USDA Natural Resources Conservation Service

Ecological site F044AF004MT
Montane Moderately Warm Dry Coniferous Pend Oreille-Kootenai Valleys Douglas fir/common snowberry

Last updated: 5/01/2024
Accessed: 05/17/2024

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): 044A–Northern Rocky Mountain Valleys

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This ecological site resides within the NRCS land classification of MLRA 44A. This MLRA includes the northern portion of the Northern Rocky Mountain Valleys Province of the Rocky Mountain System. The mountain valleys are deeply dissected and are typically bordered by mountains trending north to south. The nearly level broad flood plains are bordered by gently to strongly sloping terraces and alluvial fans. The surrounding mountains and in some areas the valleys experienced glaciation. The average precipitation is 12 to 16 inches generally, though can vary widely. The dominant soil orders are Inceptisols, Mollisols and Andisols. The valleys support coniferous forests, shrublands and grasslands.
The area of MLRA 44A is huge and is in the process of being restructured into new MLRAs further divided into new Land Resource Units (LRU). A detailed description of MLRA 44A can be found at:
https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053624

LRU notes

This ecological site group currently resides in the Major Land Resource Area (MLRA) 44A Northern Rocky Mountain Valleys. The landscape is valleys with landforms including floodplains, stream and outwash and lacustrine terraces, foothills and glacial moraines. Glaciation of this area was in the form of alpine, icecaps, and valley outlet glaciers. It also includes associated alluvium and outwash features. The geology of this area is predominantly alluvium and Belt series (Missoula group) and minor Glacial lake deposits. The valleys in this area have elevations ranging 545 to 1680m, with the mean elevation being 855m. The climate is cold and wet with mean annual air temperature of 8 degrees, mean frost free days of 106 days and mean annual precipitation of 863mm. The relative effective annual precipitation is 88cm. The soil temperature regime is frigid and the soil moisture regime is udic and xeric. Soils are generally very deep, moderately to well developed and formed in alluvium, glacial outwash and till from metasedimentary parent materials. The geology of this area is predominantly alluvium and Belt series (Missoula group) and minor Glacial lake deposits. Soils tend to be well drained, slightly acidic to slightly alkaline soils with skeletal silt loam, loam and sandy loam textures. Poorly drained soils are present, but are generally confined to areas along riparian corridors.Volcanic ash influenced soils occur here as well, but tend to be limited to stable footslope positions above the valley floor. There are numerous large lakes and reservoirs including Pend Oreille Lake, Priest Lake, Noxon Reservoir, Cabinet Gorge Reservoir, Bull Lake and numerous short rivers and creeks.

Ecological site concept

•It occurs primarily on rolling and hilly plains, and mountain slope landforms, on backslope positions, on moderate to steep slopes ranging 10-30% (rarely 50%), at elevations ranging 650-900 meters.
•Vegetation is an overstory of Douglas fir and an understory of patchy common snowberry, serviceberry and white spirea, and a ground hugging layer of creeping barberry and kinnickinnik with abundant rhizomatous grass

species of pinegrass and some perennial bunchgrasses blue wildrye, rough and Idaho fescues
•Site does not receive any additional water
•Soils are:
- o deep or very deep
- o surface with less than 15% stone and boulder cover
- o well drained; derived from glacial till
- o loamy textured; can have subsurface skeletal material typically gravels and/or cobbles
- o not strongly or violently effervescent within surface mineral 4”
- o not saline or sodic
- o not coarse-granular clay

Associated sites

F044AF001MT	**Lower Subalpine Moderately Warm and Moist Coniferous Pend Oreille-Kootenai Valleys grand fir/bride's bonnet** This associated ecological site occurs in areas that have slightly more moist site conditions such as higher elevations or north or east aspects.

Similar sites

F044AP902MT	**Shallow Warm Woodland Group** This similiar site has drier site conditions like this ecological site and the overstory is dominated by Douglas fir.

Table 1. Dominant plant species

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

Physiographic features

This site is found in well drained mountain slopes and valleys that span the lower elevations, and at higher elevations on southern and western aspects. At lower elevations it is bordered by ponderosa pine sites or grasslands, and at higher elevations by subalpine fir sites. This group is mainly on rolling and hilly plains, mountain slope landforms, and on backslope positions. The slopes range from moderate to steep, approximately 10 to 30 percent (rarely 50 percent), at elevations ranging 650 to 900 meters.

Table 2. Representative physiographic features

Landforms	(1) Valley > Outwash plain (2) Mountains > Mountain
Elevation	183–274 m
Slope	10–30%
Water table depth	152 cm
Aspect	W, NW, N, NE, E, SE, S, SW

Table 3. Representative physiographic features (actual ranges)

Elevation	275 m
Slope	6–50%
Water table depth	Not specified

Climatic features

This ecological site group is found in the frigid soil temperature regime and the udic soil moisture regime. The frigid soil temperature regime has average annual temperature less than 8 degrees C, with more than 5 degrees C summer-winter fluctuation. The udic soil moisture regime denotes that the rooting zone is usually moist throughout the winter and most of summer. Because this site is found on the west side of the Continental Divide, it also has more maritime weather influences.

Table 4. Representative climatic features

Frost-free period (characteristic range)	72-79 days
Freeze-free period (characteristic range)	126-129 days
Precipitation total (characteristic range)	457-559 mm
Frost-free period (actual range)	71-80 days
Freeze-free period (actual range)	125-130 days
Precipitation total (actual range)	457-610 mm
Frost-free period (average)	76 days
Freeze-free period (average)	128 days
Precipitation total (average)	508 mm

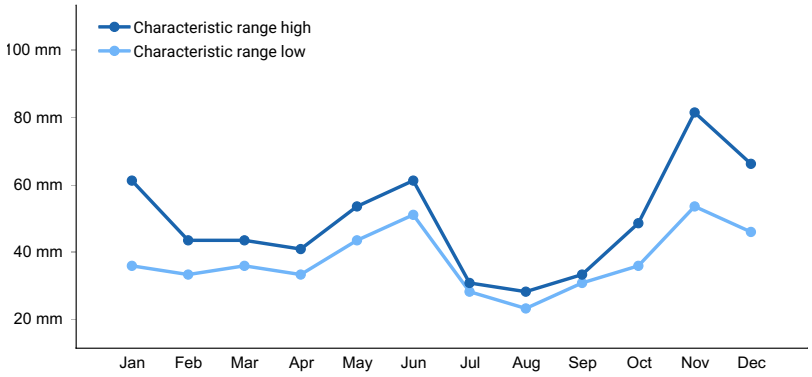


Figure 1. Monthly precipitation range

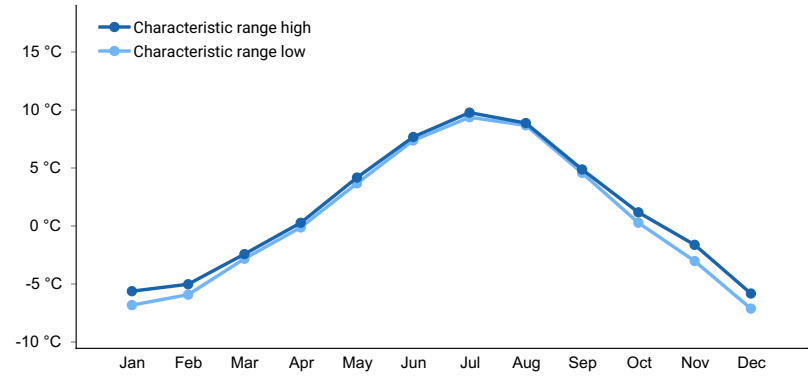


Figure 2. Monthly minimum temperature range

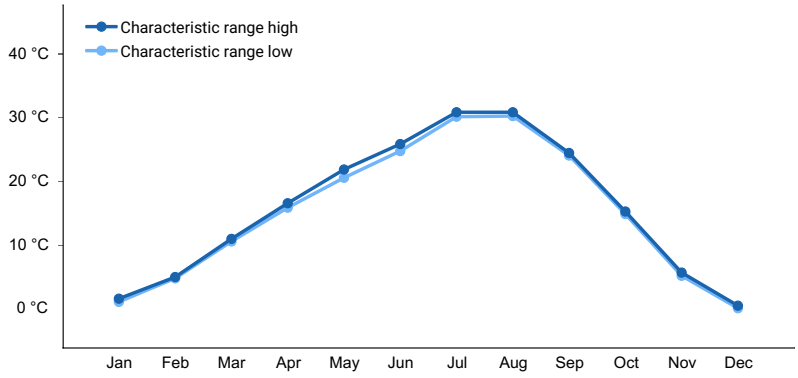


Figure 3. Monthly maximum temperature range

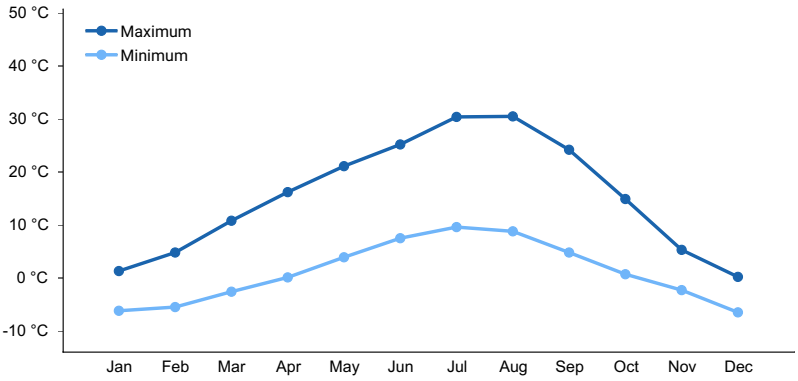


Figure 4. Monthly average minimum and maximum temperature

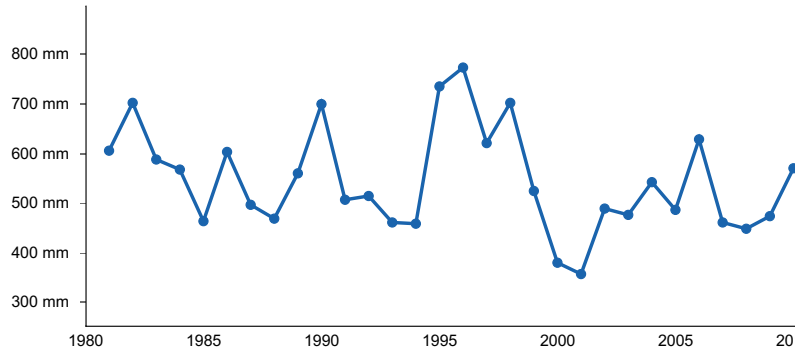


Figure 5. Annual precipitation pattern

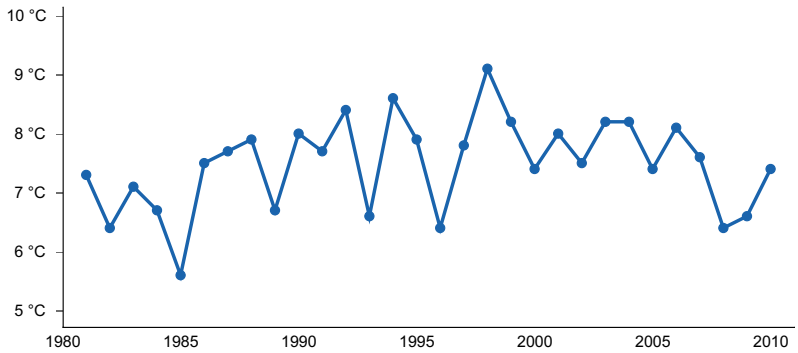


Figure 6. Annual average temperature pattern

Climate stations used

- (1) TROY [USC00248390], Troy, MT
- (2) LIBBY 1 NE RS [USC00245015], Libby, MT
- (3) ALBERTON [USC00240075], Alberton, MT

Influencing water features

This ecological site group is not influenced by wetland or riparian water features.

Soil features

Soils associated with this ecological site are typically deep or very deep, well drained to somewhat excessively drained and derived from outwash and colluvium from argillite and quartzite. Soil textures are loamy, but commonly contain some amount of rock fragments and can have skeletal subsurface horizons. These horizons have a high amount of rock fragments (greater than 35 percent by volume) and relatively lower water-holding capacity. The soils are typically classified in Eutrudepts soil order. The deep and very deep depth class means that there is no bedrock encountered within 100 cm. As is common with forested soils, there is often a thin surface layer of slightly decomposed organic material that is less than 5 cm thick.
Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - 0 to 9 inches (Oi, A, E1 horizons);
Albic horizon - 5 to 24 inches (E1, E2 horizons);
Cambic horizon - 24 to 60 inches (E/Bw horizon); and
Particle-size control section - 10 to 40 inches (E1, E2, E/Bw horizons).

Tevis soils have a frigid temperature regime and a udic moisture regime. (Soil Survey Staff, 2015).

For more information on soil taxonomy, please follow this link:
http://http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/class/?cid=nrcs142p2_053580

Table 5. Representative soil features

Parent material	(1) Outwash–argillite (2) Colluvium–argillite
Surface texture	(1) Gravelly loam
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderate to moderately rapid
Soil depth	99–150 cm
Soil reaction (1:1 water) (0-101.6cm)	5.6–7.3

Ecological dynamics

►OVERVIEW:
The 44A Montane Warm Dry Coniferous ecological site group is found in open growing stands of Douglas-fir (*Pseudotsuga menziesii*) at lower elevations, but is also found at higher elevations on southerly and westerly aspects. The overstory is dominated by Douglas-fir, with minor amounts of western larch (*Larix occidentalis*) or ponderosa pine (*Pinus ponderosa*) at lower elevations. Douglas-fir and ponderosa pine are well adapted to fire due to a thick bark at maturity which protects the cambium layer from overheating. The understory has patchy white spirea, serviceberry, and common snowberry with abundant rhizomatous grass species of pinegrass and lower cover of perennial native bunchgrasses such as rough fescue, Idaho fescue and blue wildrye. The overstory can be multi-storied Douglas-fir or an open, park-like single story. Douglas-fir is moderately shade-tolerant compared to associates ponderosa pine, western larch, and lodgepole pine (*Pinus contorta*), which are all intolerant of shade. Frequent, low severity wildfires had historically maintained open, park-like stands. All four species are adapted to the historic fire regime as they regenerate well following disturbance, especially when mineral soils were exposed. Mineral soil exposure is a key factor in regeneration of ponderosa pine and western larch (and, to a lesser degree, lodgepole pine). Ponderosa pine and western larch live about 300 to 400 years, whereas lodgepole pine live approximately 150 to 200 years (Fischer, 1987). In the absence of naturally occurring wildfire, Douglas-fir is the only species that continues to regenerate in any abundance and thus gradually becomes dominant in undisturbed stands. In this ecological site, Douglas-fir is present in all seral stages with lodgepole pine and western larch, and ponderosa pine is present in the lower-elevation sites. The understory has an abundance of rhizomatous grasses, pinegrass and the medium-sized shrubs common snowberry (*Symphoricarpos albus*), Saskatoon serviceberry

(*Amelanchier alnifolia*), creeping barberry (*Mahonia repens*), white spirea (*Spiraea betulifolia*), kinnikinnick (*Arctostaphylos uva-ursi*) and infrequently thinleafed huckleberry (*Vaccinium membranaceum*). Other grass species having lower cover include rough fescue, Idaho fescue, mountain brome and Geyer's sedge. There are diverse forbs present at the site including common yarrow, American vetch, white hawkweed, northern bedstraw, sweetcicely, heartleaf arnica and onion species. These shrubs are also adapted to frequent, low-severity fire regimes due to the ability to resprout from root crowns or rhizomes after the low-intensity fire removes the aboveground portion of the plants. Specifically, Saskatoon serviceberry resprouts from root crowns. Common snowberry, white spirea, and thinleaf huckleberry (*Vaccinium membranaceum*) sprout from rhizomes. McLean (1970) describes the response to fire for common snowberry, white spirea, as "resistant," with taproots or a fibrous root system with rhizomes 5-13 cm deep. Pinegrass (*Calamagrostis rubescens*), creeping barberry, and heartleaf arnica (*Arnica cordifolia*) are considered "intermediate," with shallower rhizomes. The "susceptible" category includes the western rattlesnake plantain (*Goodyera oblongifolia*) and the Pyrola species, although these species are rarely found at this site. Twinflower (Linnea borealis) found rarely in trace cover has rhizomes in duff, kinnikinnick has fibrous roots and stolons, and white hawkweed (*Hieracium albiflorum*) resprout with fibrous roots only. Snowbush ceanothus germinates from fire-stimulated seed, and fireweed produces many windborne seeds that will recolonize sites from unburned areas. If present at this site, these two species can dominate the re-initiation phase.

This ecological site group corresponds to the USFS Habitat Types of Douglas Fir/common snowberry phase common snowberry and phase pinegrass. The difference between the habitat types is primarily the proportional amounts of common snowberry and pinegrass. These have management implications in that common snowberry resprouts after disturbance and can dominate the understory for a period of time. The pinegrass phase has less common snowberry and post disturbance management would not have to include shrub removal. The common snowberry phase has an understory that has at least 5 percent canopy cover of common snowberry, regardless of grass or forb abundance. There is a sub-phase of pinegrass in which pinegrass cover is at least 5 percent. The pinegrass phase has an understory of less than 5 percent common snowberry and at least 5 percent cover of pinegrass. These two phases can be very similar and are managed similarly, unless common snowberry has very high cover which would increase post-disturbance. Therefore, at a very shrub dominated understory forest, post-disturbance restoration would need to include shrub management.

►FIRE REGIME DESCRIPTION:
This ecological site occurs on moderately warm and dry sites. The open, park-like stands of this ecological site were historically maintained by fires of low to moderate severity that had a return interval of approximately 36 years and stand replacing fire frequency of 141 years (Barrett, 1991). This relates to Fire Group Six: moist Douglas fir habitat types with mean fire intervals of 16 to 42 years (Fischer, 1987). Douglas fir habitat type forests on the Bitterroot, Lolo and Flathead National Forests had historic mean fire intervals ranging 25 to 49 years (USFS, FEIS, PSEMENG page). This fire regime is called mixed severity because fires range from low to moderate severity surface fires at relatively frequent intervals (7 to 20 years) to severe crown fires at long intervals (50 to 400 years). Frequent fires of moderate intensity favor lodgepole pine and western larch survival and regeneration over Douglas-fir. In the absence of short-interval understory burns, severe stand-replacement fires can occur on this ecological site if a closed canopy configuration develops along with the development of dense understories, resulting in a build-up of hazardous fuels at all levels, especially in periods of severe drought. Stand-replacement fires can favor lodgepole pine, especially if there is a serotinous cone seedbank. The average fuel loading is 12 tons per acre but can be much heavier. Fire as an agent for seedbed preparation is less important for this ecological site group, since Douglas-fir can grow in multiple types of seedbeds.

Forest succession after disturbance follows the stand initiation phase of herbs, shrubs, and seedlings to the competitive exclusion phase of dense pole-sized seral tree species, to the maturing forest stage, and with no further disturbance, the reference phase (Fischer, 1987). Douglas-fir can be present in all seral stages along with lodgepole pine, western larch, and ponderosa pine, especially at lower elevations. Quaking aspen (*Populus tremuloides*) also has been found in seral succession on certain sites. After a stand-replacement fire, grass, forb, and shrub species dominate the site with seedlings of tree species, usually Douglas-fir, western larch, and lodgepole pine. The composition of trees post-fire depends on patch size and adjacent, soil-banked conifer seed sources. If another fire occurs, then this phase would be maintained for longer. Without disturbance, the seedlings grow into saplings. Fire in the sapling stage would thin stands if ponderosa pine or western larch are dominant or eliminate Douglas-fir and lodgepole pine where these are dominant. Pole-sized Douglas-fir, western larch, and ponderosa pine would survive low to moderate fires, whereas severe fires would kill all trees and return the site to the stand initiation phase (Fischer, 1987). In the mature phase, low to moderate severity fires would thin the

overstory and understory, while severe fire would return the site to the stand initiation phase. The reference phase is rare, because of the presence of seral species whose longevity is greater than the usual fire return interval, except where Douglas-fir is also the dominant seral species. Frequent low to moderate severity fires create the open, park-like stands of the reference phase, but severe fire would return the site to the stand initiation phase (Fischer, 1987).

►PEST AND DISEASE DESCRIPTIONS:
Douglas-fir is subjected to a variety of diseases and insect pests including Armillaria and Annosus root diseases, Schweinitzii root and butt rot, laminated root rot, pouch and red belt fungus, pini rot, metallic wood borers, roundheaded borers, Douglas-fir beetle, blue-stain of sapwood, spruce canker, fir canker, Douglas-fir dwarf mistletoe, western spruce budworm, Douglas-fir needle midge, and Swiss and Rhabdocline needlecast (Hagle, 2003). Ponderosa pine, a seral species in this group, is highly susceptible to western pine beetle, pine engraver beetle, and mountain pine beetle during extreme epidemic conditions or in conjunction with drought (Hagle, 2003). Lodgepole pine is also a seral tree species found in this ecological site group and is a primary host for bark beetles. In seral stands with high composition of ponderosa pine and/or western larch, dwarf mistletoe, western gall rust and atropellis canker can occur (Hagle, 2003).

Aerial photography is a good tool to use to discern the levels of insect and disease, the damage patterns, and whether these are at endemic or epidemic levels. These maps capture only moments in time, and infestations grow and move from location to location following their preferred habitat, so repeated photography can be necessary. For the northern region, the major impact is from defoliation by western spruce budworm, occurs mostly on subalpine fir-Engelmann spruce forests, and to a lesser degree on Douglas-fir-dominated stands. As the name implies, the Douglas-fir beetle attacks Douglas-fir, with the greatest mortality occurring in stressed stands or on stressed individuals. Larch casebearer, a defoliator of western larch, and generalized needlecast of western larch was also found to a much lesser degree. Scattered smaller polygons were also found throughout the region, including mortality from mountain pine beetle on lodgepole pine.

►MANAGEMENT:
Various management strategies can be employed for this ecological site, depending upon the ownership of the land and which values are prioritized. The management of the forest determines the composition of the stand and the amount of fuel loading. A stand will be managed differently and look differently if it is managed for timber or ecological services like water quality and quantity, old growth, or endangered species. If a stand is managed for timber, then it may be missing certain attributes necessary for lynx habitat. If a stand is managed for lynx habitat, it may have increased fuels and therefore an increased risk of wildfires.

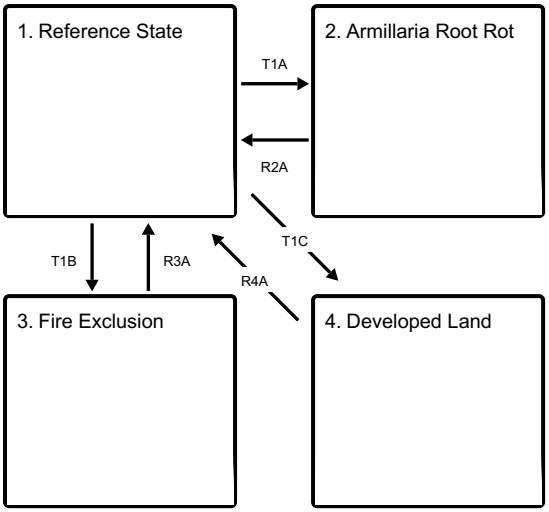
This ecological site relates to the USFS Habitat Type PSME/SYAL (Pfister, 1977). The USFS Habitat Type guide states that the basal area on the WEST side of the Continental Divide for is 172+/-23 ft2 per acre and site index at 50 years for Ponderosa pine=54, Douglas fir=52. The basal area taken at eight sites in the Tobacco Valley averaged 140 square feet per acre of basal area (range of 100-186). All of the sites had been somewhat recently thinned. Of note, the USFS Habitat Type guide states that the basal area on the east side of the Continental Divide is 196+/-26 ft2 per acre, and the site index is at 50 years for PIPO=43, PSME=41 (Pfister, 1977).

Timber production ranges from low to high and site preparation must take into account the abundance of rhizomatous grasses and management of common snowberry and other resprouting shrubs post-disturbance (Pfister, 1977).

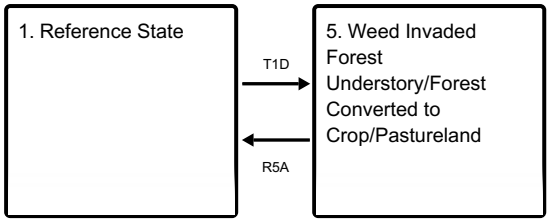
A guiding USFS document is the Green et al. document (2005) which defines “Old Growth” forest for the northern Rocky Mountains. This document provides an ecologically-based classification of old growth based on forest stand attributes including numbers of large trees, snags, downed logs, structural canopy layers, canopy cover, age, and basal area. This document finds that the bulk of the pre-settlement upland old growth in the northern Rockies was in the lower elevation, ground fire-maintained ponderosa pine/western larch/Douglas-fir types (Losensky, 1992).

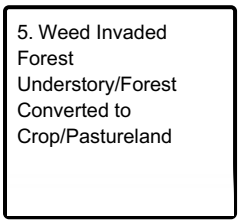
State and transition model

Ecosystem states



States 1 and 5 (additional transitions)





T1A - If a stand sustains very high levels of roots disease mortality, then a forest stand could cross a threshold and become a shrubland once all trees are gone (Kimsey et al., 2012).

T1B - Fire exclusion over long periods allowing stands to grow into homogenous multi-storied stands

T1C - Development on forest stands in which timber harvest, private housing development or road building has occurred.

T1D - Forest stand with understory dominated by weedy invasive species or forest converted to cropland or pastureland.

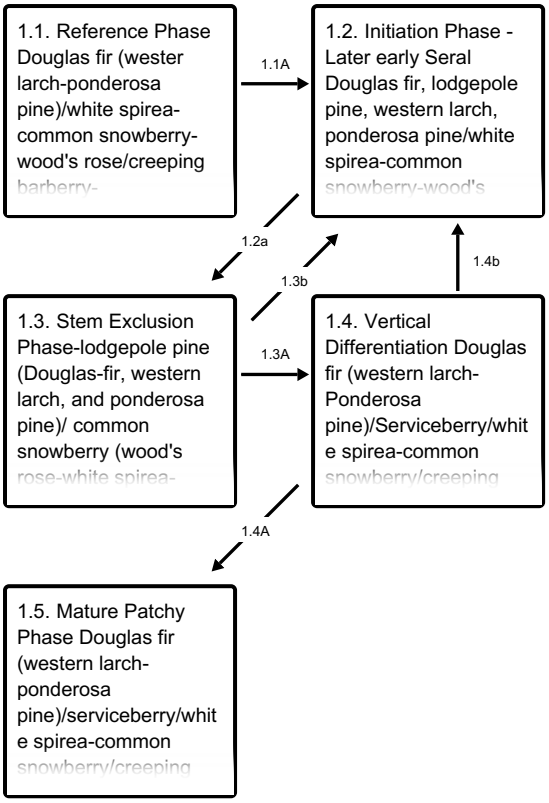
R2A - Forest management practices to convert shrubland back to forest including tree planting of less Armillaria Root Rot sensitive tree species

R3A - Forest stands restored by overstory thinning, ground and ladder fuels reduction, prescribed fire and seeding of native grasses and forbs.

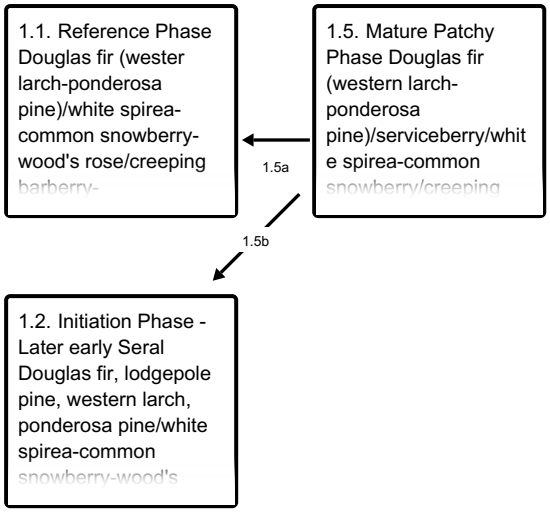
R4A - Development that has caused smaller forest patch sizes and changes to structure cease, restoration efforts on building areas, roads and harvested areas occur including tree planting and other measures.

R5A - Weed eradication measures to reduce or eliminate weedy species on site and usually restoration measures to increase cover of native vegetation community for weedy understory community. Afforestation through planting of native trees /shrubs and seeding of native grasses and forbs, treatment of invasive plants and Time for the forest converted to crop or pastureland community.

State 1 submodel, plant communities



Communities 1, 5 and 2 (additional pathways)



1.1A - This pathway represents a larger disturbance, such as an insect infestation, wind storm, or rot pocket to create this forest structure. Areas of regeneration range from approximately 2 to 5 acres.

1.2a - Time without disturbance allows seedlings to mature to pole sized trees with high overstory canopy cover.

1.3b - This pathway represents a larger disturbance, such as an insect infestation, wind storm, or rot pocket to create this forest structure. Areas of regeneration range from approximately 2 to 5 acres.

1.3A - This pathway represents continued growth over time with no further major disturbance.

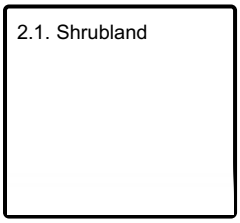
1.4b - This pathway represents a larger disturbance, such as an insect infestation, wind storm, or rot pocket to create this forest structure. Areas of regeneration range from approximately 2 to 5 acres.

1.4A - This pathway represents continued growth over time with no further major disturbance.

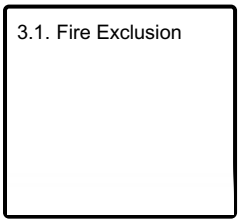
1.5a - This pathway represents no further major disturbance. Continued growth over time, as well as ongoing mortality, leads to continued vertical diversification. The community begins to resemble the structure of the Reference Community, with small pockets of regeneration and a more diversified understory.

1.5b - This pathway represents a larger disturbance, such as an insect infestation, wind storm, or rot pocket to create this forest structure. Areas of regeneration range from approximately 2 to 5 acres.

State 2 submodel, plant communities



State 3 submodel, plant communities



State 4 submodel, plant communities

4.1. Developed

State 5 submodel, plant communities

5.1. Invaded Crop or Pasture

State 1
Reference State

Structure: Multistory with small gap dynamics in forest of high canopy cover (average 60 percent canopy cover), taller, larger (average DBH 15 to 20 feet) trees dominated by Douglas fir.

Community 1.1
Reference Phase Douglas fir (wester larch-ponderosa pine)/white spirea-common snowberry-wood's rose/creeping barberry-kinnikinick/pinegrass

Structure: Multistory with small gap dynamics in forest of high canopy cover with an average 60 percent canopy cover. Has taller, larger (average DBH 15 to 20 ft) trees dominated by Douglas fir and ponderosa pine. This site has a mixture of mature Douglas fir and ponderosa pine with a trace of western larch in the tree overstory. The trees are larger than in earlier seral phases with tree girths averaging fifteen inches and ranging fourteen to sixteen inches (diameter at breast height). The total tree absolute overstory canopy cover is sixty percent, making this a dense stand. The relative overstory tree canopy is fifty percent Douglas fir and fifty percent ponderosa pine. These are older trees ranging 80 to 90 years old and are taller ranging 80-90 feet. The site index for the one site is 64, with 78 cubic feet and 270 board feet. The understory is dominated by the medium statured shrubs white spirea and common snowberry and the medium height pinegrass. In cover class data, these species were in the class 4 category, occupying 50-75% canopy cover. There is small amount of rose species present (cover class 2 with 5-25% canopy cover), and the lowest layer is dominated by creeping barberry (cover class 3 with 25-50% canopy cover). This corresponds to the similar habitat type Douglas fir/common snowberry in which the following plants were dominant with constancy and average canopy cover shown including Douglas fir (constancy 9, canopy cover 55%), ponderosa pine (constancy 3, canopy cover 61%), lodgepole pine (constancy 2, canopy cover 13%), white spirea (constancy 7, canopy cover 18%), common snowberry (constancy 10, canopy cover 20%) and grouse whortleberry (constancy 4, canopy cover 10%). Constancy values divided into classes including 1=5-15%, 2=15-25%, 3=25-35%, 4=35-45%, 5=45-55%, 6=55-65%, 7=65-75%, 8=75-85%, 9=85-95%, 10=95-100%. The presence of root rot pockets can shift the composition of this community away from its primary host species, Douglas fir, and create open patches of dying and dead trees (Hagle, 2003). Armillaria root rot is a native pathogen and if open patches are small and not coalescing, then forest stand structure is generally maintained. The understory of this community is low storied with the medium shrub white spirea and common snowberry in clumps and the herbaceous layer varied but low growing with pinegrass that can have high cover.

Forest overstory. COMMUNITY PHASE 1.1
HISTORIC WOOD 5 DATASET (1 site):
This site has been previously logged.

OVERSTORY FOREST METRICS
Absolute Total canopy cover =60%
Relative Canopy Cover by species: PSME=50%/PIPO=50%; LAOC=Trace.
Average Stand Basal Area=170.

PSME= Site Index=64 Cubic feet=78 Board feet=270
Average DBH PSME=15(14-16) AGE=80-87. HT=79-87.

Forest understory. The understory is dominated by the medium statured shrubs white spirea and common snowberry and the medium height pinegrass. In cover class data, these species were in the class 4 category, occupying 50-75% canopy cover. There is small amount of rose species present (cover class 2 with 5-25% canopy cover), and the lowest layer is dominated by creeping barberry (cover class 3 with 25-50% canopy cover).

Dominant plant species

- Douglas-fir (*Pseudotsuga menziesii*), tree
- ponderosa pine (*Pinus ponderosa*), tree
- common snowberry (*Symphoricarpos albus*), shrub

Community 1.2
Initiation Phase - Later early Seral Douglas fir, lodgepole pine, western larch, ponderosa pine/white spirea-common snowberry-wood's rose/fireweed-pinegrass-geyer's sedge

Structure: patchy clumps, single story regeneration This plant community is a forest in the stand initiation phase, possibly with scattered remnant mature trees; the composition of the seedlings depends on the natural seed sources available. Canopy cover is generally less than 10 percent and comprised of a mixture of conifers including Douglas fir, lodgepole pine, western larch, ponderosa pine and, in moister areas, resprouting aspen. If serotinous lodgepole seedbank is present, then this species will dominate the area. The understory is a mixture of shrubs and herbaceous species including: fireweed, common snowberry, pinegrass, and Geyer’s sedge. Pinegrass and Geyer’s sedge can have very high canopy cover. After severe fire and with an adequate presence of shrubs or seedbank, snowbrush ceanothus can dominate. Later Early Seral Stage: Single story overstory canopy that has high canopy cover of shorter (less than 40 feet), smaller (DBH less than 10 inches) and younger seral species with Douglas fir less than 5% canopy cover Overstory of trees predominantly of shorter, smaller and younger trees with a few large remnant trees that survived previous fires. Total overstory canopy cover in the height classes 6 to 8 is 50%. The majority of tree cover falls within height classes 6 and 7, as opposed to the taller height classes which dominate the mature and reference phase communities. These trees are young and have DBHs less than 10 inches, except for remnant fire seral trees that are larger. Foliar cover of the understory is moderate to high. The dataset is completely comprised of post logging operation sites that mimic the post-disturbance early seral phase of this ecological site.

Community 1.3
Stem Exclusion Phase-lodgepole pine (Douglas-fir, western larch, and ponderosa pine)/ common snowberry (wood's rose-white spirea-saskatoon serviceberry)/ pinegrass-starry false lily of the valley

►STRUCTURE: Dense, single story canopy of larger sized tree of seral species including Ponderosa pine and western larch Structure: Dense, single story canopy of larger sized tree of seral species including Ponderosa pine and western larch. Community Phase 1.4 is a forest in the competitive exclusion phase, possibly with scattered remnant mature trees; there is increasing competition among individual trees for the available water and nutrients. The canopy cover can range from 60-100 percent. The overstory is typically dominated by lodgepole pine, with minor amounts of Douglas-fir, western larch, and ponderosa pine; and the understory can have clumps of common snowberry and pinegrass. Canopy closure is very high within the areas successfully reforested, leading eventually to a diminished graminoid community but also providing protection for those species which do well in the shade. Depending on regeneration species, some stands can be dominated by Douglas fir or ponderosa pine or western larch. There are variations within seral dominant forests within this ecological site. All these sites that have been sampled, have been previously logged. Median age for all sites is 52 years. These are mid-seral communities that have experienced previous logging. These stands can be dominated by one or more seral tree species and include: western larch, lodgepole pine, ponderosa pine and a combination of Douglas fir-lodgepole pine dominated variations. The overstory of this plant community is predominantly comprised of shorter, smaller and younger trees compared to the reference phase, with a few large remnant trees that survived previous fires. Total overstory canopy cover in the height classes 6 to 8 is above 50 percent. The majority of tree cover falls within height classes 6 and 7, as opposed to the taller height classes which dominate the mature and reference phase communities. These trees are young and have DBHs less than 10 inches, except for larger remnant seral trees. Foliar cover of the understory is moderate to high. The dataset is completely comprised of post logging operation sites.

Forest overstory. There are 2 datasets used to describe this community phase, the 2018 and the historic. The 2018 dataset includes canopy cover which has lodgepole pine dominant (15 percent), ponderosa pine (8 percent), and less than 5 percent of western white pine, Douglas fir and western hemlock.
:
HISTORIC WOOD 5 DATASET (14 sites):
There are variations within seral dominant forests within the PSME/SYAL ecological site. All these sites have been previously logged. Median age for all sites is 52 years. These are mid-seral communities that have experienced previous logging. These stands can be dominated by one or more seral tree species and include: western larch, lodgepole pine, ponderosa pine and a combination of Douglas fir-lodgepole pine dominated variations.

FOREST OVERSTORY METRICS - ALL SITES COMBINED 14 sites
Average Age= 52 years

SPECIES/ SI FT3 BF DBH in inches AGE in years HT in feet
LAOC 74 136 533 10-12" 40-57 70-85'
PIPO 100 103 399 10-13" 45-65 65-75'
PICO 95 84 283 7-9" 60-65 58-63'
PSME 82 95 344 10-15" 50-70 60-75'

FOREST CANOPY COVER - ALL SITES COMBINED 14 sites

SPECIES/FREQUENCY/AVERAGE CANOPY COVER
ABGR 1 2
LAOC 4 45
PICO 7 44
PIMO3 1 5
PIPO 10 58
PSME 10 15

Forest understory. There are 2 datasets used to describe this community phase, the 2018 and the historic. The 2018 dataset for canopy cover shows pinegrass as dominant at 60 percent, heartleaf arnica and kinnikinick each 9 percent, the rest are 5 or less percent. The species include common yarrow, Saskatoon serviceberry, raceme pussytoes, spreading dogbane, mountain brome, pointed tip mariposa lily, fireweed and snowbrush ceonothus. The production by species in pounds per acre: common yarrow 0-8, hearleaf arnica 0-110, white hawkweed 0-8, pinegrass is 365 to 390, Saskatoon serviceberry 0-85, creeping barberry 85-435, rose 0-50, twinflower 0-30, white spirea 0-60 and dwarf bilberry 0-140.
Historic dataset: 14 sites:
UNDERSTORY CANOPY COVER CLASSES
0 ABSENT
T RARE-1%
1 1-5%
2 5-25%
3 25-50%
4 50-75%
5 75-95%
6 95-100%
SPECIES FREQUENCY AVERAGE CANOPY COVER CLASS
ACMI2 3 2.0
AMAL2 6 2.8
ANRA 1 2.0
ARCO9 3 2.3
BRMA4 2 1.5
BROMUS 1 2.0
CARU 10 3.8
COOC 2 3.0
FRVI 1 2.0
MARE11 10 2.7

PAMY 1 4.0
PRVI 1 2.0
PTAQ 3 2.3
ROSA 8 2.6
ROWO 1 3.0
RUPA 1 2.0
RUUR 1 3.0
SMST 2 3.5
SPBE2 7 3.0
SYAL 13 3.5
TROV 1 2.0
VIOLA 1 2.0

Dominant plant species

- lodgepole pine (*Pinus contorta*), tree
- western larch (*Larix occidentalis*), tree
- ponderosa pine (*Pinus ponderosa*), tree
- Douglas-fir (*Pseudotsuga menziesii*), tree
- common snowberry (*Symphoricarpos albus*), shrub
- rose (*Rosa*), shrub
- white spirea (*Spiraea betulifolia*), shrub
- Saskatoon serviceberry (*Amelanchier alnifolia*), shrub
- creeping barberry (*Mahonia repens*), shrub
- Oregon boxleaf (*Paxistima myrsinites*), shrub
- pinegrass (*Calamagrostis rubescens*), grass
- starry false lily of the valley (*Maianthemum stellatum*), other herbaceous

Community 1.4
Vertical Differentiation Douglas fir (western larch-Ponderosa pine)/Serviceberry/white spirea-common snowberry/creeping barberry/pinegrass

►STRUCTURE: Single story canopy with few small openings. Vertical differentiation in stand from insects, disease, and competition related mortality. Canopy cover ranges 30 to 60 percent. COMMUNITY PHASE 1.5: Douglas fir (western larch-Ponderosa pine)/Serviceberry/white spirea-common snowberry/creeping barberry/pinegrass Structure: Single story canopy with few small openings Community Phase 1.5 is a maturing forest which is starting to differentiate vertically. Canopy cover ranges 30-60%. The overstory is a mixture of Douglas fir, western larch, and ponderosa pine at low elevation. The understory can have clumps of the tall shrub Saskatoon serviceberry, the medium statured shrubs white spirea and common snowberry, with a carpet of diverse herbaceous layer sometimes dominated by the rhizomatous grass pinegrass and or geyer's sedge. Individual trees are dying (whether due to insects, disease, competition or windthrow) allowing some sunlight to reach the forest floor. This allows for an increase in the understory as well as some pockets of overstory tree species regeneration. This community is prone to Armillaria root rot and defoliation by Western Spruce budworm on fir.

Community 1.5
Mature Patchy Phase Douglas fir (western larch-ponderosa pine)/serviceberry/white spirea-common snowberry/creeping barberry-kinnikinick/pinegrass

Structure: Mature stand with moderate patches from disease, insects, and competition This stand resembles the reference stage but trees are not as large, robust and the understory is not as well developed.

Pathway 1.1A
Community 1.1 to 1.2

This pathway represents a larger disturbance, such as an insect infestation, wind storm, or rot pocket to create this forest structure. Areas of regeneration range from approximately 2 to 5 acres.

Pathway 1.2a
Community 1.2 to 1.3

Time without disturbance allows seedlings to mature to pole sized trees with high overstory canopy cover.

Pathway 1.3b
Community 1.3 to 1.2

This pathway represents a larger disturbance, such as an insect infestation, wind storm, or rot pocket to create this forest structure. Areas of regeneration range from approximately 2 to 5 acres.

Pathway 1.3A
Community 1.3 to 1.4

This pathway represents continued growth over time with no further major disturbance.

Pathway 1.4b
Community 1.4 to 1.2

This pathway represents a larger disturbance, such as an insect infestation, wind storm, or rot pocket to create this forest structure. Areas of regeneration range from approximately 2 to 5 acres.

Pathway 1.4A
Community 1.4 to 1.5

This pathway represents continued growth over time with no further major disturbance.

Pathway 1.5a
Community 1.5 to 1.1

This pathway represents no further major disturbance. Continued growth over time, as well as ongoing mortality, leads to continued vertical diversification. The community begins to resemble the structure of the Reference Community, with small pockets of regeneration and a more diversified understory.

Pathway 1.5b
Community 1.5 to 1.2

This pathway represents a larger disturbance, such as an insect infestation, wind storm, or rot pocket to create this forest structure. Areas of regeneration range from approximately 2 to 5 acres.

State 2
Armillaria Root Rot

Community 2.1
Shrubland

This community has crossed a threshold in which the amount and severity of Armillaria Root Rot has converted the forest community of State 1 into a shrubland of State 2. The Armillaria root rot pockets are extensive merging together to form a shrubland.

State 3
Fire Exclusion

This State has been shaped by fire exclusion in which the forest structure, species composition, patch patterns and fuel loading has been dramatically increased due to a dramatic reduction or elimination of fire from the ecological site. Tree density and fuel loading have reached a point in which fire if it did occur would be of very high severity. Dense multi-layered forests of Douglas-fir and ponderosa pine now exist and are homogenous on the landscape.

Intensive forest management practices can reduce the risk of severe fire. There has been a dramatic increase in the area of “Dry PVG” (Douglas fir dominated forests) that used to burn with low severity fires that now has a mixed severity of lethal stand replacing fire regime (Gautreaux, Russ. 1999). Forest stand composition changes with fire suppression as well. Douglas fir does not require a post-fire mineral bed for seedling development like ponderosa pine and will outcompete it when fire does not occur. There is also usually an increase in shrubs that become decadent with the lack of fire.

Community 3.1
Fire Exclusion

Multi-level canopy of mature Douglas-fir and ponderosa pine over sapling/pole/seedling stands of Douglas-fir and ponderosa pine. Eventually, Douglas fir outcompetes ponderosa pine given long-term fire suppression. These dense multi-storied Douglas fir forest can be more prone to and capable of supporting populations of western spruce budworm which results in severe defoliation and mortality (Gautreaux, Russ. 1999). Furthermore, more continuous cover of Douglas fir can increase the area of Armillaria root disease of which Douglas fir is a primary host. Large areas of lodgepole pine can have high levels of bark beetle caused mortality. These increases in mortality change forest structure and allow for higher fuel build up and the potential for severe, stand-replacing fire. In areas without tree regeneration dense stands of shrubs will occur, mainly serviceberry, white spirea or snowberry. Forest management practices which include selective overstory removal along with understory fuel load management, including prescribed fire, can transition the forest into a more drought, insect and fire resilient condition.

State 4
Developed Land

Community 4.1
Developed

A portion of this ecological site has been developed for human uses including timber harvest and the private development of houses or roads. This has occurred on the lower slope foothills and valleys. Additionally, other factors have changed forest structure including years of hygrading (harvesting largest best trees on site), prevalence of many roads which create fire breaks, and tree plantations. There are generally more early seral stands now due to the frequency and scale of timber harvest in recent decades on the Kootenai N.F. (Gautreaux, Russ. 1999). Timber harvesting and road development lead to changes in forest patch size.

State 5
Weed Invaded Forest Understory/Forest Converted to Crop/Pastureland

Community 5.1
Invaded Crop or Pasture

A portion of this ecological site has either been significantly altered by weedy species invasion or the forest has been converted to annual cropland or pasture. This has occurred on the lower slope foothills and valleys. Weedy or increaser species that may be a problem including: slender crupina, rush skeletonweed, musk thistle, leafy spurge, knapweed species, tansy ragwort, dalmatian and yellow toadflaxes, common St. John’s wort and sulphur cinquefoil (Gautreaux, Russ. 1999).

Transition T1A
State 1 to 2

If a stand sustains very high levels of roots disease mortality, then a forest stand could cross a threshold and become a shrubland once all trees are gone (Kimsey et al., 2012). Persistent shrub fields may take a century or longer for the infected root mass to decline, which will return the root disease potential to background levels and allow the reintroduction of resistant conifer species. Extensive management is needed to convert the resultant shrubland back to a forest community. The shrubs that would create the converted shrubland are from those already on the ecological site such as common snowberry, serviceberry, and white spirea. A mosaic of brushy openings, patches of dying trees, and apparently unaffected trees may cover large areas.

Transition T1B
State 1 to 3

Fire exclusion over long periods allowing stands to grow into homogenous multi-storied stands

Transition T1C
State 1 to 4

Development on forest stands in which timber harvest, private housing development or road building has occurred.

Transition T1D
State 1 to 5

Forest stand with understory dominated by weedy invasive species or forest converted to cropland or pastureland.

Restoration pathway R2A
State 2 to 1

Forest management practices to convert shrubland back to forest including tree planting of less Armillaria Root Rot sensitive tree species There can be highly significant losses, usually requiring species conversion in the active management approach. Management tactics include to correctly identify the type of root disease(s) on the management unit, and manage species such as late seral pine and larch. Pre-commercial thinning will improve growth and vigor of the residual stand. Thinning and harvest operations should remove susceptible species (Douglas-fir or true firs) to the degree practical, retaining late seral species such as western larch and pine (Hagle, 2010). Tree planting can be used to facilitate a shift in species composition to those conifers which have greater tolerance to root diseases.

Restoration pathway R3A
State 3 to 1

Forest stands restored by overstory thinning, ground and ladder fuels reduction, prescribed fire and seeding of native grasses and forbs. VRU Recommendations for sivicultural practices (Gautreaux, Russ. 1999): • Desired forest structures would reflect the product of frequent low to moderate severity ground fires, and occasional stand replacement events • Largely multi-storied and two-aged conditions would be sustained through prescribed fire and timber harvest at frequencies consistent with natural fire return interval (15-45 years). A variety of successional stages represented. • Create small openings (2-5 acres) within an irregularly shaped, large treatment area (20-200 acres). • Individual or small group selection on a 20-25 year re-entry schedule • Shelterwood preparatory cuts and shelterwood seed cuts • Intermediate harvest methods (improvements cuttings and thinning from below (where stand regeneration is not the intent and root disease is not a concern) • Prescribed fire as a tool for periodic reduction in fuels, restoring and maintaining vegetative composition and structure • Reforestation and species management

Restoration pathway R4A
State 4 to 1

Development that has caused smaller forest patch sizes and changes to structure cease, restoration efforts on building areas, roads and harvested areas occur including tree planting and other measures.

Restoration pathway R5A
State 5 to 1

Weed eradication measures to reduce or eliminate weedy species on site and usually restoration measures to increase cover of native vegetation community for weedy understory community. Afforestation through planting of native trees /shrubs and seeding of native grasses and forbs, treatment of invasive plants and Time for the forest converted to crop or pastureland community.

Additional community tables

Table 6. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Forb					
1				–	
	Idaho goldthread	COOC	*Coptis occidentalis*	–	0–6
	heartleaf arnica	ARCO9	*Arnica cordifolia*	–	0–5
	western brackenfern	PTAQ	*Pteridium aquilinum*	–	0–5
	San Joaquin bluecurls	TROV	*Trichostema ovatum*	–	0–4
	violet	VIOLA	*Viola*	–	0–4
	Virginia strawberry	FRVI	*Fragaria virginiana*	–	0–4
	common yarrow	ACMI2	*Achillea millefolium*	–	0–4
	raceme pussytoes	ANRA	*Antennaria racemosa*	–	0–4
Grass/Grasslike					
2				–	
	pinegrass	CARU	*Calamagrostis rubescens*	–	0–10
	mountain brome	BRMA4	*Bromus marginatus*	–	0–3
Shrub/Vine					
3				–	
	longrunner	ROSA	*Rorippa sarmentosa*	–	0–10
	Saskatoon serviceberry	AMAL2	*Amelanchier alnifolia*	–	0–10
	creeping barberry	MARE11	*Mahonia repens*	–	0–10
	Oregon boxleaf	PAMY	*Paxistima myrsinites*	–	0–8
	common snowberry	SYAL	*Symphoricarpos albus*	–	0–7
	California blackberry	RUUR	*Rubus ursinus*	–	0–6
	white spirea	SPBE2	*Spiraea betulifolia*	–	0–6
	Woods' rose	ROWO	*Rosa woodsii*	–	0–6
	thimbleberry	RUPA	*Rubus parviflorus*	–	0–4
	chokecherry	PRVI	*Prunus virginiana*	–	0–4

Table 7. Community 1.3 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
lodgepole pine	PICO	*Pinus contorta*	Native	18.3–27.4	30–50	25.4–38.1	–

Other references

Arno, S. Forest Regions of Montana. USDA Forest Service Research Paper INT-218. USFS. USDA.

Arno, S. and R. Hammerly. Northwest Trees, by Stephen F. Arno and Ramona P. Hammerly. Anniversary Edition, the Mountaineers Books, 2007.

Arno S., D. Parsons and R. Keane. Mixed-Severity Fire Regimes in the Northern Rocky Mountains: Consequences of Fire Exclusion and Options for the Future. USDA Forest Service Proceedings RMRS-P-15-VOL-5.2000.

Barrett, S., S. Arno and C. Key. Fire regimes of western larch-lodgepole pine forests in Glacier National Park,

Montana. 1991.

Byler, James and Hagle, Susan. 2000. Succession functions of pathogens and insects. FHP Report No. 00-09.

Fischer W., A. Bradley. Fire Ecology of Western Montana Forest Habitat Types. US Department of Agriculture. Forest Service. Intermountain Research Station. GTR-INT-223.

Garrison-Johnston, R. Lewis, L. Johnson. 2007. Northern Idaho and Western Montana Nutrition Guidelines by Rock Type. Intermountain Forest Tree Nutrition Cooperative. Forest Resources Department, University of Idaho.

Green, P. J. Joy, D. Sirucek, W. Hann, A. Zack, and B. Naumann. April 1992. Old Growth Criteria. R-1 SES 4/92. Northern Region. USDA USFS.

Hagle, S., USFS, Forest Health Protection and State Forestry Organizations. A field guide to diseases & insect pests of Northern & Central Rocky Mountain conifers. 2003.

Hagle S., USFS, Forest Health Protection and State Forestry Organizations. Management Guide for Armillaria Root Disease. February 2008. WEB July 2010.

Kimsey M., T. Shaw, M. Johnston, P. McDaniel. 2012. Intermountain Forest Tree Nutrition Cooperative. Ecological and physiological overview of volcanic soils and their influence on tree growth and vegetation.

Kimsey M. Intermountain Forest Tree Nutrition Cooperative. Geospatial tools for estimating and maintaining soil-site productivity. Northwest Forest Soils Council Meeting, February 28, 2012.

Losensky, J. L. "Personal communication. Jack Losensky." Ecologist, Lolo National Forest, Missoula, MT (1992).

McDonald, A. Harvey and J. Tonn. USDA U.S.F.S., Rocky Mountain Research Station. Fire, competition and forest pests: landscape treatment to sustain ecosystem function.

McKenzie, D. and D. Tinker. 2012. Fire-induced shifts in overstory tree species composition and associated understory plant composition in Glacier National Park, Montana. Plant Ecology 2012: 213:207-224.

McLean, Alastair. 1970. Plant communities of the Similkameen Valley, British Columbia. Ecological Monographs. 40(4): 403-424.

NatureServe, 2007. U.S. National Vegetation Classification Standard: Terrestrial Ecological Classifications. Waterton-Glacier International Peace Park, Local and Global Association Descriptions.

N.P.S. Fire Ecology Annual Report, Calendar Year 2014.

Gautreaux, Russ. 1999. Vegetation Response Unit characterizations and Target Landscape Prescriptions. USDA. Forest Service, Northern Region. Kootenai National Forest.

Soil Survey Staff. 2015. Illustrated guide to soil taxonomy. U.S. Department of Agriculture, Natural Resources Conservation Service, National Soil Survey Center, Lincoln, Nebraska.

Pfister, R., B. Kovalchik, S. Arno, R. Presby. Forest Habitat Types of Montana. USDA Forest Service General Technical Report INT-34. Intermountain Forest and Range Experiment Station, US Department of Agriculture. May 1977.

Zack, A. Region One, Vegetation Classification, mapping, inventory and analysis report. U.S. Department of Agriculture, US Forest Service, Northern Region. Report 09-08 v1.0. 1997, revised 2005.

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Approval

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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	10/25/2023
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

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

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

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

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

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

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

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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):**

---

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:**

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17. **Perennial plant reproductive capability:**
