USDA Natural Resources Conservation Service

Ecological site F022BI112CA
Frigid Sandy Loam Moraines Or Lake Terraces

Accessed: 05/03/2024

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.

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 022B–Southern Cascade Mountains

Site concept:
Landform: (1) Moraine, (2) Lake terrace
Elevation (feet): 5,500-8,200
Slope (percent): 1-40
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: No Influence on this site
Mean annual precipitation (inches): 35.0-109.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 38 and 43 degrees F (3.3 to 6.1 degrees C)
Restrictive Layer: Dense till at 40 to 60 inches; silica cemented duripan at 20 to greater than 60 inches below the surface
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Lake terrace; tephra and glacial till from andesite and basalt; lake sediments from volcanic rocks
Surface Texture: (1) Gravelly medial sandy loam, (2) Medial Sandy loam
Surface Fragments <=3" (% Cover): 18-40

Surface Fragments > 3" (% Cover): 0-35
Soil Depth (inches): 20-80
Vegetation: Heavily dominated by California red fir (*Abies magnifica*) with Sierra lodgepole pine ((*Pinus contorta* var. murrayana) and western white pine (*Pinus monticola*) commonly present. White fir (*Abies concolor*) is present at the lower elevations. Sierra lodgepole pine is a post fire pioneer species on this site.
Notes: This ecological site is found on moraines and dry lake terraces.

Classification relationships

Forest Alliance = *Abies magnifica* - Red fir forest; Association = *Abies magnifica-Pinus contorta* ssp. murrayana. (Sawyer, John O., Keeler-Wolf, Todd, and Evens, Julie M. 2009. A Manual of California Vegetation. 2nd ed. California Native Plant Society Press. Sacramento, California.)

Associated sites

F022BI102CA	**Frigid Bouldery Glacially Scoured Ridges Or Headlands** This is an open California red fir forest found in moderate deep soils with bedrock contact.
F022BI108CA	**Frigid Moist Sandy Lake Or Stream Terraces** This is a moist lodgepole pine forest found on lake and stream terraces.

Similar sites

F022BI107CA	**Frigid Moderately Deep Slopes** This is red fir-white fir forest at lower elevations.
F022BI118CA	**Frigid Landslide Undulating Slopes** This is a dense red fir forest found on landslides with fine textured soils.

Table 1. Dominant plant species

Tree	(1) *Abies magnifica* (2) *Pinus contorta var. murrayana*
Shrub	Not specified
Herbaceous	(1) *Penstemon gracilentus* (2) *Lupinus arbustus*

Physiographic features

This ecological site is found on moraines and dry lake terraces between 5,500 and 8,200 feet in elevation. Slopes range from 1 to 40 percent.

Table 2. Representative physiographic features

Landforms	(1) Moraine (2) Lake terrace
Flooding frequency	None
Ponding frequency	None
Elevation	1,676–2,499 m
Slope	1–40%
Aspect	Aspect is not a significant factor

Climatic features

This ecological site receives most of its annual precipitation in the winter months in the form of snow. The mean annual precipitation ranges from 35 to 109 inches (889 to 2,769 mm) with an average of 49 inches (1245 mm). The mean annual temperature is between 38 and 43 degrees F (3.3 to 6.1 degrees C). The frost free (>32 degrees F) season is 60 to 85 days. The freeze free (>28 degrees F) season is 75 to 190 days.

There are no representative climate stations for this site.

Table 3. Representative climatic features

Frost-free period (average)	85 days
Freeze-free period (average)	190 days
Precipitation total (average)	2,769 mm

Influencing water features

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

Soil features

This site is associated with the Juniperlake and Humic Haploxerands-lake terrace soil components. These soils are moderately deep to very deep (1.6 to greater than 5 feet deep) over a root restrictive layer. They are skeletal soils, meaning they have a high percentage of rock fragments. These soils are well drained with moderately rapid to rapid permeability in the upper layers, and very slow to slow permeability through the root restrictive layer.

The Juniperlake soils are deep and formed in tephra and glacial till from andesite and basalt. They are classified as Medial-skeletal, amorphic, frigid Humic Haploxerands. There is a thin O horizon over two A horizons (from 1 to 10 inches) which have a gravelly medial sandy loam texture. The AB horizon (10 to 21 inches) and the Bw1 horizon (21 to 30 inches) have very cobbly medial sandy loam textures with 20 percent cobbles. The Bw2 horizon (30 to 47 inches) has a very gravelly medial sandy loam texture with 31 percent gravel and 20 percent cobbles. A root restrictive layer that formed from dense till occurs between 40 to 60 inches below the surface. The available water capacity in the upper 60 inches of soil is 0.52 to 5.35 inches (very low to moderate) with an RV of 3.2 inches (low).

The Humic Haploxerands-lake terrace soils formed in lake sediments from volcanic rocks. They are also classified as Medial-skeletal, amorphic, frigid Humic Haploxerands. They have a negligible O horizon over 3 A horizons. The A1 horizon (from 0 to 3 inches) has a medial sandy loam texture. The A2 and A3 horizons (3 to 11 and 11 to 18 inches respectively) have very bouldery medial fine sandy loam and extremely bouldery medial fine sandy loam textures, with 14 to 15 percent gravel, 5 to 10 percent cobbles, 5 to 10 percent stones, and 30 percent boulders. A Bw horizon (from 18 to 26 inches) has a very cobbly medial fine sandy loam texture with 30 percent gravel, 15 percent cobbles, and 5 percent stones. A root restrictive, silica cemented duripan occurs between 20 to greater than 60 inches below the surface. The available water capacity in the upper 60 inches of soil is 0.26 to 4.55 (very low to low) with an RV of 1.4 inches (low).

This ecological site is associated with the following major soil components within the Lassen Volcanic National Park Soil Survey Area (CA789):

Map Unit Component, Comp %
103 Juniperlake, 10
104 Juniperlake, 20
105 Juniperlake, 85
105 Humic Haploxerands-lake terrace, 4
107 Juniperlake, 3
148 Humic Haploxerands-lake terrace, 70
148 Juniperlake, 5

Table 4. Representative soil features

Family particle size	(1) Sandy
Drainage class	Well drained

Permeability class	Rapid to slow
Soil depth	51–203 cm
Surface fragment cover <=3"	18–40%
Surface fragment cover >3"	0–35%
Available water capacity (0-101.6cm)	0.66–13.59 cm
Soil reaction (1:1 water) (0-101.6cm)	4.5–6.3
Subsurface fragment volume <=3" (Depth not specified)	18–65%
Subsurface fragment volume >3" (Depth not specified)	5–40%

Ecological dynamics

This forest is heavily dominated by California red fir (*Abies magnifica*) with Sierra lodgepole pine ((*Pinus contorta* var. murrayana) and western white pine (*Pinus monticola*) commonly present. White fir (*Abies concolor*) is present at the lower elevations. Sierra lodgepole pine is a post fire pioneer species on this site. It also has fair cover in flat areas that accumulate water, and in cold air drainages. This forest has the potential to grow very dense in the absence of fire or other natural disturbances.

The understory tends to be sparse, but in some areas the cover of longspur lupine (*Lupinus arbustus*), slender penstemon (*Penstemon gracilentus*), and mountain monardella (*Monardella odoratissima*) is over 40 percent. Other common species are western needlegrass (*Achnatherum occidentale*), squirreltail (*Elymus elymoides*), pinemat manzanita (*Arctostaphylos nevadensis*), California brome (*Bromus carinatus*), buckwheats (Eriogonum spp.) and Mt. Hood pussypaws (*Cistanthe umbellata* var. umbellata).

California red fir (*Abies magnifica*) is generally dominant in this ecological site. California red fir is a tall, long lived conifer with short branches and a narrow crown. It produces single needles that are 0.8 to 1.4 inches long, which are distributed along the young branches. Firs produce upright cones that open and fall apart while still attached to the tree, so cones are not often seen on the forest floor unless cut by squirrels or chipmunks in fall. California red fir cones are about 9 inches long. California red fir prefers cold wet winters in areas with deep snow accumulation, followed by warm summers. The young trees have thin bark and are very susceptible to fire, but as trees mature the bark thickens and fire resistance increases.

Western white pine is also a long lived conifer with a narrow crown. It has 2 to 4 inch long needles in bundles of 5. It produces a deep tap root and extensive lateral roots. Most of the lateral roots are within the upper 2 feet of soil. Young trees have thin bark and are very susceptible to fire due to damage to the cambial tissue. Mature trees develop thicker bark and have high branches, making them less prone to mortality from fire (Griffith, 1992). Western white pine bark, when damaged by fire, can allow infestations of pathogens that can eventually kill the trees.

Sierra lodgepole pine does not grow as tall and is not generally as long lived as California red fir and western white pine. It can be a pioneer species on this site after fire, which is eventually replaced by California red fir and western white pine in the absence of disturbance. Sierra lodgepole pine has a complex disturbance regime which includes cyclic beetle infestations and fire. The mountain pine beetle (Dendroctonus ponderosae) is a natural pest which can kill a significant portion of the larger trees in a stand. Infestations can last for several years and often return in 20 to 40 year cycles (Cope, 1993).

Conifers have evolved with their environment developing characteristics that enable them to survive specific climatic conditions. Temperature and precipitation are important environmental variables that determine which conifer species are most likely to be present in a given area. Temperature is critical in initiating conifer growth after snowmelt. Trees generally start stem growth about 2 weeks after snow melt, a delay that may be related to the warming of soils and roots. If the snow melt is unusually early, trees will not begin annual growth until specific air temperatures and/or a photoperiod (a ratio of light hours to dark hours during one 24 hour period) is met. The pines associated with this site begin leader growth at cooler temperatures than the firs. The pines have heavily insulated terminal buds, whereas the terminal buds of the fir trees are less insulated and more susceptible to frost damage (Royce and Barbour, 2001). Seedling establishment and survival are also dependent upon the frost resistance of the species. After temperatures and the photo period criteria have been met, precipitation and soil available water determine the length of the growing season. The length of the leader growth is predetermined by growth conditions of the prior year. If drought conditions set in before the leader has reached its determinate length, growth will be terminated prematurely. If precipitation comes after the snow has melted, it can prolong the growing season. Conifer growth ceases with the onset of drought conditions and the decline of water potentials (Royce and Barbour, 2001). In addition to drought conditions, the growing season is shorter at higher elevations due to late snow melt and early frost dates in fall. California red fir takes advantage of the short growing season with rapid initial growth, which gradually declines through the summer (Royce and Barbour, 2001).

This forest has evolved with fire for centuries. Although it has the potential for dense growth and fuel accumulation, growth and fuel production is slower than for lower elevation forests. Also, fuels remain moist for later in the season than at lower elevations, so the fire season is shorter. These properties create longer fire return intervals at upper elevation sites. The point fire return interval for the red fir-western white pine forests on Prospect Peak between the years of 1685 and 1937 ranged from 26 to 109 years, with a mean of 70 (Taylor, 2000).). In the Thousand Lakes Wilderness point fire return interval ranges from 4 to 55 years with a mean of 24 for red fir-white fir forests, and 9 to 91 years with a mean of 20 for red fir-mountain hemlock forests (Bekker and Taylor, 2001). In the Caribou Wilderness the mean fire return interval between the years of 1768 and 1874 was 66 years for red fir-western white pine forest (Taylor and Solem, 2001). Fire studies in the lodgepole pine forest of the Caribou Wilderness report a fire return interval of 67 years between 1735 and 1929. Even low intensity fires resulted in high mortality rates of the lodgepole pine (Taylor and Solem, 1995). Prior to the practice of fire suppression Sierra lodgepole pine forest may have been more extensive, since there may not have been enough time between fires for the forest to develop into the later successional stages. This forest is probably comparable to the Prospect Peak and Caribou Wilderness red fir western white pine forests, and may have a similar fire regime with a mean fire return interval between 66 to 70 years. In a separate study, Beaty and Taylor report that fire return intervals are longer on north facing slopes than on south facing slopes. Stand replacing fire is more common on the upper slopes, while low to moderate intensity fires occur only along the lower slopes. This is probably due to the tendency of fire to burn upslope, preheating the fuels as it goes. Large fires and multiple small fires in the same season are associated with dry and very dry years (Beaty and Taylor, 2001).

This forest type exhibits evidence of fire suppression. Even in the most open forests young seedlings and saplings are filling in the understory and shading out the understory. Some areas are further along in understory development with several canopy layers being dominated by California red fir. As the canopy cover increases, the shade intolerant Sierra lodgepole pine and western white pine decline in the understory. The overstory canopy is unhealthy and dying in some areas due to forest pathogens.

This forest is susceptible to several pathogens that can break out to epidemic levels and cause extensive stand mortality. Native pathogens are a natural component of the ecosystem and, at times, have important functions within the forest cycle. If trees are overstressed due to drought or competition for sunlight they become more vulnerable to pests and disease. Pathogens often infest the weak trees and spread in overcrowded conditions. The surviving trees may benefit from the death of the overstocked trees, and canopy gaps provide an opportunity for regeneration of the same species or other species.

The major pathogens that affect California red fir in this area are red fir dwarf mistletoe (*Arceuthobium abietinum* f. sp. magnificae), fir broom rust (Melampsorella caryophyllacearum), annosus root rot (Heterobasidion annosum), and the fir engraver (Scolytus ventralis) (Murphy et al., 2000). Other diseases that can affect red fir are the heart rots yellow cap fungus (Pholiota limonella) and Indian paint fungus (Echinodontium tinctorium). Insects that can affect red fir are cone maggots (Earomyia spp.), several chalcids (Megastigmus spp.) and cone moths (Barbara spp. and Eucosma spp.) (Burns, et al., 1990).

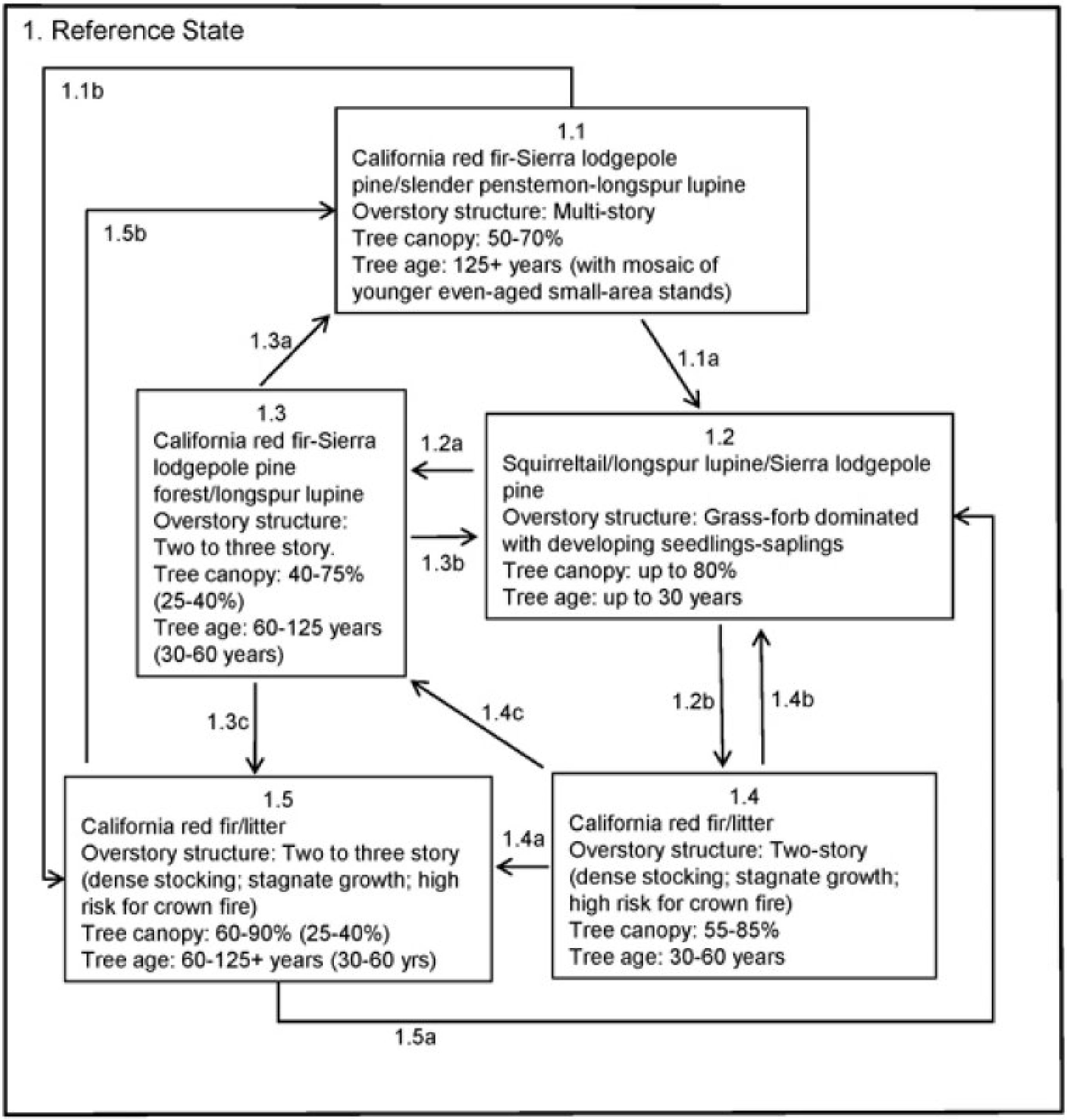
The major pathogen affecting western white pine is the white pine blister rust (Cronartium ribicola). It is a non-native disease that was introduced from Europe and Asia in the 1920s. The fungus causes cankers on five-needle pines and eventually kills most of the infected trees. Visible symptoms are swollen cankers with an abundance of pitch flowing down the branch or stem. The cankers can eventually girdle the tree, killing the portions above and causing leaves to turn red and fall (Hagle et al., 2003). Pruning cankers from infected stems has shown to be beneficial. Some strains of western white pine have shown resistance to the disease. Other pathogens that affect western white pine are needle cast fungi (Lophodermella arcuata, Lophodermium nitens, and Bifusella linearis) and butt-rot fungi (Phellinus pini, Phaeolus schweinitzii, Heterobasidion annosum, and Armillaria spp.). Insects that can cause damage include the mountain pine beetle (Dendroctonus ponderosae), emarginate ips (Ips emarginatus), and ips beetle (Ips montanus) (Graham, 1990).

The reference state consists of the most successionally advanced community phase (numbered 1.1) as well as other community phases which result from natural and human disturbances. Community phase 1.1 is deemed the phase representative of the most successionally advanced pre-European plant/animal community including periodic natural surface fires that influenced its composition and production. Because this phase is determined from the oldest modern day remnant forests and/or historic literature, some speculation is necessarily involved in describing it.

All tabular data listed for a specific community phase within this ecological site description represent a summary of one or more field data collection plots taken in communities within the community phase. Although such data are valuable in understanding the phase (kinds and amounts of ground and surface materials, canopy characteristics, community phase overstory and understory species, production and composition, and growth), it typically does not represent the absolute range of characteristics nor an exhaustive listing of species for all the dynamic communities within each specific community phase.

State and transition model

State-Transition Model - Ecological Site F022BI112CA
Abies magnifica-Pinus contorta var. murrayana/Penstemon gracilentus-Lupinus arbustus
(California red fir-Sierra lodgepole pine/slender penstemon-longspur lupine)



State 1
Reference

Community 1.1
California red fir-Sierra lodgepole pine/slender penstemon-longspur lupine

The mature open California red fir forest is the reference community phase for this ecological site, which has evolved with natural disturbances such as fire and disease. Low intensity understory burns remove some of the understory vegetation and young trees. Wind throw, disease and other disturbances create canopy openings and break up the uniformity and density of the stand. California red fir or Sierra lodgepole pine or shrubs may regenerate in these openings. It is difficult to find this forest in this phase since tree density has increased in most areas due to lack of fire. A natural fire regime reflects the time it takes for a forest to naturally develop fuels sufficient to carry fire. At the upper elevations in red fir dominated forests, fuel accumulation is slow and relatively compact, reducing flammability. Red fir seedlings develop slowly due to physiographic characteristics and climatic variables, so ladder fuels take decades to develop. The natural fire return interval may be 20 to 70 years for this site. Taylor reports a significant drop in fire after 1905 on Prospect Peak, just over 100 years ago (Taylor, 2000). The photo of the community was taken from the site location, but California red fir was very unhealthy here. Many of the overstory trees are dying or dead, and living ones have swollen trunks and witches brooms. Mistletoe is visible throughout the stand. California red fir is regenerating in the understory, but this may be in response to the open canopy left from dying trees as much as fire suppression.

Forest overstory. California red fir dominates this forest with up to a quarter of the canopy composed of western white pine. Sierra lodgepole pine is often present but in low proportions. At the lowest elevations white fir is present. Total canopy cover averages ranges from 50 to 70 percent and basal area is approximately 200-ft2/acre. The upper canopy is roughly 110 feet above the forest floor with one to two understory canopies dominated by red fir. Overstory trees are over 100 years old and have a 20 to 30 d.b.h. (diameter at breast height).

Forest understory. The understory is dominated by forbs with some grasses and pinemat manzanita (Arctostaphylos nevadensis). Understory cover increases with an open overstory canopy. Common plants are needlegrasses (Achnatherum spp.), California brome (Bromus carinatus), Mt. Hood pussypaws (Cistanthe umbellata var. umbellata), longspur lupine (Lupinus arbustus), mountain monardella (Monardella odoratissima) and slender penstemon (Penstemon gracilentus).

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Forb	45	108	170
Shrub/Vine	4	34	67
Grass/Grasslike	–	13	27
Tree	–	10	21
Total	**49**	**165**	**285**

Table 6. Ground cover

Tree foliar cover	50-70%
Shrub/vine/liana foliar cover	2-15%
Grass/grasslike foliar cover	0-12%
Forb foliar cover	15-50%
Non-vascular plants	0-1%
Biological crusts	0%
Litter	50-80%
Surface fragments >0.25" and <=3"	15-40%
Surface fragments >3"	0-35%
Bedrock	0%
Water	0%
Bare ground	6-10%

Community 1.2
Squirreltail/longspur lupine/Sierra lodgepole pine

California red fir, western white pine and Sierra lodgepole pine will germinate from wind or animal dispersed seed after a fire. Sierra lodgepole pine is often the pioneer conifer species on this site after fire because it tends to produce high volumes of viable seeds, which germinate well in full sun and on mineral soil. Sierra lodgepole pine can be a nurse tree for California red fir. California red fir seedling establishment may be delayed for 3 to 4 years after a fire. This may be due to the mortality of the seedlings during the first few years or be related to the timing of cone production, which occurs in 2 to 6 year intervals (Chappell and Agee 1996). The seeds germinate best in bare soil or in light litter, in full sun to partial shade. Initial growth of California red fir is best in dense shade, but as the seedlings get older they grow better in full sun. The winged red fir seeds are wind dispersed 1 to 1.5 times the height of the parent tree. The seeds generally germinate the spring after they are shed and are not stored in the soil. It may take 10 to 25 years for California red fir to reach 4.5 feet (Cope, 1993). Seeds of western white pine can be dispersed over 2,000 feet by wind. The seeds can remain viable in litter for up to 4 years, but viability decreases quickly (Griffith, 1992). Birds, squirrels and other rodents will cache some of these seeds in the soil, where they will germinate in bunches if not consumed. Sierra lodgepole pine is often dominant post-fire due to high production of viable seeds and the tolerance of the seedlings to open sunlight. It is eventually overtopped and shaded out by California red fir. It may persist into the young forest community phases (1.4 and 1.3) and in moist flats. The severity and size of a fire influences the structure of regeneration. California red fir seems to regenerate better after a low to moderate intensity fire, or in high intensity fires of smaller size. This is most likely due to proximity to a seed source and the benefits from partial shade (Chappell and Agee 1996). Pinemat manzanita is killed by fire. It does not re-sprout from the root crown but re-establishes itself from seed. It colonizes disturbed sites and continues to grow well under an open canopy as long as there is sufficient sunlight (Howard, 1993). Other forbs and grasses germinate from on-site stored seed or wind dispersed seed from adjacent areas. Some understory species may re-sprout after low to moderate intensity fires.

Community 1.3
California red fir-Sierra lodgepole pine forest/longspur lupine

Sierra lodgepole pine generally has a shorter life span than California red fir and is eventually replaced in time. It is also shorter in stature at maturity than mature California red fir, and does not survive well in the understory. Small gap disturbances allow Sierra lodgepole pine to persist to some degree within the forest. This community phase benefits from an occasional lightening induced surface fire, which reduces the understory canopy. This community phase experiences rapid growth in conifer height and canopy cover. California red fir reaches seed bearing age at 35 to 40 years, but western white pine can bear seed at 10 years (Cope, 1993, and Griffith, 1992). Therefore California red fir needs a longer fire free interval to develop new seed crops. This community phase begins with pole-sized trees and lasts until the trees are about 125 years old. California red fir will slowly continue to regenerate under the forest canopy during this time.

Community 1.4
California red fir/litter

The development of this community phase is relatively common within this ecological site since young even-aged dense stands generally form after fire and a period of forest regeneration. The trees may be pole-sized and even aged at first, developing into a mature forest over time. Density increases as California red fir continues to establish in the understory, creating multiple canopy layers. When this forest develops it is defined by a dense canopy and high basal area of Sierra lodgepole pine and California red fir and, to a lesser degree western white pine. Canopy cover ranges from 55 to 80 percent. The trees are overcrowded and often diseased and stressed due to competition for water and nutrients, making the trees more susceptible to death from infection and drought. Fire hazard increases in this community, a result of the deep accumulation of litter, standing dead and down trees, and the dense multi-layered structure of the forest.

Community 1.5
California red fir/litter

The mature closed California red fir forest develops with the continued exclusion of fire, allowing tree density to increase to unhealthy levels. This community phase often develops through pathway 1.1b, from increased understory growth under the mature open canopy. Competition for water and sunlight continues, and tree health and vigor decreases.

Pathway 1.1a

Community 1.1 to 1.2

Wind-throw, fire, or tree die off from disease creates openings in the forest that present suitable conditions for California red fir regeneration (Community Phase 1.2).

Pathway 1.1b
Community 1.1 to 1.5

If fire is excluded from the old growth community phase, tree density continues to increase in the understory and shifts the community toward the closed California red fir forest (Community Phase 1.5).

Pathway 1.2a
Community 1.2 to 1.3

The natural pathway is to Community Phase 1.3, the young California red fir-Sierra lodgepole pine forest. This pathway is followed in time and growth with small low to moderate intensity surface fires.

Pathway 1.2b
Community 1.2 to 1.4

An alternate pathway is created when fire is excluded from the system and leads to the young closed California red fir forest (Community Phase 1.4).

Pathway 1.3a
Community 1.3 to 1.1

This is the natural pathway for this community phase, which evolved with a historic fire regime of small low to moderate intensity surface fires, and/or partial tree mortality from a pest outbreak. This pathway leads to a mature open California red fir-Sierra lodgepole pine forest (Community Phase 1.1).

Pathway 1.3b
Community 1.3 to 1.2

In the event of a canopy fire this community phase would return to Community Phase 1.2, Sierra lodgepole pine regeneration.

Pathway 1.3c
Community 1.3 to 1.5

If fire does not occur, forest density increases. The increased density shifts this community phase toward the closed California red fir forest (Community Phase 1.5).

Pathway 1.4b
Community 1.4 to 1.2

At this point the density of ground fuels and ladder fuels formed in the mid-canopy create conditions for a high intensity canopy fire. A severe fire would initiate Sierra lodgepole pine regeneration (Community Phase 1.2).

Pathway 1.4c
Community 1.4 to 1.3

This pathway is triggered by a high mortality fire, which initiates dense Sierra lodgepole pine regeneration (Community Phase 1.3) provided ample cones and seed are present under optimum seed germination conditions.

Pathway 1.4a
Community 1.4 to 1.5

If fire continues to be excluded from this system the mature closed California red fir forest develops (Community Phase 1.5).

Pathway 1.5b
Community 1.5 to 1.1

The natural event of a moderate or surface fire in this forest is unlikely due to the high accumulation of fuels. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it had developed with fire over time. Manual treatments to thin understory trees and other fuels, and/or prescribed burns, could be implemented to shift this forest back to its natural state of an open California red fir-Sierra lodgepole pine forest (Community Phase 1.1). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.1 but tree mortality will increase the already high fuel amount.

Pathway 1.5a
Community 1.5 to 1.2

At this point a severe fire is likely and would initiate Sierra lodgepole pine regeneration (Community Phase 1.2).

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
0	**Tree (understory only)**			0–21	
	California red fir	ABMA	*Abies magnifica*	0–6	0–5
	western white pine	PIMO3	*Pinus monticola*	0–6	0–3
	white fir	ABCO	*Abies concolor*	0–6	0–2
	Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0–4	0–2
Shrub/Vine					
0	**Shrub**			4–67	
	pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	4–34	2–15
	mountain monardella	MOOD	*Monardella odoratissima*	0–34	0–15
Grass/Grasslike					
0	**Grass/Grasslike**			0–27	
	needlegrass	ACHNA	*Achnatherum*	0–22	0–10
	California brome	BRCA5	*Bromus carinatus*	0–4	0–2
Forb					
0	**Forb**			45–170	
	longspur lupine	LUAR6	*Lupinus arbustus*	45–123	15–40
	slender penstemon	PEGR4	*Penstemon gracilentus*	0–45	0–8
	Mt. Hood pussypaws	CIUMU	*Cistanthe umbellata var. umbellata*	0–2	0–1

Table 8. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
California red fir	ABMA	*Abies magnifica*	Native	–	40–50	–	–
western white pine	PIMO3	*Pinus monticola*	Native	–	8–20	–	–
white fir	ABCO	*Abies concolor*	Native	–	1–5	–	–
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	1–5	–	–

Table 9. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
needlegrass	ACHNA	*Achnatherum*	Native	–	0–10
California brome	BRCA5	*Bromus carinatus*	Native	–	0–2
Forb/Herb					
longspur lupine	LUAR6	*Lupinus arbustus*	Native	–	15–40
slender penstemon	PEGR4	*Penstemon gracilentus*	Native	–	0–8
Mt. Hood pussypaws	CIUMU	*Cistanthe umbellata var. umbellata*	Native	–	0–1
Shrub/Subshrub					
mountain monardella	MOOD	*Monardella odoratissima*	Native	–	0–15
pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	Native	–	2–15
Tree					
California red fir	ABMA	*Abies magnifica*	Native	–	0–5
western white pine	PIMO3	*Pinus monticola*	Native	–	0–3
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	0–2
white fir	ABCO	*Abies concolor*	Native	–	0–2

Animal community

Animals that use California red fir forests include martin, fisher, wolverine, black bear, squirrel, chickadee, pileated woodpecker, great gray owl, Williamson's sapsucker, mountain beaver, and pocket gopher.

Deer browse the new growth of conifers in the spring. Birds forage for insects in the foliage of mature conifers. Spruce grouse feed on Sierra lodgepole pine needles during the winter (Cope, 1993).

The California red fir cones are cut and cached by squirrels. Western white pine seeds are eaten by red squirrels and deer mice (Griffith, 1992). The seeds of Sierra lodgepole pine are eaten by squirrels, chipmunks, birds, and mice (Cope, 1993).

The fruit of pinemat manzanita is eaten by black bear, deer, coyote, and various birds and rodents. Young foliage after fire is browsed by deer, but older foliage is not desirable.

The grasses provide forage for deer and small rodents.

Recreational uses

This site is suitable for trails and has excellent views.

Wood products

The wood from California red fir is straight-grained and light. California red fir is soft but stronger than the wood of other firs, and has a low specific gravity. The wood is used for fuel, coarse lumber, quality veneer, solid framing, plywood, printing paper, high-quality wrapping paper, and is preferred for pulping (Cope, 1993).

Western white pine wood is straight-grained and light and highly valued. The wood is used to make window and door sashes, doors, paneling, dimension stock, matches, wood carvings and toothpicks (Griffin, 1992).

Other products

California red fir is used for Christmas trees (Cope, 1993).

Native Americans chewed the resin of western white pine, wove baskets from the bark, concocted a poultice for dressing wounds from the pitch, and collected the cambium in the spring for food (Griffith, 1992).

Cones of western white pine are collected for novelty items. The wood is good for carving. The tree is also planted as an ornamental (Griffin, 1992).

Other information

Forest Pathogens:

The parasitic red fir dwarf mistletoe (*Arceuthobium abietinum* f. sp. magnificae) is common in the survey area, as evident by witches brooms, top kill, stem cancers and swellings. The vegetative shoots of the dwarf mistletoe are also often present from spring to fall. Infestation of the red fir dwarf mistletoe can cause reduced growth and vigor. A fungus, (Cytospora abietis), kills the branches that are infected with dwarf mistletoe. Dwarf mistletoe weakens the tree and allows other pathogens to infest the tree. The mistletoe cankers create an entry point for other diseases, such as heart rots (Burns, et al., 1990).

Fir broom rust (Melampsorella caryophyllacearum) is a disease that causes dense witches brooms with stunted yellow needles. The infected branch sheds its needles in fall, leaving a barren dead looking branch. The alternate host for this rust is the chickweeds (Stellaria spp. and Cerastium spp.) (Hagle et al., 2003). This disease can damage tree growth by reducing crown development. Mortality is less common in mature trees than in younger regeneration trees.

Annosus root rot (Heterobasidion annosum) can affect large acres of fir forest. It spreads from infected roots to healthy roots. It slowly decays the roots, the root collar and the stem butt for many years, causing structural weaknesses and making the tree vulnerable to wind throw. Annosus root rot can also be spread aerially, infecting freshly cut stumps or other fresh tree wounds. Painting borax on freshly cut stumps restricts the entry of the fungus. In all management activities, it is important to reduce damage to the bark. The rot itself does not often kill red fir directly, but it weakens the tree and makes it easier for bark beetles (Scolytus spp.) to infest the tree (Burns, et al., 1990).

The fir engraver (Scolytus ventralis) can cause extensive damage to red fir forests and outbreaks can cause mortality to several acres of trees. Epidemic levels can be reached when trees are stressed due to drought, annosus root rot, dwarf mistletoe, or from fire damage. (Burns, et al., 1990).

SITE INDEX DOCUMENTATION:

Schumacher (1928), Schumacher (1926), Alexander (1966) and Haig (1932) were used to determine forest site productivity for red fir, white fir, lodgepole pine and western white pine, respectively. Low to High values of Site index and CMAI (culmination of mean annual increment) give an indication of the range of inherent productivity of this ecological site. Site index relates to height of dominant trees over a set period of time and CMAI relates to the average annual growth of wood fiber in the boles/trunks of trees. Site index and CMAI listed in the Forest Site Productivity section are in units of feet and cubic feet/acre/year, respectively. Both site index and CMAI are estimates; on-site investigation is recommended for specific forest management units for each soil classified to this ecological site. The historical and actual basal area of trees within a growing stand will greatly influence CMAI.

Conifer trees appropriate for site index measurement typically occur in community phases 1.3 and 1.4. They are selected according to guidance listed in the site index publications.

Table 10. Representative site productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age Of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
California red fir	*ABMA*	46	52	157	180	140	050	–	
California red fir	*ABMA*	46	52	157	180	–	–	50TA	Haig, Irvine T. 1932. Second-growth yield, stand, and volume tables for the western white pine type. USDA, Forest Service. Northern Rocky Mountain Forest Experiment Station Technical Bulletin 323.
Sierra lodgepole pine	*PICOM*	94	99	111	119	100	520	–	
white fir	*ABCO*	57	57	117	117	–	–	50TA	Haig, Irvine T. 1932. Second-growth yield, stand, and volume tables for the western white pine type. USDA, Forest Service. Northern Rocky Mountain Forest Experiment Station Technical Bulletin 323.
white fir	*ABCO*	57	57	117	117	70	030	–	
Sierra lodgepole pine	*PICOM*	94	99	83	88	–	–	50TA	Haig, Irvine T. 1932. Second-growth yield, stand, and volume tables for the western white pine type. USDA, Forest Service. Northern Rocky Mountain Forest Experiment Station Technical Bulletin 323.
western white pine	*PIMO3*	38	42	81	87	–	–	50TA	Haig, Irvine T. 1932. Second-growth yield, stand, and volume tables for the western white pine type. USDA, Forest Service. Northern Rocky Mountain Forest Experiment Station Technical Bulletin 323.
western white pine	*PIMO3*	38	42	81	87	100	570	–	

Inventory data references

The following NRCS vegetation plots were used to describe this ecological site:

789147
789148 (lab 148)- site location
789166
789249
789251
789284

Type locality

Location 1: Plumas County, CA	
Township/Range/Section	T30 N R6 E S22
UTM zone	N
UTM northing	4478508
UTM easting	645060
General legal description	The type location is about 2,600 feet south southeast from the new Juniper Lake ranger station in Lassen Volcanic National Park.

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Contributors

Lyn Townsend
Marchel M. Munnecke

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	
Approved by	
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):**

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

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

---

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

---

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

---

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

---

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

---

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

---

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

---

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

---

14. **Average percent litter cover (%) and depth (in):**

---

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

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

17. **Perennial plant reproductive capability:**