USDA Natural Resources Conservation Service

Ecological site F022BI118CA
Frigid Landslide Undulating Slopes

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General information

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

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: Landslide
Elevation (feet): 5,830-8,100
Slope (percent): 10-50
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: South, East, West
Mean annual precipitation (inches): 99.0-113.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 39 degrees F (3.9 degrees C)
Restrictive Layer: None
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent materials: Colluvium from hydrothermally altered rock
Surface Texture: Ashy Fine sandy loam
Surface Fragments <=3" (% Cover): 8-20
Surface Fragments > 3" (% Cover): 12-55

Soil Depth (inches): 60
Vegetation: Dominated by a dense California red fir (*Abies magnifica*) forest with a very sparse understory.
Notes: This ecological site is found on landslides from hydrothermally altered volcanic rocks; slopes are undulating with a moderate amount of rocks and boulders from the landslide.

Classification relationships

Forest Alliance = *Abies magnifica* – Red fir forest; Association = *Abies magnifica*. (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

R022BI209CA	**Loamy Seeps** This is a riparian site found in drainages.
R022BI203CA	**Moderately Deep Fragmental Slopes** This is a rangeland site dominated by woolly mule-ears.

Similar sites

F022BI112CA	**Frigid Sandy Loam Moraines Or Lake Terraces** This site is not associated with the hydrothermally altered soils but has dense red fir.

Table 1. Dominant plant species

Tree	(1) *Abies magnifica*
Shrub	Not specified
Herbaceous	(1) *Carex* (2) *Hieracium albiflorum*

Physiographic features

This ecological site is found on landslides from hydrothermally altered volcanic rocks between 5830 and 8,100 feet in elevation. Slopes range from 10 to 50 percent.

Table 2. Representative physiographic features

Landforms	(1) Landslide
Flooding frequency	None
Ponding frequency	None
Elevation	1,777–2,469 m
Slope	10–50%
Aspect	E, S, W

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 99 to 113 inches (2,515 to 2,870 mm) and the mean annual temperature is about 39 degrees F (3.9 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)	2,870 mm

Influencing water features

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

Soil features

The Typic Dystroxerepts, landslides soil component is associated with this site. These are very deep, well drained soils with moderate available water capacity (AWC) that developed in landslide deposits. The landslide occurred in a portion of the park that was hydrothermally altered. The original rock mineralogy was modified by acidic steam and water of various temperatures and pH to produce soils that have significantly higher amounts of clay and lower pH values than most soils in the rest of the park. The surface texture is an ashy fine sandy loam, with very stony ashy sandy clay loam subsurface textures. Percent clay increases from 13 percent in the upper horizon to 28 percent in the lowest horizon. Rock fragments increase with depth, with about 25 percent cobbles and stones in the lowest horizon. The surface pH is 5.0, decreasing to 4.3 in the lower horizons. These soils are extremely acid to strongly acid and have high levels of aluminum and manganese. The soil lab report indicates levels of aluminum and manganese that could cause toxicity in plants. Aluminum +++ becomes soluble in acidic soils and impairs root growth, reducing the plant’s ability to access water. Plants with aluminum toxicity may show symptoms of phosphorus (P), calcium (Ca), and magnesium (Mg) deficiencies due to the low pH. Manganese toxicity is also associated with acidic soils. The symptoms of manganese toxicity are reduced shoot growth, discoloring and chlorosis of leaves.

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

Map Unit Component/ Comp %
118 Typic Dystroxerepts, landslides/ 90

Table 4. Representative soil features

Surface texture	(1) Ashy fine sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderate
Soil depth	152 cm
Surface fragment cover <=3"	8–20%
Surface fragment cover >3"	12–55%
Available water capacity (0-101.6cm)	0.48–19.89 cm
Soil reaction (1:1 water) (0-101.6cm)	4.5–6.5
Subsurface fragment volume <=3" (Depth not specified)	4–75%
Subsurface fragment volume >3" (Depth not specified)	0–50%

Ecological dynamics

This ecological site is dominated by a dense California red fir (*Abies magnifica*) forest with a very sparse understory. The canopy cover in this forest ranges from 40 to 55 percent. The slope is undulating with a moderate amount of rocks and boulders from the landslide.

The soils are unique to this area because of a high clay content, low pH, and potentially toxic levels of aluminum and manganese. In addition to the inherent properties of the soil, there may be ongoing chemical deposition from the active hydrothermal vents and bare areas. Deposition can sometimes be seen as a yellow coating on the snow, which can affect surface pH and mineralogy. Hydrogen sulfide (H_2S), carbon dioxide (CO_2), hydrogen gas (H_2), nitrogen (N), and helium (He) are some of the chemicals found in the thermal springs, which react with oxygen and other elements to form the variety of chemicals found in the steam deposits.

Despite the low pH values and possible toxicity levels, the fastest growing red firs within the park are found on this soil. The initial height growth for these trees is very rapid during the first 60 to 70 years and results in a relatively high site index. After this period however, height growth slows and the site index (based on limited data) computes to about 10 to 15 feet lower. The soils are very deep with fine textures that hold seasonal water longer than most of the other soils in the park, providing the trees with a longer growing season. The growing season may also be extended by the many springs nearby, which may add to the ground waterflow. It is possible that the landslide altered conditions that affected the ability of conifers to establish as on the nearby Diamondpeak soils (see ecological sites F022BI113CA and R022BI203CA).

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 0.8 to 1.4 in long needles that 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.

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 that gradually declines through the summer (Royce and Barbour, 2001).

This forest type has evolved with fire over the centuries. It is dense but slow growing and accumulates fuels slower than lower elevation forests. Therefore fire spreads across this site less frequently. The point fire return interval for the red fir-western white pine forest 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). This site is most like the red fir-mountain hemlock site, so it may have a similar fire history. 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).

There is evidence everywhere in this forest type of fire suppression. Young seedlings and saplings are filling in the understory and shading out pinemat manzanita. Some of this area is further along in understory development, with several canopy layers dominated by California red fir. As the canopy cover increases, the shade intolerant western white pine declines in the understory.

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. Trees become more vulnerable to pests and disease when overstressed due to drought or competition for sunlight. Pathogens often infest weak trees and spread in overcrowded conditions. Surviving trees may benefit from the death of overstocked trees when canopy gaps open and provide opportunities for the regeneration of the same or different species.

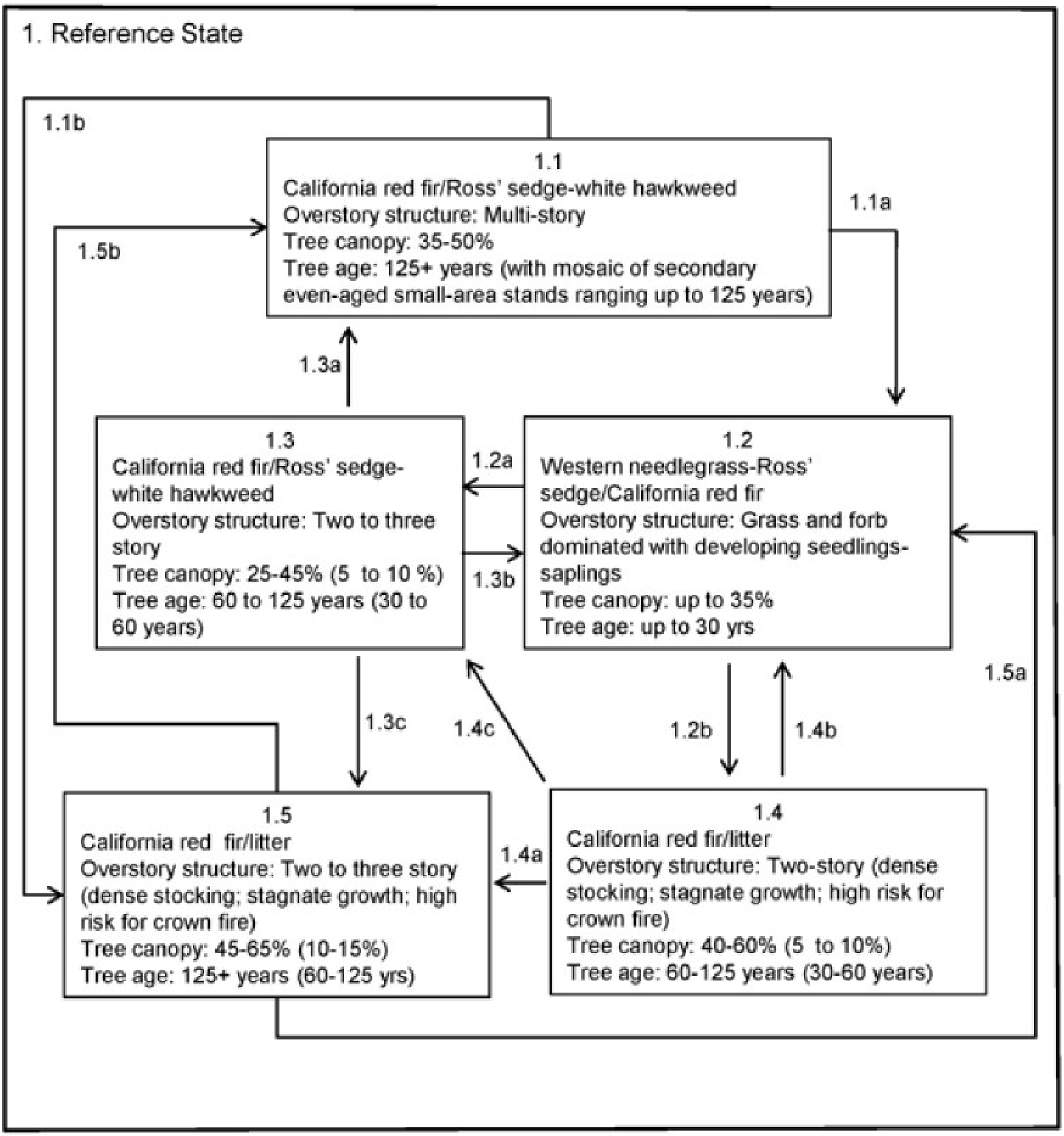
The major pathogens that affect California red fir in this area are red fir dwarf mistletoe (*Arceuthobium abietinum* f. sp. magnificae), fir broom rust (Melampsorella caryophyllacearum), annosus root rot (Heterobasidion annosum), and the fir engraver (Scolytus ventralis) (Murphy et al., 2000). Other 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 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 F022BI118CA
Abies magnifica/Carex rossii-Hieracium albiflorum
(California red fir/Ross' sedge-white hawkweed)



State 1
Reference

Community 1.1
California red fir/Ross sedge-white hawkweed

The mature open California red fir forest community phase is of very limited extent. In most areas California red fir has continued to reproduce in the understory, creating very dense forest. This community phase needs fire in order to maintain an open understory and reduce dense understory canopy layers. The historic fire return interval for this site may be between 9 to 91 years, with an average of 20 years. If the average of 20 years is correct, this site has missed up to 5 fire cycles. The 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. Understory growth is visible in the community phase photo. Some of the understory trees would be killed in the event of a fire.

Forest overstory. This forest is composed of large California red fir trees with a dbh (diameter at breast height) of 30 inches or greater. Canopy cover ranges from 35 to 50 percent. Canopy height is over 100 feet. Basal area is approximately 180 ft/acre.

Forest understory. Understory data was not collected under an open canopy. The species listed below are from a closed forest and may increase in cover under an open canopy.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Tree	–	17	35
Shrub/Vine	–	11	18
Grass/Grasslike	–	7	13
Forb	–	–	7
Total	**–**	**35**	**73**

Community 1.2
Western needlegrass-Ross sedge/California red fir

This community develops after a stand replacing fire or in small gaps created by a canopy disturbance. California red fir will germinate from wind or animal dispersed seed after a fire. 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). Birds, squirrels and other rodents will cache some of these seeds in soil, where they may germinate in bunches if not consumed. 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).

Community 1.3
California red fir/Ross sedge-white hawkweed

California red fir continues to grow in the overstory and understory, but lightening induced surface fires are needed to maintain an open forest. This community phase experiences rapid growth in conifer height and canopy cover. California red fir reaches seed bearing age in 35 to 40 years (Cope, 1993). 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 within this ecological site is relatively common; however dense stands seem to form more often through pathway 1.1b, from increased understory growth under the mature open canopy. This forest develops after 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 California red fir and, to a lesser degree, western white pine. Canopy cover ranges from 40 to 60 percent and overstory trees may be up to 125 years old. The trees are overcrowded and often diseased and stressed due to competition for water and nutrients. This stress makes 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. Competition for water and sunlight continues, and tree health and vigor decreases. An estimated age for this community is from 100 to 200+ years. As mentioned above, the dense community phase is usually reached by community pathway 1.1b, with tree density increasing from the development of the understory under the mature open canopy. The plant community phase photo shows an opening created by red fir dwarf mistletoe (*Arceuthobium abietinum* f. sp. magnificae) and probably other forest pathogens. The photo is not the best representation of the closed forest community phase but depicts what can happen if forests become overstocked and diseased. Young California red fir is regenerating in the openings, but they may become infected as well.

Forest overstory. California red fir forms several canopy layers which provide 50 to 70 percent cover. The upper canopy is over 100 feet tall and the trees have a dbh of 30 inches or greater. A secondary canopy is layered at 80 to 90 feet. These trees are 60 to 90 years old and have an average dbh of 20 inches. Basal area ranges from 220 to over 330 ft2/acre.

Forest understory. The understory is very sparse.

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 (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 open California red fir forest. This pathway includes the effects of time and growth with periodic 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 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 periodic 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 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, Stand 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 community phase 1.5.

Pathway 1.4b
Community 1.4 to 1.2

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 conifer regeneration (Community Phase 1.2).

Pathway 1.4c
Community 1.4 to 1.3

The natural event of a moderate or surface fire in this forest is unlikely due to high fuel accumulation. 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 the red fir and other fuels in the understory, and/or prescribed burns, could be implemented to shift this forest back to its natural state of a California red fir forest (Community Phase 1.3). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.3.

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 high fuel accumulation. 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 out the 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 forest (Community Phase 1.1). A partial mortality disease or pest infestation could also create a shift toward Community Phase 1.1.

Pathway 1.5a
Community 1.5 to 1.2

A fire would likely be severe and would initiate conifer regeneration (Community Phase 1.2).

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
0	**Tree (understory only)**			0–35	
	California red fir	ABMA	*Abies magnifica*	0–26	0–5
	mountain hemlock	TSME	*Tsuga mertensiana*	0–7	0–2
	western white pine	PIMO3	*Pinus monticola*	0–2	0–1
Shrub/Vine					
0	**Shrub**			0–18	
	gooseberry currant	RIMO2	*Ribes montigenum*	0–17	0–1
	whiteveined wintergreen	PYPI2	*Pyrola picta*	0–1	0–1
Grass/Grasslike					
0	**Grass/Grasslike**			0–13	
	Ross' sedge	CARO5	*Carex rossii*	0–7	0–2
	squirreltail	ELEL5	*Elymus elymoides*	0–3	0–1
	western needlegrass	ACOC3	*Achnatherum occidentale*	0–3	0–1
Forb					
0	**Forb**			0–7	
	slender penstemon	PEGR4	*Penstemon gracilentus*	0–3	0–1
	white hawkweed	HIAL2	*Hieracium albiflorum*	0–2	0–1
	Holboell's rockcress	ARHO2	*Arabis holboellii*	0–1	0–1

Table 7. 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	–	2–5	–	–
mountain hemlock	TSME	*Tsuga mertensiana*	Native	–	1–3	–	–

Table 8. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
Ross' sedge	CARO5	*Carex rossii*	Native	–	0–2
squirreltail	ELEL5	*Elymus elymoides*	Native	–	0–1
western needlegrass	ACOC3	*Achnatherum occidentale*	Native	–	0–1
Forb/Herb					
Holboell's rockcress	ARHO2	*Arabis holboellii*	Native	–	0–1
white hawkweed	HIAL2	*Hieracium albiflorum*	Native	–	0–1
slender penstemon	PEGR4	*Penstemon gracilentus*	Native	–	0–1
Shrub/Subshrub					
whiteveined wintergreen	PYPI2	*Pyrola picta*	Native	–	0–1
gooseberry currant	RIMO2	*Ribes montigenum*	Native	–	0–1
Tree					
California red fir	ABMA	*Abies magnifica*	Native	–	0–5
mountain hemlock	TSME	*Tsuga mertensiana*	Native	–	0–2
western white pine	PIMO3	*Pinus monticola*	Native	–	0–1

Table 9. Community 1.5 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	30.5–	45–65	–	–
California red fir	ABMA	*Abies magnifica*	Native	–	10–15	–	–

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 leaves of these conifers in winter and the new growth 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.

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, 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 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. It can reach epidemic levels when the trees are stressed due to drought, annosus root rot, dwarf mistletoe, or from fire damage. (Burns, et al., 1990).

Site index documentation:

Schumacher (1928) was used to determine forest site productivity for red fir. 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*	60	60	214	214	140	050	–	
California red fir	*ABMA*	60	60	214	214	–	–	50TA	Schumacher, Francis X. 1928. Yield, stand and volume tables for red fir in California. University of California Agricultural Experiment Station Bulletin 456.

Inventory data references

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

789177
789363
789364- type location

Type locality

Location 1: Tehama County, CA	
Township/Range/Section	T30 N R4 E S28
General legal description	The type location is about 3,250 feet northwest of the Southwest Entrance Station to Lassen Volcanic National Park, north of the trail that goes from the southwest entrance to Brokeoff Mountain.

Other references

Beaty, Matthew and Taylor, Alan H. (2001). Spatial and Temporal Variation of Fire Regimes in a Mixed Conifer Forest Landscape, Southern Cascades, California, USA. Journal of Biogeography, 28, 955-966.

Bekker, Mathew F. and Taylor, Alan H. (2001). Gradient Analysis of Fire Regimes in Montane Forest of the Southern Cascade Range, Thousand Lakes Wilderness, California, USA. Plant Ecology 155: 15-23.

Burns, Russell M., and Barbara H. Honkala, tech. coords. 1990. Silvics of North America: 1. Conifers; 2. Hardwoods. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC. vol.2, 877 p.

Chappell, Christopher B. and Agee, James K, 1996. Fire Severity and Tree Seedling Establishment in Abies Magnifica Forests, Southern Cascades, Oregon. Ecological Applications, Vol. 6, No. 2. (May, 1996), pp. 628-640.

Cope, Amy B. 1993. *Abies magnifica*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer).
Available: http://www.fs.fed.us/database/feis/ [2009, April 23].

Graham, Russell T. Pinus monticola Western White Pine. In: Silvics of North America, Volume 1. Conifers. U.S Department of Agriculture, Forest Service, Agricultural Handbook 654. pp.385-393.

Griffith, Randy Scott. 1992. Pinus monticola. In: Fire Effects Information System, [Online].
U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2009, April 23].

Hagle, Susan K.; Gibson, Kenneth E.; Tunnock, Scott 2003. Field Guide to Diseases and Insect Pests of Northern and Central Rocky Mountain Conifers. U.S. Department of Agriculture, Forest Service, State and Private Forestry, Intermountain Region.

Haig 1932, Western White Pine. USDA Tech. bul. 323. NASIS ID 570

Howard, Janet L. 1993. Arctostaphylos nevadensis. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2009, April 23].

Kilgore, Bruce M. 1981. Fire in ecosystem distribution and structure: western forests and scrublands. In: Mooney, H. A.; Bonnicksen, T. M.; Christensen, N. L.; [and others], technical coordinators. Proceedings of the conference: Fire regimes and ecosystem properties; 1978 December 11-15; Honolulu, HI. Gen. Tech. Rep. WO-26. Washington, DC: U.S. Department of Agriculture, Forest Service: 58-89.

Laacke, Robert J. *Abies magnifica* California Red Fir. In: Silvics of North America, Volume 1. Conifers. U.S Department of Agriculture, Forest Service, Agricultural Handbook 654. pp.71-77.

Parker, Albert J., 1995. Comparative Gradient Structure and Forest Cover Types in Lassen Volcanic and Yosemite National Parks, California. Bulletin of the Torrey Botanical Club, Vol. 122, No. 1. (Jan. - Mar., 1995), pp. 58-68.

Parker, Albert J., 1991. Forest/Environment Relationships in Lassen Volcanic National Park, California, U.S.A. Journal of Biogeography, Vol. 18, No. 5. (Sep., 1991), pp. 543-552.

Potter, Donald A. (1998). Forested Communities of the Upper Montane in the Central and Southern Sierra Nevada. U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, General Technical Report PSW-GTR-169.

Royce, E. B. and Barbour, M. G., 2001.Mediterranean Climate Effects. I. Conifer Water Use Across a Sierra Nevada Ecotone. American Journal of Botany 88(5): 911–918. 2001.

Royce, E. B. and Barbour, M. G., 2001. Mediterranean Climate Effects. II. Conifer Growth Phenology Across a Sierra Nevada Ecotone. American Journal of Botany 88(5): 919–932. 2001.

Schumacher, Francis X. 1928. Yield, stand and volume tables for red fir in California. University of California Agricultural Experiment Station Bulletin 456. NASIS ID 050

Taylor, Alan. H., 2000. Fire Regimes and Forest Changes in Mid and Upper Montane Forest of the Southern Cascades, Lassen Volcanic National Park, California, U.S.A. Journal of Biogeography, 27, 87-104.

Taylor, Alan H. and Halpern, Charles B., 1991. The structure and dynamics of *Abies magnifica* forests in the southern Cascade Range, USA. Journal of Vegetation Science. 2(2): 189-200. [15768]

Taylor, Alan H. and Solem, Michael N., 2001. Fire Regimes and Stand Dynamics in an Upper Montane Forest Landscape in the Southern Cascades, Caribou Wilderness, California. Journal of the Torrey Botanical Society, Vol. 128, No. 4. (Oct. - Dec., 2001), pp. 350-361.

Contributors

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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	
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):**

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):**

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:

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

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

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

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

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17. **Perennial plant reproductive capability:**
