622
Douglas-fir/pinegrass - CDG121
Douglas-fir/Rocky Mountain maple-ninebark - CDS722
Douglas-fir/spirea - CDS634
Grand fir/pinegrass - CWG112
Grand fir/spirea - CWS321

Ecological site concept

This ecological site occurs mainly on forested backslopes of mid to high elevation mountain slopes, and plateaus. They typically have a frigid temperature regime and xeric moisture regime. Parent materials are typically derived from basalt or other igneous extrusive geologies (andesite, dacite, ignimbrites, etc.) with an influence of volcanic ash in the surface. They are well drained with adequate available water capacity. An open overstory of mature Douglas-fir codominant with ponderosa pine with lesser amounts of grand fir and western larch represents the historical condition of this site. This composition was maintained by frequent low intensity fires, yet presently due to widespread fire suppression, much of this forest type includes a much higher proportion of grand fir and Douglas-fir, relative to ponderosa pine. These sites represent a transition between drier ponderosa pine and Douglas-fir communities and wetter grand fir communities. Common understory species include pinegrass, elk sedge, heartleaf arnica, snowberry and spiraea.

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

F043CY503OR	**Mountain Riparian Forest (PIEN/ALIN)** Occupying adjacent moderate to high-energy riparian areas
F043CY603OR	**Cool Wet Conifer Mountains and Plateaus (ABGR/VAME/LIBO)** Occupying adjacent soils with higher soil moisture due to aspect or landscape position
F043CY607OR	**Cool Moist Conifer Foothills and Mountains (PIPO-PSME/SYAL)** Occupying adjacent shallower soils with lower soil moisture

Similar sites

F043CY603OR	**Cool Wet Conifer Mountains and Plateaus (ABGR/VAME/LIBO)** Lower number of dry days (<45), Engelman spruce and grand fir more common.
F043CY607OR	**Cool Moist Conifer Foothills and Mountains (PIPO-PSME/SYAL)** Somewhat shallower soils, warmer climate, greater dry days (60-90)

Table 1. Dominant plant species

Tree	(1) *Pseudotsuga menziesii* (2) *Pinus ponderosa*
Shrub	Not specified
Herbaceous	(1) *Calamagrostis rubescens*

Physiographic features

This site occurs on forested backslopes of plateaus and mountain slopes within the Blue and Wallowa mountains of Oregon. This site occurs on all aspects with typical slopes between 7.5 - 50% but occasionally as steep as 65%. Slope profiles are most commonly convex or linear across and down slopes, and occasionally concave. Elevations are typically between 4,100 - 5,175 ft (1,250 - 1,575 m) but can range from 3,150 - 6,000 ft (950 - 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) Mountains > Plateau
Flooding frequency	None
Ponding frequency	None
Elevation	4,100–5,175 ft
Slope	8–50%
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	3,150–6,000 ft
Slope	0–65%
Ponding depth	Not specified
Water table depth	Not specified

Climatic features

The climate of this site is characterized by intermountain weather patterns. Winters are cool and wet with considerable snowfall and summers are cool and dry with occasional convective thunderstorms bringing measurable precipitation. Compared to continental systems influencing interior Rocky Mountain landscapes, these storms are less frequent and therefore summer precipitation is often lower. Mean annual precipitation is typically between 20 - 29 inches (510 – 735 mm) but ranges from 17 – 35 inches (430 – 890 mm). Mean annual temperatures are typically 39 - 43 °F (3 - 6°C) but range from 37 – 45°F (2.5 - 7°C). The soil temperature regime is Frigid and the moisture regime is Xeric with between 45 – 60 dry days per year. Frost free days average 30 to 100 per year. Climate graphs are populated from the closest available weather stations and are included to represent general trends rather than representative values.

Table 4. Representative climatic features

Frost-free period (characteristic range)	30-100 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	20-29 in
Frost-free period (average)	
Freeze-free period (average)	
Precipitation total (average)	24 in

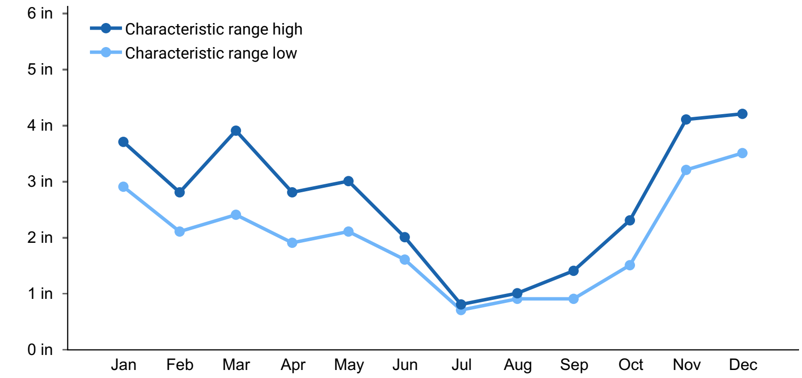


Figure 1. Monthly precipitation range

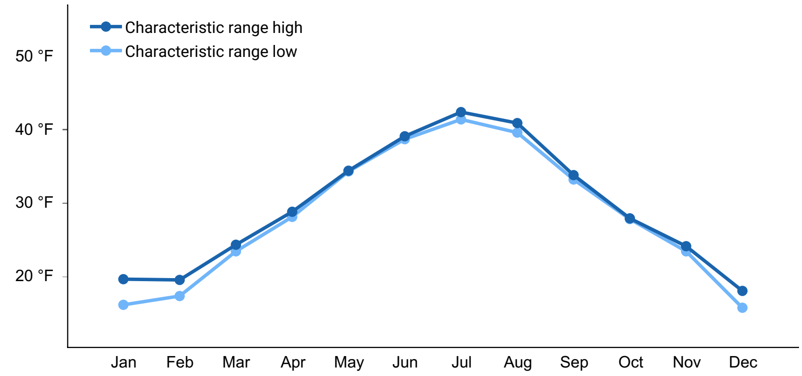


Figure 2. Monthly minimum temperature range

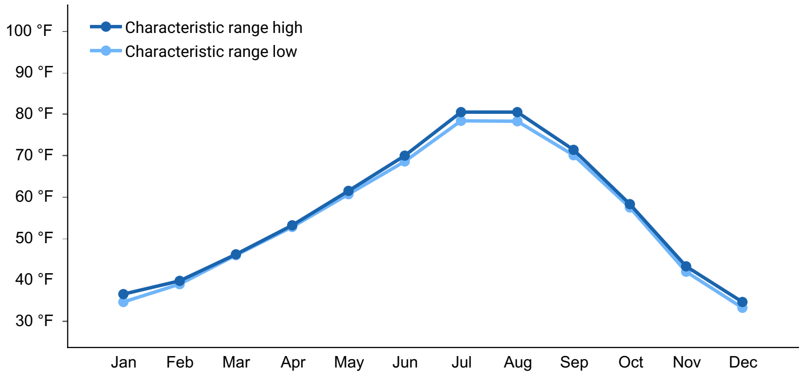


Figure 3. Monthly maximum temperature range

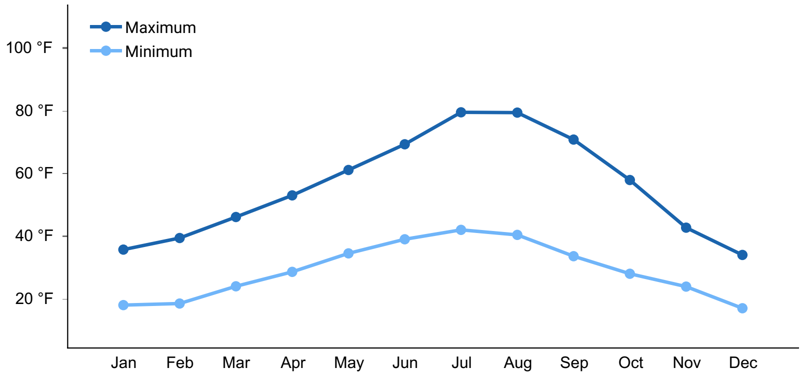


Figure 4. Monthly average minimum and maximum temperature

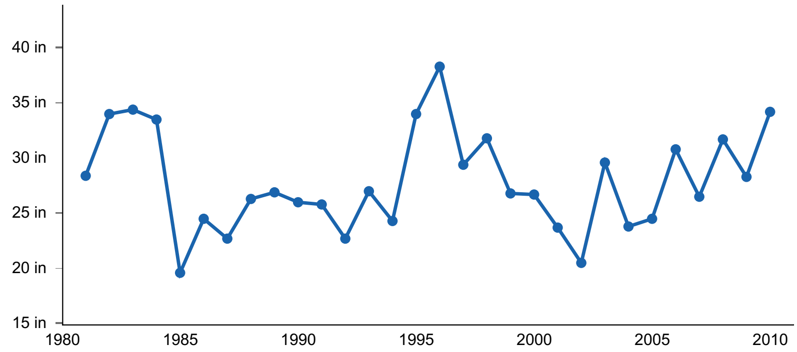


Figure 5. Annual precipitation pattern

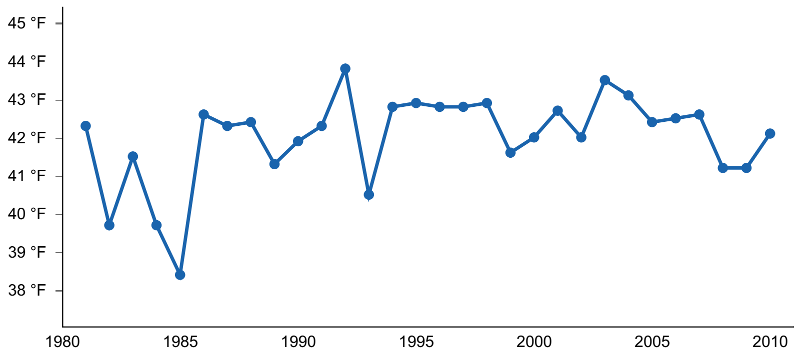


Figure 6. Annual average temperature pattern

Climate stations used

- (1) AUSTIN 3 S [USC00350356], Prairie City, OR
- (2) MEACHAM [USW00024152], Pendleton, OR

Influencing water features

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

Soil features

Soils that typify this site concept are typically moderately deep to very deep and well drained. Subsurface horizons are typically skeletal with coarse fragment ranges from very gravelly to extremely cobbly or stony. The family particle size class is typically loamy-skeletal but may vary. The soil moisture control sections are usually moist but are dry for 45 to 60 days following the summer solstice. These soils have typically developed in colluvium and/or residuum from basalt, other hard igneous extrusive geologies as well as metasedimentary and metavolcanic rocks. Mount Mazama volcanic ash is often mixed in the upper layer yet rarely in significant quantities to qualify as Andisols. See Analulu, Getaway, and Larabee for modal series concepts.

Table 5. Representative soil features

Parent material	(1) Colluvium–volcanic rock (2) Residuum–volcanic rock (3) Residuum–metasedimentary rock (4) Residuum–metavolcanics (5) Volcanic ash–volcanic rock
Surface texture	(1) Ashy loam (2) Gravelly silt loam (3) Cobbly loam (4) Stony sandy loam

Family particle size	(1) Ashy over loamy-skeletal (2) Clayey-skeletal (3) Fine (4) Loamy-skeletal
Drainage class	Well drained
Permeability class	Moderately slow to moderately rapid
Depth to restrictive layer	20–80 in
Soil depth	20–80 in
Surface fragment cover <=3"	0–45%
Surface fragment cover >3"	0–45%
Available water capacity (0-40in)	3–7.7 in
Soil reaction (1:1 water) (0-40in)	5.6–7.3
Subsurface fragment volume <=3" (4-60in)	0–30%
Subsurface fragment volume >3" (4-60in)	0–35%

Ecological dynamics

In its historical reference condition, a mature forest with an open stand structure was the most common expression of this ecological site. In this representative stage, widely spaced, older mature Douglas-fir (Pseutotsuga menziesii) and ponderosa pine (*Pinus ponderosa*) dominate the upper canopy layer, with mature grand fir (*Abies grandis*) and limited western larch (*Larix occidentalis*) in the mid-and upper layer(s) of the forest. Lodgepole pine (*Pinus contorta*) may also be found on this site, especially during early development phases following fire. Pinegrass (Calamagrosis rubescens) and elk sedge (*Carex geyeri*) dominate the herbaceous vegetation layer along lesser amounts of forbs that commonly include strawberry (Fragaria spp.), heartleaf arnica (*Arnica cordifolia*), common yarrow (*Achillea millefolium*), white hawkweed (*Hieracium albiflorum*) and tailcup lupine (*Lupinus caudatus*). Shrub species found on this site may include common snowberry (*Symphoricarpos albus*), creeping Oregon grape (Berberis repens), baldhip rose (*Rosa gymnocarpa*), birchleaf spirea (Spirea betulifolia), service berry (Amalanchier alnifolia) Scouler’s willow (*Salix scouleriana*) and mallow ninebark (*Physocarpus malvaceus*).

The modal plant associations that define this ecological site group concept are the widespread Douglas fir/Common snowberry and Grand fir/Pinegrass associations (as described in Johnson and Clausnitzer 1992, and Johnson and Simon 1987). Additional closely related plant associations include Douglas-fir/Pinegrass and Douglas-fir/Ninebark. Within MLRA 43C in Oregon, these communities exist in areas with greater moisture than pure ponderosa pine and ponderosa pine Douglas-fir forests and the warm and dry end of the climate range supporting grand fir forests. This site group corresponds to the USFS potential vegetation group “Dry Upland Forest” and plant association group “Warm Dry Upland Forest”.

Dry mixed conifer 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). Landfire estimated average fire return intervals for this forest type are 135 years, 110 years and 30 years for replacement, mixed and surface severity fires respectively. Frequent, low intensity fires would have decreased the density of young regenerating understory conifers, such as Douglas-fir and grand fir which are less tolerant of fire when young. Overtime, these fires, would have favored the development of mature, uneven-aged stands of Douglas-fir and ponderosa pine with open canopies. Less frequent mixed and surface severity fires would have increased the spatial and structural heterogeneity of these forests by creating patches of regeneration and removing portions of overstory components.

Fire-resistant ponderosa is well-adapted to fire, often surviving low severity fire when very young and developing increasing resistance with age by growing thick bark and self-thinning lower limbs. Douglas-fir is intolerant of fire until later developmental stages (~40 years) at which time it’s resistance is bolstered by very thick bark and deepening root habit. Western larch exhibits similar protective bark attributes, along with an open growing crown (i.e. low foliage volumes) that makes this species less vulnerable to consumption or scorch damage in the event of a crown fire. Grand fir is very intolerant of fire when young yet with advanced maturity gains some moderate resistance due to thickened bark and deep roots. Lodgepole pine is susceptible to mortality from fire with thin bark even with maturity, yet is well adapted to colonize following fire with prolific seed production and cones sometimes exhibiting serotiny. With longer time between fire, increased development of understory fuels such as young conifers, shrubs and down wood, along with the development of a closed canopy, can promote an increased frequency of stand replacing fires and insect outbreaks. Much of this site currently exists within this condition, as long-term fire exclusion has allowed for understory infill of shade tolerant Douglas-fir and grand fir and increases in fuel loads.

Understory species in these forests were adapted to respond to this fire driven disturbance regime. The dominant graminoids, such as elk sedge and pinegrass, will resprout from rhizomes and increase in cover following fire. Many shrubs found on site, including spiraea and snowberry, would also resprout from crowns or rhizomes following fire. These and other shrubs including serviceberry, may respond to high severity fire by forming dense shrubfields on sites where they were present prior to disturbance. Understory forbs, such as common yarrow and heartleaf arnica, 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.

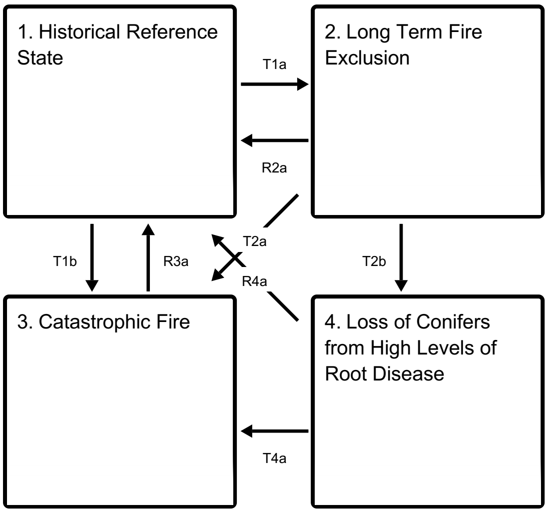
As a forested site with a productive herbaceous component in the understory, much of these forests were historically subject to livestock grazing, especially cattle and sheep, and use by native ungulates such as elk and mule deer. Often adjacent to climax grand fir sites with more dense understories and higher shrub cover, these sites may attract increased use. Prolonged historical use by these ungulates may have altered the composition of understory herbaceous and shrub communities. A decrease in preferred perennial grasses such as pinegrass as well as trampling impacts, may parallel increases in forbs such as heartleaf arnica, strawberry, vetch (Vicia spp.) and lupine, elk sedge 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, yet this site may be less prone to widespread invasion than drier forest types.

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 biotic damage agents. Ponderosa pine is prone to injury or mortality from bark beetles, pine engraver, mistletoe, and other adapted insects and diseases. Douglas-fir is often killed or weakened by Douglas-fir beetle and other wood borers, tussock moth and western spruce budworm. These agents often cause “secondary effect” post-fire mortality when fire stresses, but does not outright kill, individual mature Douglas-fir. Endemic bark beetle results in patch mortality, whereas epidemic outbreaks typically cause larger scale mortality. Root disease, age, overstocking, and other biotic and abiotic stressors will also impact the health and well-being of individual Douglas-fir trees, often leading to mortality. Western larch is susceptible to damage from dwarf mistletoe, needlecast and various fungi. Larch casebearer, sawfly, spruce budworm and tussock moth are common defoliators of larch.

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



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

T1b - Widespread stand replacing fire event

R2a - Treatment practices that reduce excessive ladder fuels

T2a - Time elapsed with understory fuels accumulating

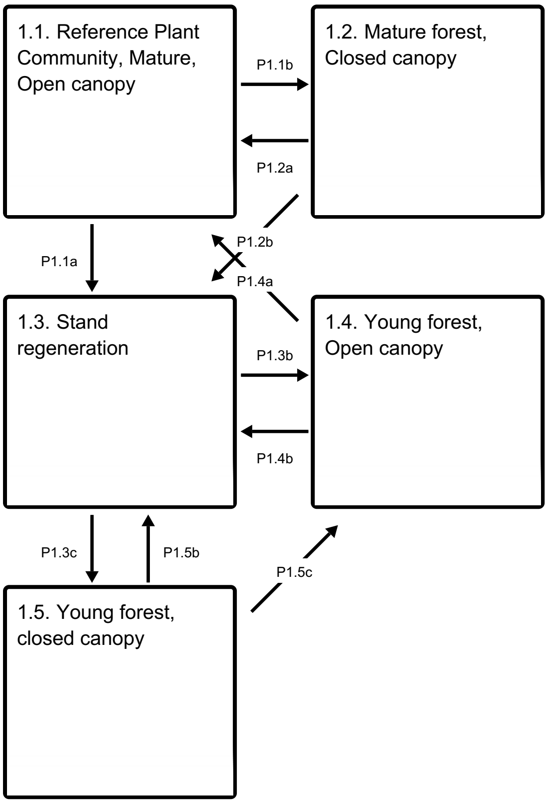
T2b - Time elapsed in the absence of catastrophic fire

R3a - Conifer planting/reestablishment with significant time elapsed

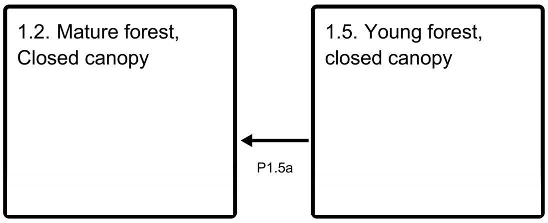
R4a - Conifer planting/reestablishment with significant time elapsed

T4a - Widespread catastrophic fire

State 1 submodel, plant communities



Communities 2 and 5 (additional pathways)



P1.1b - Absence of disturbance such as low/mixed severity fire events or disease/insect outbreaks

P1.1a - Stand replacement fire

P1.2a - Mixed fire events or endemic insect/disease impacts

P1.2b - Stand replacement fire

P1.3b - Absence of larger scale fire disturbance for ~ 40 years

P1.3c - Absence of larger scale fire disturbance for ~ 40 years

P1.4a - Time elapsed with regular surface fires

P1.4b - A large-scale stand disturbance, such as a stand replacement fire

P1.5a - Absence of large-scale stand replacement or mixed fires for a short number of decades

P1.5b - A large-scale stand disturbance

P1.5c - Mixed fire events or endemic insect/disease impacts

State 1
Historical Reference State

The historical reference state existed across the landscape as a spatially complex forest mosaic of plant communities in various stages of development and with varying composition. The most common expression was the mature open canopy stand, yet young open canopy stands were also common. Closed canopy conditions were less common due to site productivity and conditions favoring short intervals between mixed and low severity fire. At the landscape scale, these historic stand structures were represented by a combination of patch openings, clumpy (dense or overstocked) tree groups which were often pole size or smaller, and as well-spaced mature overstory trees encompassing larger stand groups. A wide range of conifer establishment and expression was possible due to the influence of a mixed fire regime. Following a disturbance in which large representatives of individual conifers were eliminated, the key to conifer re-establishment in the reference state relied on the recruitment of seed from adjacent sites, or from the few remnant surviving seed bearing sources. In a replacement fire of an older, mature stand, the trees that did survive tended to be the mature and over-mature early seral species because they have the most resistance to fire induced mortality.

Dominant plant species

- Douglas-fir (*Pseudotsuga menziesii*), tree
- ponderosa pine (*Pinus ponderosa*), tree
- grand fir (*Abies grandis*), tree
- common snowberry (*Symphoricarpos albus*), shrub
- pinegrass (*Calamagrostis rubescens*), grass
- elk sedge (*Carex garberi*), grass

Community 1.1
Reference Plant Community, Mature, Open canopy

This community phase is a common representation of the Pre-European reference state. The class size of the overstory layer is very large, but overall canopy closure is low, and canopy gaps and patches are common. Sites can be single or multi-canopied. Ponderosa pine is well represented in the dominant overstory layer. Mature Douglas-fir and Western larch are common as dominant overstory species as well in mid-layer canopy positions. Grand fir regeneration can be found. Reproduction varies with disturbance history. Low intensity, non-lethal surface fires will limit mid and late seral conifer development and maintain the grass dominated understory and the open nature of the stand. In some instances, a mixed fire event may result in limited mid-sized openings which will undergo secondary succession. A sward of pinegrass, less competitive elk sedge, along with scattered shrubs commonly dominates the understory. Snowberry and wild rose are present but limited in extent due of the surface moisture competition of the rhizomatous grass species. Microsites with steeper slopes and protected aspects with higher soil moisture will support greater shrub composition including spiraea, common ninebark and serviceberry.

Community 1.2
Mature forest, Closed canopy

Large, mature trees dominate this community phase, which is a less common representation of the mature forest ecological site in the historic Pre-European context. Ponderosa pine, Douglas-fir and lesser amounts of Western larch occur in the upper canopy layer, with grand fir found in the mid-layer canopy positions. Closed stands rarely exceed 80% crown closure. This in turn increased the likelihood of a stand replacement fire due to the contribution of excessive ladder fuels. Fire suppression may exacerbate this condition within this state and at sustained levels may promote a transition to alternative state 2 or 3.

Community 1.3

Stand regeneration

Following a stand replacement fire or other wide-spread disturbance (i.e. epidemic outbreaks, etc.) resprouting species such as grasses, forbs and some shrubs will dominate. In some cases, dense shrubfields including species such as spiraea, serviceberry, Scouler's willow and ninebark may develop. Post-disturbance older (relict) seed trees such as mature Ponderosa pine, western larch and Douglas-fir usually survive in sufficient quantities to provide seed sources for seedling establishment. In other cases, young patches of conifer seedlings and saplings, along with banked viable conifer seed in the surface of the soil, provide the source for initial conifer recruitment within the stand. A short fire return interval of repeat fires can eliminate virtually all young conifer reproduction when they are still relatively small and susceptible to damage (recruitment is most prone to fire caused mortality in the seedling/sapling stage). Successful conifer reestablishment will increasingly be hindered from the lack of seed sources and regeneration opportunities when successive burns occur. Long term persistent grass/shrub fields may develop in severe instances.

Community 1.4
Young forest, Open canopy

Canopy closure does not occur for a number of reasons (as described in community pathway 1.3B). In this community phase, fuels are discontinuous, resulting in a low probability of a stand replacement fire. Shade intolerant species remain dominant components in the subcanopy. Dominant understory plants include elk sedge, pinegrass, common snowberry and wild rose. Low intensity ground fires may occur on a regular basis, thereby maintaining the mid development (open) expression of the community phase. These events without altering the basic structure of the overall stand at this stage.

Community 1.5
Young forest, closed canopy

Abundant seed source(s) and successful establishment results develop a closed, mid-development successional stage stand. Even though this is a "closed" canopy, closure rarely exceeds 80%. Developing small and medium size ponderosa pine and western larch (to a lesser extent) begin to dominate the upper canopy layer. Mid-seral Douglas-fir and late seral grand fir will begin to establish as shade levels increase. These species will often develop to occupy the understory mid-layer canopy position as the general stand ages. Lodgepole pine can be found on colder micro-sites across the landscape. This state may be at higher risk of a stand replacement fire due to the contribution of excessive ladder fuels. Fire suppression may exacerbate this condition within this state and at sustained levels may promote a transition to alternative state 2 or 3.

Pathway P1.1b
Community 1.1 to 1.2

In the absence of low/mixed severity fire events or disease/insect outbreaks regeneration and recruitment will continue to occur in the stand eventually leading to densely stocked closed canopy conditions.

Pathway P1.1a
Community 1.1 to 1.3

Stand replacement fire shifts the stand to the early development phase. Secondary succession is initiated.

Pathway P1.2a
Community 1.2 to 1.1

Mixed fire events or endemic insect/disease impacts shift the stand structure to the mature, late development open, mature structural phase.

Pathway P1.2b
Community 1.2 to 1.3

Stand replacement fire transitions the stand to the early development plant community phase; Secondary succession is initiated. Re-establishment of the conifer portion of the stand is dependent on successful seedling recruitment and establishment, similar to community pathway 1.1B

Pathway P1.3b
Community 1.3 to 1.4

The absence of larger scale fire disturbance for ~ 40 years, along with a scattered seed source of adapted conifers in the establishment phase, develop over time to the open mid-development community phase. Early seral species such as Ponderosa pine, and lesser amounts of Douglas-fir and other adapted conifer species result in low levels of overall conifer occupancy (spotty recruitment and low-density development of conifers may also occur due to impacts of other on-going disturbance events). Under these conditions, the stand develops to an open young forest phase.

Pathway P1.3c
Community 1.3 to 1.5

Absence of larger scale fire disturbance for ~ 40 years, with abundant conifer recruitment (with low levels of other disturbance events), results in the progression to the closed mid-development structure phase.

Pathway P1.4a
Community 1.4 to 1.1

The canopy density remains low as the stand grows towards maturity, with limited levels of additional seedling recruitment of early seral species. Regular surface fires also help to keep young tree recruitment in check.

Pathway P1.4b
Community 1.4 to 1.3

A large-scale stand disturbance (such as a stand replacement fire, which would be a rare event given the nature of the fuels in plant community 1.4) shifts the stand back to community phase 1.3 (early development). The re-establishment of the conifer portion of the site is again dependent on the factors described in phase 1.3.

Pathway P1.5a
Community 1.5 to 1.2

In the absence of large-scale stand replacement or mixed fires for a short number of decades, the stand continues to develop towards the late-development, closed community phase. Surface fires can maintain an open understory, but in the relative absence of surface fires late seral grand fir and other shrub and grass species will increase in abundance.

Pathway P1.5b
Community 1.5 to 1.3

A large-scale stand disturbance (such as a stand replacement fire shifts the stand back to community phase 1.3 (early development). The re-establishment of the conifer portion of the site is dependent on the factors described in phase 1.3.

Pathway P1.5c
Community 1.5 to 1.4

Mixed fire events or endemic insect/disease impacts shift the stand structure to the young forest open canopy structural phase. In order for this to occur, the impacts of the disturbance would have to by patchy and small scale in nature.

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 and land managers, allowed many stands to progress without the natural occurrence of any fire, including frequent surface fires. The ecologic benefits of the low intensity fires were lost. Fire suppression 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 increased, shifting the fire regime/condition class toward a greater likelihood of stand replacement fire episodes. The overall consequences of the changes to the forest structure and function due to the combined management actions in the last century are: INCREASED • Stand Density • Shift towards mid and late seral species • Amount of understory and secondary stand levels of conifers • Fuel loads and risk of catastrophic high severity fires DECREASED • Large old pine and other fire adapted early seral species • Regeneration of early seral species • Habit for species of open stands of old pine forests • Decreased levels of snags and large organic debris • Reduction in soil quality due to loss of soil wood and organic matter • Decrease in genetic variation of early seral species

Dominant plant species

- grand fir (*Abies grandis*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- ponderosa pine (*Pinus ponderosa*), tree
- common snowberry (*Symphoricarpos albus*), shrub
- pinegrass (*Calamagrostis rubescens*), grass
- elk sedge (*Carex garberi*), grass

State 3
Catastrophic Fire

State 3 represents conditions immediately following a catastrophic, stand replacement fire. These types of fires, when they occurred within the historic context of the reference state, transitioned the stand to this alternative state if and when the vast majority of the cone producing conifers were eliminated by the fire, and when other sources of conifer recruitment are also absent (i.e. resulting in unstocked stand conditions). State 3 would infer a much longer post-fire stand recovery period compared to situations that normally existed in the reference state (where older relict, seed producing early and mid-seral seed sources existed). The basic natural resource values (especially soil quality) were generally preserved or quickly restored in these instances. State 3 could also result from catastrophic stand replacement fires that originate from conditions found in alternative state 2.1 and 4.1 (as shown on the state and transition diagram by the T2A and T4A transition symbols). The destructive heat generated impacts of these events are much greater than naturally occurring replacement fires, and in these instances the basic natural resource values (plants, animals, hydrology and especially soil quality elements) have been degraded and are very slow to recover. Natural sources for conifer recruitment are absent.

Dominant plant species

- spirea (*Spiraea*), shrub
- common snowberry (*Symphoricarpos albus*), shrub
- serviceberry (*Amelanchier*), shrub
- pinegrass (*Calamagrostis rubescens*), grass
- elk sedge (*Carex garberi*), grass
- heartleaf arnica (*Arnica cordifolia*), other herbaceous
- common yarrow (*Achillea millefolium*), other herbaceous
- lupine (*Lupinus*), other herbaceous

State 4
Loss of Conifers from High Levels of Root Disease

This state may seem to mimic the conditions of Alternative state 3.1 in that forest stocking is virtually non-existent, but the underlying cause leading to the unstocked condition and the recovery options are vastly different. In this state, immediate restoration by planting is not feasible because the root mass is still active in the soil, and young developing conifer seedlings will succumb to root disease mortality in a short period of time. Poorer quality sites are at greater risk of root disease occurrence and impacts, and species such as grand fir and Douglas-fir are most susceptible. Note that Alternative State 4.1 is at risk of catastrophic wildfire while fuel levels are in excess, which would transition the site to Alternative State 3.1 (by way of T4A.).

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- western larch (*Larix occidentalis*), tree
- common snowberry (*Symphoricarpos albus*), shrub
- spirea (*Spiraea*), shrub
- serviceberry (*Amelanchier*), shrub
- pinegrass (*Calamagrostis rubescens*), grass
- elk sedge (*Carex garberi*), 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 wide spread stand replacing fire event occurs as a natural event in any community phase of the reference state. A vast majority of the cone producing conifers are eliminated, but site quality values remains relatively intact.

Restoration pathway R2a
State 2 to 1

Treatment practices that reduce excessive ladder fuels (low thinning) and reduce overstory bulk density and continuity (crown and selective thinning) may provide immediate benefits in terms of reducing the potential of catastrophic wildfire. Other practices which reduce overstocking, or which shift species towards early seral species (pre-commercial and commercial thinning, tree planting), as well as introducing understory prescribed burning as a maintenance practice, can contribute to increased resiliency and will improve the ecologic function of the stand if done properly.

Transition T2a
State 2 to 3

Fuel build-up in Alternative State 2 results in a catastrophic wildfire, similar to that of T1B, but the likelihood of replacement fire and the intensity and detrimental impact(s) exceed historic norms.

Transition T2b
State 2 to 4

In the absence of catastrophic fire, the long-term site occupancy of mid to late seral Douglas-fir and grand-fir leads to increased levels of root disease, especially on poor quality sites, eventually excluding all conifer species from the site over time.

Restoration pathway R3a
State 3 to 1

Ponderosa pine and Douglas-fir are planted in order to overcome the virtual lack of adequate seed source of surviving Ponderosa pine, larch, or Douglas-fir of any size or age class. Natural recovery will be extremely long without tree planning efforts, up to many 100’s of years as Ponderosa pine and associated Douglas-fir and western larch slowly re-establish perimeter areas and migrate inwards by natural reproduction and under favorable circumstances. It is likely that persistent brush or grass/brush cover would exist for hundreds of years if un-planted. Soil quality is slow to respond to pre-fire levels, especially with the lack of soil organic wood input and other contributors to soil health.

Restoration pathway R4a

State 4 to 1

Reforestation, after the underground root infestation has receded to threshold levels, is applied. Site preparation may be necessary to control competition from brush and grass species

Transition T4a
State 4 to 3

Widespread catastrophic fire occurs similar to that of T2A, with varying levels of live and dead conifer individuals, along with abnormal levels of native brush species.

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:**

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:**

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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:

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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):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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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:**