USDA Natural Resources Conservation Service

Ecological site F043CY601OR
Cold Wet Conifer Mountains and Plateaus (ABLA/VASC-VAME)

Last updated: 9/08/2023
Accessed: 04/25/2024

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

MLRA notes

Major Land Resource Area (MLRA): 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)
Subalpine fir/grouse huckleberry (blueberry) - CES411 (modal)
Lodgepole pine(subalpine fir)/big huckleberry - CLS514
Lodgepole pine(subalpine fir)/big huckleberry/pinegrass - CLS516
Lodgepole pine(subalpine fir)/elk sedge - CLG322
Lodgepole pine(subalpine fir)/grouse huckleberry - CLS418
Lodgepole pine(subalpine fir)/western needlegrass - CLG11
Subalpine fir/big huckleberry - CES311
Subalpine fir/elk sedge - CAG111
Subalpine fir/heartleaf arnica - CEF412
Subalpine fir/queencup beadlily - CES314
Subalpine fir/twinflower - CES414
Subalpine fir/western (false) bugbane - CEF331

Plant Assoc. Of Wallowa-Snake Province (R6 E 255-86)
Subalpine fir/grouse huckleberry/Jacob's ladder - CES415 (modal)
Engelmann spruce/queencup beadlily - CEM222
Lodgepole pine (subalpine fir)/blue(big) huckleberry - CLF211
Lodgepole pine(subalpine fir)/big huckleberry - CLS515
Lodgepole pine(subalpine fir)/grouse huckleberry/Jacob's ladder - CLS415
Subalpine fir/big huckleberry - CES315

Subalpine fir/pinegrass - CEG312
Subalpine fir/queencup beadlily - CES131
Subalpine fir/skunkleaf polemonium - CEF411
Subalpine fir/twinflower - CEF221
Subalpine fir/twistedstalk - CEF311

U.S. National Vegetation Classification (NVC) Standard
Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest & Woodland - Group-219
Rocky Mountain Mesic-Wet Subalpine Fir-Engelmann Spruce Forest - Alliance-3614

Forest Service Ecological Sub-region
Blue Mountains - M332

LANDFIRE BpS model
Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland - 0910560

Ecological site concept

This Ecological Site occurs mainly on forested backslopes and summits of higher elevation mountain slopes, and plateaus. As one of the highest forest types in MLRA 43C, this site is often adjacent to subalpine meadows and parklands. In higher elevation mountain ranges such as the Elkhorns, Strawberries or Wallowas, forests and subalpine woodlands dominated by whitebark pine may occur above and adjacent to this site. This site has a cryic temperature regime and udic moisture regime. The climate is characterized by cold winters during which deep snowpacks accumulate, and cool, dry summers. Parent materials are derived from basalt or other igneous extrusive geologies (andesite, dacite, ignimbrites, etc.) with a thick mantle of volcanic ash and loess. Other geologies such as granitics or metavolcanics may also be present. These are well drained soils with adequate available water capacity. Subalpine fir generally represents late seral stages however Engelman spruce may be codominant, and other species such as grand fir, western larch, Douglas-fir, whitebark pine and lodgepole pine may be present. Major understory species may range from grouse whortleberry, thinleaf huckleberry, and twinflower, to elk sedge and Columbia brome.

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 warmer temperatures due to aspect or landscape position
F043CY605OR	**Cool Moist Conifer Mountains and Plateaus (PSME-PIPO/CARU)** Occupying adjacent soils with warmer and drier micro climates due to aspect or landscape position
R043CY801OR	**Cold Dry Subalpine Grasslands (FEVI)** Shallower soils, often on exposed, rocky positions with lower moisture holding capacity

Similar sites

F043CY603OR	**Cool Wet Conifer Mountains and Plateaus (ABGR/VAME/LIBO)** Frigid soil temperature regime, subalpine fir uncommon or absent
R043CY801OR	**Cold Dry Subalpine Grasslands (FEVI)** Shallower soils, often on exposed, rocky positions with lower moisture holding capacity

Table 1. Dominant plant species

Tree	(1) *Abies lasiocarpa*
Shrub	(1) *Vaccinium scoparium* (2) *Vaccinium membranaceum*
Herbaceous	Not specified

Physiographic features

As one of the highest elevation forest types in MLRA 43c, this site occurs primarily on upper elevation backslopes of mountain slopes and plateaus. Sites that occur on summit positions may be more exposed to desiccation by wind. Slopes are most commonly 7.5 - 45% but may be as steep as 65%. Slope profiles range from concave, to convex to linear across and down slope. Elevations are typically 5,750 to 6,550 (1,750 to 2,000 m) but may range from 4,900 to 9,000 ft (1,500 to 2,750 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	5,750–6,550 ft
Slope	8–45%
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	4,900–9,000 ft
Slope	0–65%
Ponding depth	Not specified
Water table depth	Not specified

Climatic features

The climate of this site is characterized by high elevation, intermountain patterns. Winters are cold and wet with deep accumulations of snow persisting into late spring or early summer. 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 lower. This site has a Cryic soil temperature regime and a Udic soil moisture regime typically experiencing fewer than 45 dry days per year. Mean annual precipitation is typically 30 - 52 in. (1,045 – 1,415 mm) but ranges from 25 – 65 in. (710 – 1,590 mm). Mean annual temperatures are typically 36 – 39°F (2 - 4 °C) but may range from 34 – 41°F (1 - 5°C). Frost free days average 15 to 70 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)	15-70 days
Freeze-free period (characteristic range)	

Precipitation total (characteristic range)	30-52 in
Frost-free period (average)	40 days
Freeze-free period (average)	
Precipitation total (average)	38 in

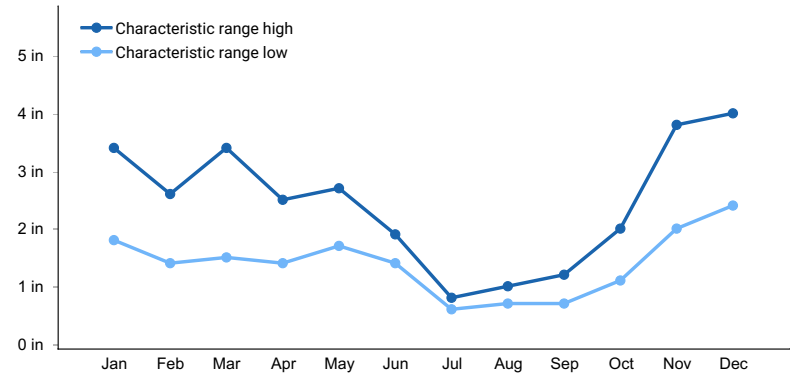


Figure 1. Monthly precipitation range

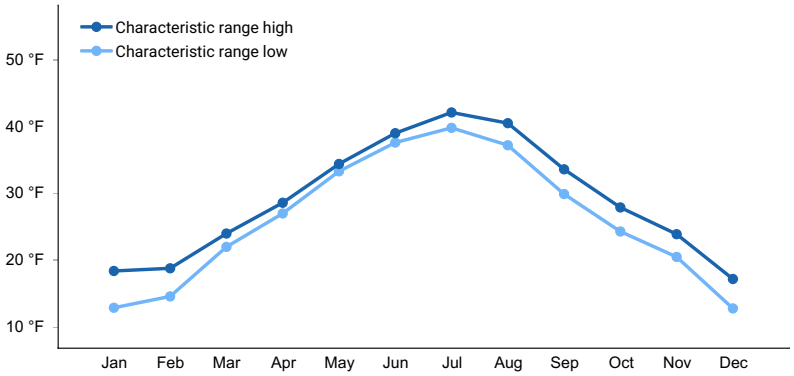


Figure 2. Monthly minimum temperature range

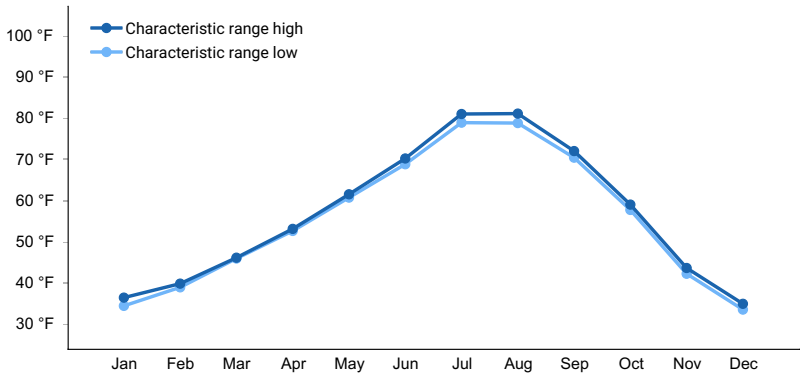


Figure 3. Monthly maximum temperature range

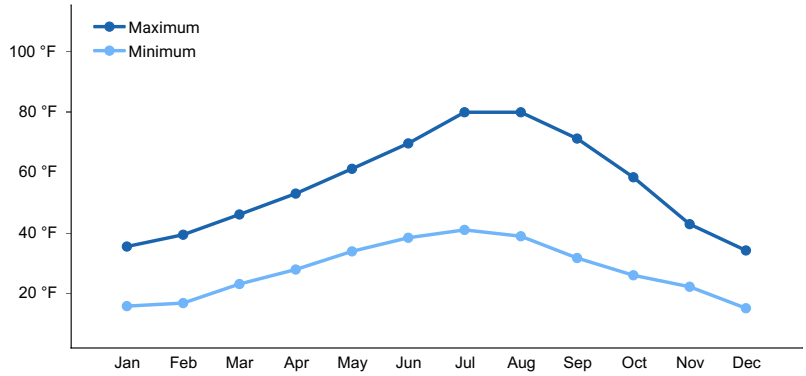


Figure 4. Monthly average minimum and maximum temperature

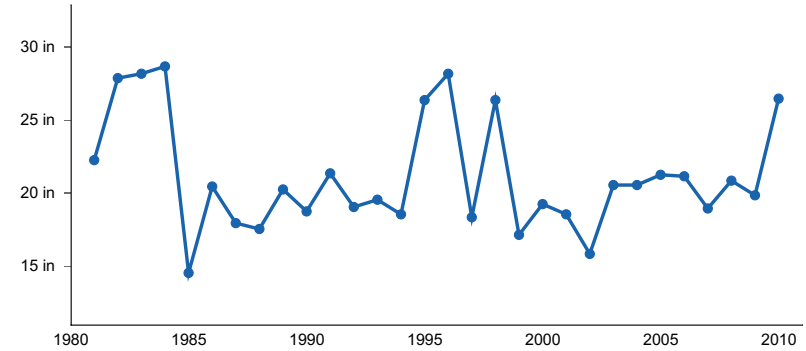


Figure 5. Annual precipitation pattern

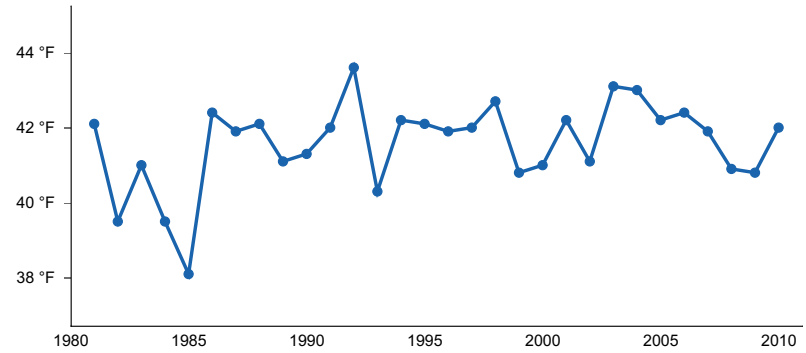


Figure 6. Annual average temperature pattern

Climate stations used

- (1) MEACHAM [USW00024152], Pendleton, OR
- (2) AUSTIN 3 S [USC00350356], Prairie City, OR
- (3) SENECA [USC00357675], Seneca, 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 moderately deep to very deep and well drained. Parent materials are diverse and typically composed of materials ranging from colluvium, residuum and glacial till derived from basalt, andesite, granite and argillite beneath thick mantles of volcanic ash. Surface textures are commonly silt loams and may be significantly ashy or stony. The family particle size is typically ashy over loamy skeletal or loamy skeletal but may also be ashy over loamy. See Troutmeadows, Mountemily, and Mudlakebasin for modal series concepts.

Table 5. Representative soil features

Parent material	(1) Colluvium–volcanic rock (2) Residuum–volcanic rock (3) Residuum–argillite (4) Residuum–granite (5) Volcanic ash–volcanic rock
Surface texture	(1) Gravelly silt loam (2) Ashy silt loam (3) Stony silt loam
Family particle size	(1) Ashy over loamy-skeletal (2) Ashy over loamy (3) 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)	4.6–10.4 in
Soil reaction (1:1 water) (0-40in)	5.1–7.3
Subsurface fragment volume <=3" (4-60in)	7–25%
Subsurface fragment volume >3" (4-60in)	5–25%

Ecological dynamics

Occurring in the high elevations of the Blue and Wallowa mountains, the reference plant community of this site at maturity is represented by a subalpine fir dominated forest. Engelman spruce (Picea Englemanii) may be subdominant or codominant at maturity, with other conifers such as lodgepole pine (*Pinus contorta*), western larch (*Larix occidentalis*) and Douglas-fir (Pseudotsuga menzisii) more common in younger forests. Douglas-fir and grand fir (*Abies grandis*) may be more common on warmer microsites within this concept, while whitebark pine (*Pinus albicaulis*) may be present toward the coldest, upper elevation limits of the site. The modal concept for this site is the USFS plant association, subalpine fir/grouse huckleberry (ABLA/VASC) yet the breadth of the concept also includes plant associations such as subalpine fir/grouse huckleberry/Jacob's ladder, subalpine fir/big huckleberry, subalpine fir/twinflower and subalpine fir/pinegrass. The understory of mid development and mature forests is often characterized by shrubs and herbaceous species such as grouse whortleberry (*Vaccinium scoparium*), thinleaf huckleberry (*Vaccinium membranaceum*), prince’s pine (*Chimaphila umbellata*), twinflower (Linnea borealis), heartleaf arnica (*Arnica cordifolia*), pinegrass (*Calamagrostis rubescens*), elk sedge (*Carex geyeri*), Ross’ sedge (*Carex rossii*), Columbia brome (*Bromus vulgaris*) and Oregon boxwood (Pachistima myrsinites).

These forest sites were historically subject to relatively infrequent, stand replacing and mixed severity wildfires approximating Landfire fire regime 3,35-100+ year frequency, mixed severity (Landfire 2007). Both mixed and stand replacement fires occurred at roughly equal frequencies, with an average estimate of 125 for any fire event. Surface fires were largely absent from this forest type. Fire frequency is influenced by the cold, wet climate and intensity is influenced by the low fire resistance of the dominant tree species. The two most common conifers on this site at maturity, subalpine fir and Engelman spruce, share very low resistance to fire with high mortality occurring even with low intensity fires. This is the result of shallow rooting, thin bark and low hanging branches that characterize both species. Following fire, lodgepole pine will often dominate young tree regeneration due to its prolific seed production and establishment on newly burned sites. Engelmann spruce also produces high amounts of viable seed and may be common following disturbance, whereas subalpine fir often regenerates later in the subcanopy. The superior shade tolerance of Engelmann spruce and subalpine fir in comparison to lodgepole pine, will help to allow

them to dominate the canopy overtime in the absence of fire. This is common within the reference conditions, yet sites experiencing more frequent fire will tend toward forest compositions with higher proportions of lodgepole pine, sometimes persisting for 100s of years.

Western larch is also common following disturbance and given adequate light will grow quickly. With thick bark at maturity, western larch is highly resistant to fire and large individuals may persist in mature stands. Douglas-fir is common on warmer microsites such as southern aspects or the lower elevations of this site. Like western larch, older individuals are highly fire resistant and may survive in mature stands. Grand fir may be present on lower elevation sites and is especially common during early regeneration and young forest phases. As a shade tolerant conifer, it may also regenerate in mature stands where sites are favorable.

Many of the common understory shrubs and graminoids species of this site are adapted to resprout following fire. Both big huckleberry and grouse huckleberry will resprout, with big huckleberry sometimes following after grouse huckleberry. Pinegrass and elk sedge will resprout from rhizomes in addition to some forbs such as heartleaf arnica which may increase following fire. Understory composition will change overtime with canopy closure and subsequent alteration of surface microclimates. Relative cover of grouse huckleberry will decrease with canopy closure as big huckleberry increases somewhat.

In addition to fire disturbance, this ecologic site is also impacted by periodic windthrow, and by significant insect and disease disturbances that affect major tree species. Of particular interest are spruce beetles which can kill both mature subalpine fir and Engelman spruce trees, and mountain pine beetle which targets lodgepole pine, especially mature trees. The interactions of the disturbances are described in the Landfire BPS model 0710550, Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland. The state and transition model below is largely based on the dynamics described in this BPS.

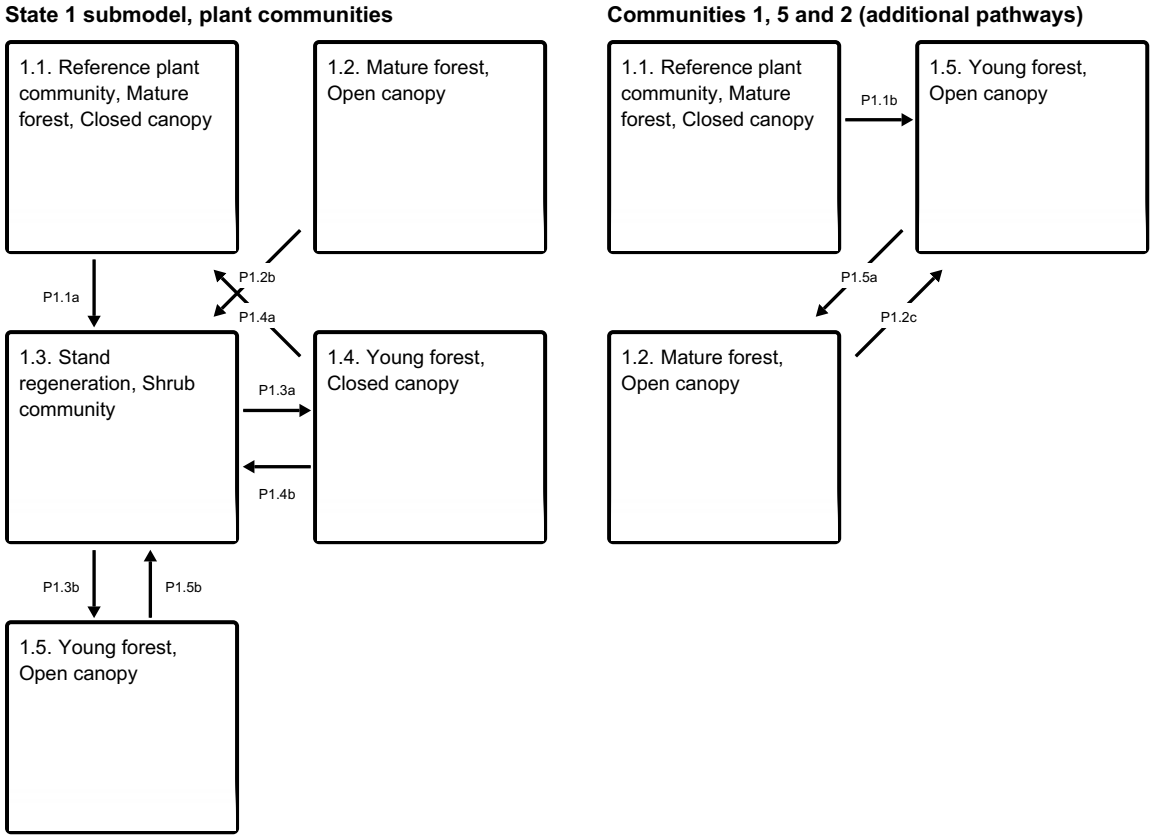
More protected sites with less droughty or windswept aspects may include dynamics that include those described in the Landfire BPS model 0710560 Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland, which has a somewhat longer replacement fire return interval and includes root diseases as a disturbance agent. Note that Balsam wooly adelgid is not present in this historical reference model since it is an introduced insect, despite currently contributing to high mortality of true firs.

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). While these changing conditions are likely to impact lower elevation forests first, catastrophic fire may carry through to higher elevation forests. However, when combined with the interacting impacts of drought and insect outbreaks, it is possible that this ecological system will experience unpredictable ecosystem shifts and additional alternative states. Further, while the effects of climate change may contribute to transitions of this forest type to species adapted to warmer and drier climates, further research is required to confidently model these impacts. For this reason, this scenario has not yet been included as a potential alternative state.

State and transition model

Ecosystem states

1. Historical reference state



P1.1a - Mixed or stand replacement fire, Epidemic outbreak of spruce beetle

P1.1b - Small scaled spruce beetle (or equivalent) disturbance

P1.2b - Stand replacement fire (MFRI ~200 years), or insect or disease epidemic of similar magnitude

P1.2c - Epidemic insect mortality

P1.3a - Time elapses, allowing for stand development

P1.3b - Time elapses with frequent disturbance and/or low regeneration rates

P1.4a - Time elapses allowing for stand maturation

P1.4b - Stand replacement, or extensive mixed fire, or similar stand impact by insect/disease disturbance

P1.5a - Time elapses, allowing for stand development

P1.5b - Stand replacement, or extensive mixed fire, or similar stand impact by insect/disease disturbance

State 1
Historical reference state

The historical reference state of this ecological site was influenced by a variety of disturbance elements, including the impacts of mixed and stand replacement fires which occurred on a relatively infrequent basis. Disturbances to the ecologic site also came in the form of other biotic and abiotic factors, most notably from larger scaled insect and disease mortality. Although the impact of wildfire was a less dominant disturbance agent compared to warmer and drier forests, it was still an important factor in the ecological processes of these forests. Given the high elevation of this site, potential constraints to timber production and ecological resilience to altered disturbance due to high precipitation, no alternative states are described.

Dominant plant species

- subalpine fir (*Abies lasiocarpa*), tree
- grouse whortleberry (*Vaccinium scoparium*), shrub
- thinleaf huckleberry (*Vaccinium membranaceum*), shrub
- elk sedge (*Carex garberi*), grass
- pinegrass (*Calamagrostis rubescens*), grass
- Columbia brome (*Bromus vulgaris*), grass

Community 1.1

Reference plant community, Mature forest, Closed canopy

The closed community phase is the most common representation of this ecological site at stand maturity. Canopy closure is typically 40-70% and mixed aged stands are common. Large trees dominate the overstory where Engelmann spruce and subalpine fir are often co-dominant. Subalpine fir is likely the only tree species regenerating in the understory of the closed canopy. Understory vegetation is sparse, grouse huckleberry may decline with big huckleberry present in openings and shade tolerant forbs in understory. Some lodgepole pine stands are present but most have succumbed to age and density related insect mortality, however viable seed is often available and lodgepole regeneration is likely.

Community 1.2
Mature forest, Open canopy

This phase is characterized by mature, large trees with canopy coverage of 10-40%. The open nature of the stand persists from the mid development phase where the canopy closure and proximity to un-stocked areas are mainly the result of site limitations. Mountain pine beetle continue to attack and remove the over mature lodgepole pine within the stand, providing opportunity for the establishment of early to mid-seral species in the resulting openings.

Community 1.3
Stand regeneration, Shrub community

Some sites will take a long period of time to regenerate to tree cover, fire adapted shrubs dominate the site and rhizomatous herbaceous species are common. Grouse huckleberry may precede the establishment of big huckleberry. Establishment of conifer seedlings is dependent on many factors, but the overall ecologic site is harsh and proximity to conifer seed source and site conditions is vital. Dense stands of lodgepole pine can develop depending on seed source and opportunity, and aspen reemergence is common where conditions are favorable.

Community 1.4
Young forest, Closed canopy

Areas of Engelmann spruce and subalpine fir establish, depending on site conditions and seed availability, canopy cover is 30-60%. Limited smaller areas of pure, dense lodgepole pine are found interspersed within the larger landscape. As these pine stands grow and mature, individual lodgepole trees will experience endemic mountain pine beetle mortality. Subalpine fir typically establishes in the understory shade of both spruce and lodgepole stands.

Community 1.5
Young forest, Open canopy

Open canopy stands may be a result of inherent site limitations or periodic disturbances such as bark beetle outbreaks. Inherent factors include the impact of persistent snowpack in drainage ways (expressing as “ribbon forests”), or soil limitations, for example shallow soils, or harsh climatic damage, such as constant wind, snow and ice injury to individual trees. These open stands are often transitional to high elevation tundra or dwarf shrub plant communities.

Pathway P1.1a
Community 1.1 to 1.3

Mixed or stand replacement fire MFRI (“mean annual return interval”) of ~125 for either of these types, transition the stand to community phase 1.3. Epidemic outbreak of spruce beetle (or another insect/disease impact of similar scale) may also transition the stand to phase 1.3 depending on the degree and extent of tree mortality.

Pathway P1.1b
Community 1.1 to 1.5

Small scaled spruce beetle (or equivalent) disturbance transitions the stand to community phase 1.5. Surviving remnant older spruce and fir provide seed for regeneration, or regeneration comes from nearby seed sources in relatively undisturbed parts of the larger landscape forest.

Pathway P1.2b
Community 1.2 to 1.3

A stand replacement fire (MFRI ~200 years), or an epidemic insect or disease impact of similar magnitude, moves the stand back to the early development community phase.

Pathway P1.2c
Community 1.2 to 1.5

Epidemic insect mortality moves the stand back to mid-development phase.

Pathway P1.3a
Community 1.3 to 1.4

In the absence of frequent disturbance and with high regeneration rates, the stand develops in time to closed, mid-development phase.

Pathway P1.3b
Community 1.3 to 1.5

With frequent disturbance and/or low regeneration rates, the stand develops in time to an open, mid-development phase.

Pathway P1.4a
Community 1.4 to 1.1

Stand grows and develops to closed, late development phase.

Pathway P1.4b
Community 1.4 to 1.3

Stand replacement, or extensive mixed fire, or similar stand impact by insect/disease disturbance (e.g. spruce beetle outbreak).

Pathway P1.5a
Community 1.5 to 1.2

Stand grows and develops to open, late development phase. Especially common in the absence of frequent disturbance and with high regeneration rates.

Pathway P1.5b
Community 1.5 to 1.3

Stand replacement, or extensive mixed fire, or similar stand impact by insect/disease disturbance (e.g. spruce beetle outbreak).

Additional community tables

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United States National Vegetation Classification (2008) - A3643 Rocky Mountain Dry-Mesic Subalpine Fir-Engelmann Spruce Forest.

Contributors

Andrew Neary - Concept development for 2020 PES initiative
Kurt Moffit - Initial PES grouping

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:**

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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:

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17. **Perennial plant reproductive capability:**
