Natural Resources
Conservation Service

Ecological site F022BI117CA
Frigid Coarse Glaciolacustrine Gentle Slopes

Accessed: 05/19/2024

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) Outwash terrace, (2) Outwash plain
Elevation (feet): 6,280-6,800
Slope (percent): 0-15
Water Table Depth (inches): 7-60
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: No Influence on this site
Mean annual precipitation (inches): 57.0-63.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 41 degrees F (5 degrees C)
Restrictive Layer: Silica cemented duripan varies from 20 to 60 inches
Temperature Regime: Frigid
Moisture Regime: Xeric/Aquic
Parent materials: Volcanic ash over glaciolacustrine deposits over outwash from volcanic rocks
Surface Texture: Gravelly ashy loamy coarse sand
Surface Fragments <=3" (% Cover): 10-50
Surface Fragments > 3" (% Cover): 0-5

Soil Depth (inches): 20-60
Vegetation: Sierra lodgepole pine and California red fir.
Notes: This ecological site occurs on glacial outwash plains and outwash 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

F022BI108CA	**Frigid Moist Sandy Lake Or Stream Terraces** This is a moist Sierra lodgepole pine forest found in lower positions closer to the stream channel.
R022BI206CA	**Cryic Lacustrine Flat** This is a meadow ecological site associated with a stream channel.

Similar sites

F022BI120CA	**Frigid Gravelly Sandy Loam Outwash-Stream Terraces** This is a mixed white fir-Sierra lodgepole pine site found in lower elevations in wetter conditions.
F022BI125CA	**Cold Frigid Tephra Over Outwash Plains Or Lake Terraces** This is a Sierra lodgepole pine forest found in cold air drainages and basins.
F022BI126CA	**Cold Frigid Tephra Over Moraine Slopes** This is a Sierra lodgepole pine forest that is replaced by Jeffrey pine and ponderosa pine over time without disturbance.
F022BI123CA	**Frigid Flat Outwash Terraces** This is a similar site found at lower elevations with white fir in place of red fir.

Table 1. Dominant plant species

Tree	(1) *Abies magnifica* (2) *Pinus contorta var. murrayana*
Shrub	Not specified
Herbaceous	(1) *Elymus elymoides*

Physiographic features

This ecological site occurs on glacial outwash plains and outwash terraces. It is between 6,280 and 6,800 feet in elevation. Slopes range from 0 to 15 percent.

The Duric Vitraquands soil component has a seasonal water table that fluctuates between the duripan to 7 inches below the surface.

Table 2. Representative physiographic features

Landforms	(1) Outwash terrace (2) Outwash plain
Flooding frequency	None
Ponding frequency	None
Elevation	1,914–2,073 m
Slope	0–15%
Water table depth	18–152 cm
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 57 to 63 inches (1,499 to 1,600 mm) and the mean annual temperature is about 41 degrees F (5 degrees C). The frost free (>32F) season is 50 to 85 days. The freeze free (>28F) season is 60 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)	1,600 mm

Influencing water features

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

Soil features

This site is correlated with the Duric Vitraquands and Vitrixerands soil components.
Duric Vitraquands are deep, somewhat poorly drained soils that formed in volcanic ash over glaciolacustrine deposits over outwash from volcanic rocks. The surface texture is gravelly ashy loamy coarse sand, with similar subsurface textures. Redoximorphic features are present below 7 inches. The depth to the silica cemented duripan varies from 40 to 60 inches below the surface.

Vitrixerands are moderately deep and deep, well drained soils that formed in glaciolacustrine deposits from volcanic rocks. The surface texture is gravelly ashy loamy coarse sand with similar subsurface textures to 21 inches, below is a horizon with a very stony medial loamy sand texture. The depth to the silica cemented duripan varies from 20 to 60 inches below the surface.

These soils have very low to low AWC (available water capacity) in the upper 60 inches of soil. Permeability is rapid to moderately rapid through the upper horizons and very slow through the duripan.

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

Map Unit Component / Component %
139 Duric Vitraquands / 60
139 Vitrixerands / 1
140 Vitrixerands / 90
140 Duric Vitraquands / 10
163 Duric Vitraquands / 1

Table 4. Representative soil features

Family particle size	(1) Sandy
Drainage class	Somewhat poorly drained to well drained
Permeability class	Rapid to very slow
Soil depth	51–152 cm
Surface fragment cover <=3"	10–50%
Surface fragment cover >3"	0–5%

Available water capacity (0-101.6cm)	3.23–9.63 cm
Soil reaction (1:1 water) (0-101.6cm)	5.1–7.3
Subsurface fragment volume <=3" (Depth not specified)	15–45%
Subsurface fragment volume >3" (Depth not specified)	1–35%

Ecological dynamics

This ecological site is located on outwash terraces and glacial outwash plains with a root restrictive duripan occurring at varying depths between 20 to 60 inches. The Duric Vitraquands have a seasonal water table which fluctuates from above the duripan to 7 inches below the surface after snow melt. Shallow seasonal water tables and root restrictive layers are often associated with Sierra lodgepole pine forests due to the exclusion of other conifers. However, the conditions are not extreme enough at this site to exclude California red fir.

In 2009, the forest communities are mainly dominated by Sierra lodgepole pine (*Pinus contorta* var. murrayana), but a partial canopy of older California red fir (*Abies magnifica*) exists over the lodgepole pine canopy. Past disturbances created conditions for Sierra lodgepole pine regeneration, but did not remove all of the red fir in the overstory. If this site continues without disturbance, California red fir will eventually prevail. The understory is sparse with carex (Carex spp.), little prince's pine (*Chimaphila menziesii*), Mt. Hood pussypaws (*Cistanthe umbellata* var. umbellata), squirreltail (*Elymus elymoides*), sulphur-flower buckwheat (*Eriogonum umbellatum*), and white hawkweed (*Hieracium albiflorum*).

Sierra lodgepole pine can be long-lived exceeding 150 years old. The overstory trees cored to obtain representative site index data were between 110 to 135 years old. Sierra lodgepole pine does not usually gain much in girth with age, and the older trees averaged 16 to 21 inches in diameter. It grows tall and narrow with short branches. Needles are 1.2 to 2.4 inches long, in fascicles of two. Although its thin bark and shallow root system make Sierra lodgepole pine susceptible to fire, it is the only non-serotinous lodgepole pine. Therefore it does not need fire to open its cones to release seeds. The roots of Sierra lodgepole pine are generally shallow, which enable it to grow on this site. Sierra lodgepole pine produces a taproot, but it may atrophy or grow horizontally in cases of a high water table or a root restrictive layer.

Sierra lodgepole pine regenerates prolifically after fire and evenly aged stands are formed. The mountain pine beetle (Dendroctonus ponderosae) is a natural pest that 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). After an outbreak the forest may be dominated by standing dead trees. These trees eventually fall, creating layers of overlapping logs. Fuel loads are high, but the downed logs burn slowly and at a low intensity. However, even low intensity fire can cause damage to live trees, and fire damaged trees are more susceptible to the next beetle attack. Pine beetle infestations, wind throw and other small scale disturbances create gaps for Sierra lodgepole pine or California red fir regeneration. Over time these gaps break up the uniformity of evenly aged stands that formed after the last large fire event. This site rarely develops into old growth lodgepole pine since red fir establishes in the understory and eventually overtops and shades out the shade-intolerant Sierra lodgepole pine.

California red fir is a tall, long-lived conifer with short branches and a narrow crown. It produces single 0.8 to 1.4 inch 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. Trees are adapted to cold wet winters in areas with deep snow accumulation followed by warm summers. Young trees have thin bark and are very susceptible to fire, but as the trees mature the bark thickens and fire resistance increases.

California red fir is a shade tolerant conifer and is able to establish in the understory of the Sierra lodgepole pine on this site. It will continue to grow and reproduce in the understory and eventually dominate the forest in the absence of disturbance. In the past, the natural fire regime kept these forests from developing into the later successional stages dominated by red fir (Taylor, and Solem, 2001).
Sierra lodgepole pine has a complex disturbance regime which includes cyclic beetle infestations and fire. 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). 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, the point fire return interval ranged from 4 to 55 years, with a mean of 24 for red fir-white fir forests. In the Caribou Wilderness, the mean fire return interval between the years of 1768 and 1874 was 66 years for the red fir-western white pine forest (Taylor and Solem, 2001). A fire return interval for this site might range from 24 to 70 years. Topography and aspect affect fire frequency and intensity (Beaty and Taylor, 2001). This site is in a basin with low slopes. Fire tends to burn upward with increasing intensity as it preheats the fuels. Since this site is in a low position it may experience low to moderate fires, rather than high intensity fires. However, Sierra lodgepole pine will have high mortality rates even after low and moderate intensity fires. Mature California red fir is more likely to survive these fires.

The mountain pine beetle is the most significant forest pathogen affecting this site, but several other pathogens have the potential to cause mortality or diminished productivity. Most of these pathogens represent a natural cycle of regulation and can push the closed forest types into more open forest types. Large outbreaks are often associated with drought years or overstocked forests.

There is evidence that warming temperatures are allowing mountain pine beetles to exist farther north and into upper elevations. Warmer temperatures are altering the reproductive cycles and distribution of the mountain pine beetle. It is possible that the warmer temperatures will increase mountain pine beetle infestations for several decades. The southern mountain pine beetle may move northward due to temperature change as well (Carroll et al, 2003)

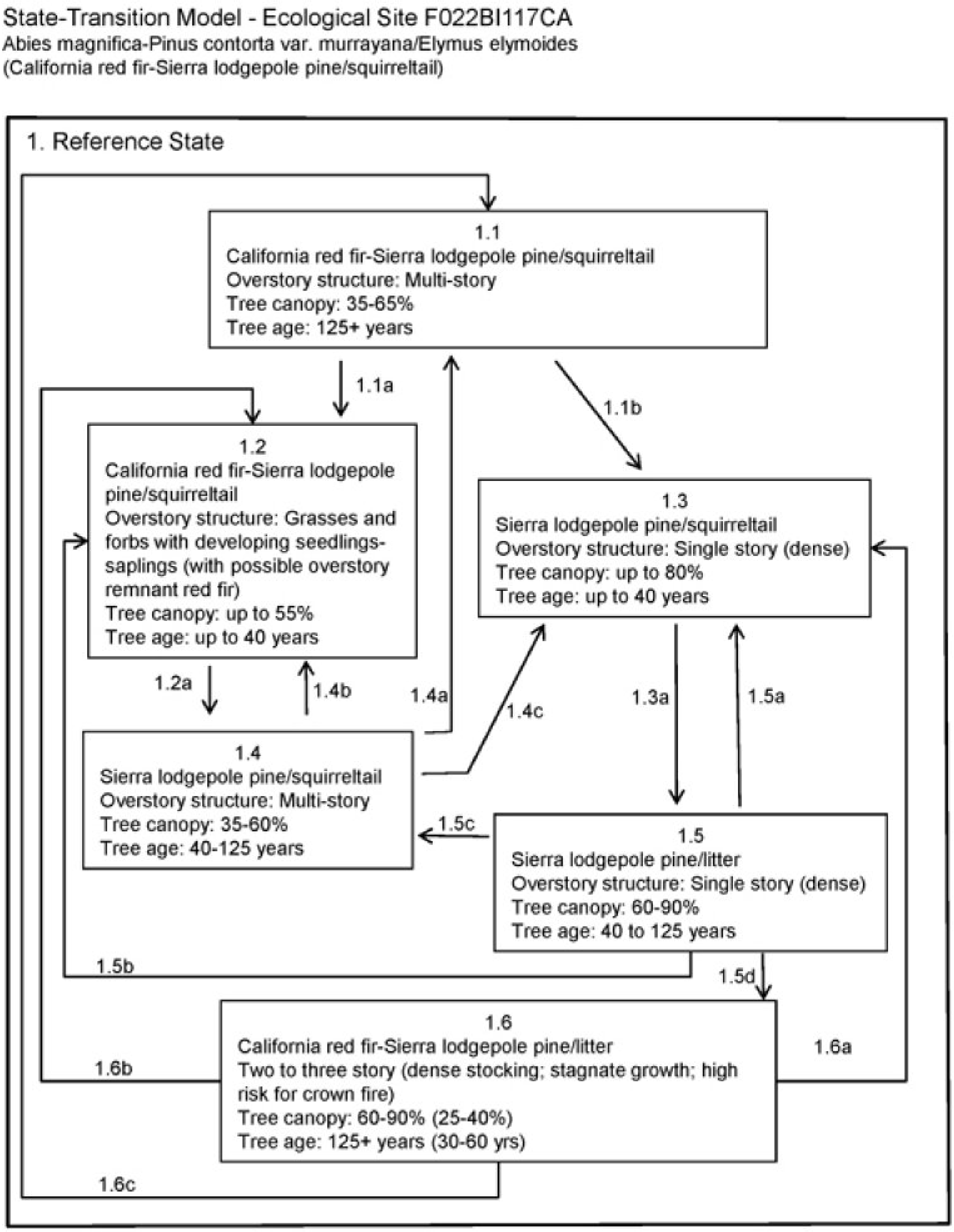
Pathogens that affect Sierra lodgepole pine include other insects such as the pine engraver (Ips pini), weevil (Magdalis gentiles), lodgepole terminal weevil (Pissodes terminalis), Warren's collar weevil (Hylobius warreni), pine needle scale (Chionaspis pinifoliae), black pineleaf scale (Nuculaspis californica), spruce spider mite (Oligonychus ununguis), lodgepole sawfly (Neodiprion burkei), lodgepole needle miner (Coleotechnites milleri), sugar pine tortrix (Choristoneura lambertiana), pine tube moth (Argyrotaenia pinatubana), and the pandora moth (Coloradia pandora). Ips commonly develops in logging slash, especially slash that is shaded and does not dry quickly. Prompt slash disposal is an effective control measure. Ips also can build up in windthrows. Fungal diseases that affect lodgepole pine productivity include the stem cankers caused by atropelius canker (Atropellis piniphilia), comandra blister rust (Cronartium comandrae), and western gall rust (Peridermium harknessii). The honey mushroom (Armillaria mellea) and annosus root disease (Heterobasidion annosum) are sources of root rot, and wood decay is caused by such fungi as red rot (Phellinus pini) and red heart wood stain (Peniophora pseudo-pini). Dwarf mistletoe (*Arceuthobium americanum*) is a common parasite that affects large areas of lodgepole pine (Lotan and Critchfield, 1990).

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 1
Reference

Community 1.1
California red fir-Sierra lodgepole pine/squirreltail

This mature California red fir-Sierra lodgepole pine forest develops with small scale disturbances that create gaps in the canopy. These gaps (single tree fall to 0.25 acre in size) provide suitable sites for Sierra lodgepole pine regeneration and, over time, create an uneven forest structure and composition. Several age classes of Sierra lodgepole pine and California red fir are present. The tallest Sierra lodgepole pines to persist in the overstory provide a seed source for gap areas. Occasional small scale, very low intensity understory burns can perpetuate community structure and conditions, by killing the young understory of California red fir and some of the overstory Sierra lodgepole pine trees.

Forest overstory. A patchy overstory canopy of large California red fir exists over the younger and shorter statured Sierra lodgepole pine canopy. Canopy cover of the red fir ranges from 10 to 30 percent and is 110 to 130 feet above the forest floor. The large red fir trees are over 200 years old. The cover of the Sierra lodgepole pine ranges from 20 to 40 percent, and is between 75 to 100 feet tall. Total canopy cover ranges from 35 to 65 percent. Basal area ranges from 95 to 200 ft2/acre.

Forest understory. The understory is very sparse. Common plants are carex (Carex sp.), little prince's pine (Chimaphila menziesii), Mt. Hood pussypaws (Cistanthe umbellata var. umbellata), squirreltail (Elymus elymoides), sulphur-flower buckwheat (Eriogonum umbellatum), and white hawkweed (Hieracium albiflorum).

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	–	9	45
Tree	3	12	22
Forb	–	1	6
Shrub/Vine	–	3	4
Total	**3**	**25**	**77**

Community 1.2
California red fir-Sierra lodgepole pine/squirreltail

After a stand replacing event such as a high mortality fire or mountain pine beetle infestation, Sierra lodgepole pine will regenerate from wind dispersed seed. This site generally has less than 500 stems per acre and will develop into a relatively open forest. The seedlings can develop into pole sized trees, with up to 55 percent canopy cover. Grasses and forbs may increase in cover for a few years. There may be 5 to 25 percent canopy cover from mature California red fir that survived the fire or other high mortality event.

Community 1.3
Sierra lodgepole pine/squirreltail

This regeneration community phase is defined by dense Sierra lodgepole pine seedlings. More research is needed to determine the cause of dense versus open seedling establishment, and appropriate indicators need to be defined which distinguish the two regeneration patterns. For now, it has been observed that more than 500 to 700 stems of Sierra lodgepole pine per acre can cause stagnant forest growth. There are many variables that influence seedling density. Sierra lodgepole pine produces good seed crops every 1 to 3 years, and seeds are dispersed from late August to mid October. These seeds can be stored in the soil for several years, but regeneration is often from wind dispersed seeds deposited after the fire. Therefore, the season of a burn and its timing in relation to seed crop cycles may affect seedling density. Smaller fires may produce higher seedling densities due to the proximity of an available seed source. Fires leave bare soil and disturbed duff in open sunlight, which are ideal conditions for Sierra lodgepole pine seed germination. Seasonal precipitation patterns and air temperatures during the season influence the germination and survival of seedlings. As the seedlings develop they form dense thickets. The trees will self-thin their lower branches to some extent as they grow taller and thinner, but most will persist even with limited sunlight on their canopy. Growth becomes stagnant due to competition for light, water and nutrients. After a certain point of stagnation, Sierra lodgepole pine may not respond to competitive releases from thinning, disease, or fire. There may be 5 to 25 percent canopy cover from mature California red fir that survived the fire or other high mortality event.

Community 1.4
Sierra lodgepole pine/squirreltail

This forest is multi-aged with an irregular canopy distribution due to small scale or patchy disturbances. Mountain pine beetle infestations are the most significant disturbance to create canopy openings. After a pest infestation, patches of the stand die, leaving gaps for lodgepole pine regeneration. Since low intensity fire is often fatal to mature lodgepole pine and can be a stand replacing event, small fire-created gaps are uncommon. However low intensity smoldering fires have been documented which spread through downed trees after a mountain pine beetle infestation. The smoldering fires occasionally created fire scars on the live trees, rendering them more susceptible to the next mountain pine beetle attack. Shallow roots make lodgepole pine more susceptible to wind throw, also creating canopy gaps. The California red fir that survived the last major fire event create an open upper canopy, with young seedlings regenerating in the shade of the lodgepole pine.

Community 1.5
Sierra lodgepole pine/litter

This dense Sierra lodgepole pine forest develops after dense seedling establishment and the absence of canopy disturbance. The forest is even-aged with a high basal area of tall thin trees. The forest is stagnant. Only the upper crowns get sunlight, and the understory branches die back. The self-thinning process is slow and does not eliminate competition. There is almost no regeneration due to the lack of openings in the forest. Understory production and cover decreases due to the lack of sunlight. The potential for a severe pest infestation or disease is high because the trees are stressed from competition for sunlight, water, and nutrients. The close proximity of the trees will enable the pathogens to spread quickly. Severe fire is likely during this phase because of the high accumulation of fuels on the forest floor. The surviving California red fir from the last major fire event create an open canopy above the dense lodgepole pine canopy. California red fir seedlings regenerate in the shade of the lodgepole pine.

Community 1.6
California red fir-Sierra lodgepole pine/litter

The dense California red fir-Sierra lodgepole pine forest develops with the continued exclusion of fire or other disturbances, allowing the tree density to increase to unhealthy levels. Competition for water and sunlight continues and tree health and vigor decreases. Sierra lodgepole pine persists in the understory of the red fir for some time, but eventually declines due to the lack of sunlight and natural senescence. Fuel loads are high from the trees dying in the understory. Understory vegetation is absent due to the high cover of litter and debris and the lack of sunlight on the forest floor.

Pathway 1.1a
Community 1.1 to 1.2

This pathway is created by a high mortality fire or forest infestation, followed by relatively open Sierra lodgepole pine seedling regeneration (Community Phase 1.2).

Pathway 1.1b
Community 1.1 to 1.3

This pathway is created by a high mortality fire or forest infestation with favorable conditions for dense Sierra lodgepole pine seedling regeneration (Community Phase 1.3) based on ample cones and seeds and optimum conditions for seed germination.

Pathway 1.2a
Community 1.2 to 1.4

This pathway is followed with time and growth and small scale canopy disturbances. An open multi-age lodgepole pine forest develops (Community Phase 1.4).

Pathway 1.3a
Community 1.3 to 1.5

With time and growth the stand remains dense and evenly aged (Dense lodgepole pine forest, Community Phase 1.5). Trees are generally healthy and few gaps are created from tree mortality in this young forest.

Pathway 1.4a
Community 1.4 to 1.1

With time and growth and small scale disturbances, this forest continues to develop into an open California red fir-Sierra lodgepole pine forest (Community Phase 1.1) with a multi-aged, complex forest structure.

Pathway 1.4b
Community 1.4 to 1.2

This pathway is triggered by a high mortality fire, which initiates open 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).

Pathway 1.5b
Community 1.5 to 1.2

This pathway is triggered by a high mortality fire, with appropriate conditions for open lodgepole pine regeneration (Community Phase 1.2). It is common with the natural fire cycle. The historic fire return interval for a nearby Sierra lodgepole pine forest is 67 years. Such a fire return interval does not allow for later succession communities (Community Phases 1.1 and 1.6) to develop.

Pathway 1.5a
Community 1.5 to 1.3

This pathway is triggered by a high mortality fire, with appropriate conditions for dense lodgepole pine regeneration (Community Phase 1.3) based on ample presence of cones and seed and optimum germination of seeds. It is common with the natural fire cycle. The historic fire return interval for a nearby Sierra lodgepole pine forest is 67 years. Such a fire return interval does not allow for later succession communities (Community Phases 1.1 and 1.6) to develop.

Pathway 1.5c
Community 1.5 to 1.4

This pathway is initiated by repeated small scale canopy disturbances caused by mountain pine beetle infestations, low-mortality fires, or wind throw. The forest becomes a more open Sierra lodgepole pine forest (Community Phase 1.4) with several age classes. With continued small scale disturbances it can eventually develop into Community Phase 1.1.

Pathway 1.5d
Community 1.5 to 1.6

With time and growth and the absence of disturbance, the stand remains evenly aged and dense. California red fir establishes in the understory and becomes increasingly prevalent in the canopy, creating a dense California red fir-Sierra lodgepole pine forest (Community Phase 1.6).

Pathway 1.6c
Community 1.6 to 1.1

This pathway is created in time with a high incidence of small scale disturbances that break up the uniformity and density of this forest. With continued disturbances, the open multi-aged California red fir-Sierra lodgepole pine forest (Community Phase 1.1) may develop. The natural event of a moderate or surface fire in this forest is unlikely due to the high fuels and low fire tolerance of the dominant tree species. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest had it developed with small scale disturbances over time.

Pathway 1.6b
Community 1.6 to 1.2

A severe fire would initiate open lodgepole pine regeneration (Community 1.2)

Pathway 1.6a
Community 1.6 to 1.3

A severe fire would initiate dense lodgepole pine regeneration (Community Phase 1.3) based on ample presence of cones and seeds and optimum germination of seeds.

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)**			3–22	
	California red fir	ABMA	*Abies magnifica*	3–17	1–5
	Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0–6	0–2
Shrub/Vine					
0	**Shrub**			0–4	
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0–3	0–1
	little prince's pine	CHME	*Chimaphila menziesii*	0–1	0–1
Grass/Grasslike					
0	**Grass/Grasslike**			0–45	
	squirreltail	ELEL5	*Elymus elymoides*	0–34	0–3
	sedge	CAREX	*Carex*	0–11	0–2

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							
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	20–40	–	–
California red fir	ABMA	*Abies magnifica*	Native	–	10–30	–	–

Table 8. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
squirreltail	ELEL5	*Elymus elymoides*	Native	–	0–3
sedge	CAREX	*Carex*	Native	–	0–2
Forb/Herb					
Mt. Hood pussypaws	CIUMU	*Cistanthe umbellata var. umbellata*	Native	–	0–2
white hawkweed	HIAL2	*Hieracium albiflorum*	Native	–	0–1
Shrub/Subshrub					
sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	Native	–	0–1
little prince's pine	CHME	*Chimaphila menziesii*	Native	–	0–1
Tree					
California red fir	ABMA	*Abies magnifica*	Native	–	1–5
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	0–2

Animal community

Sierra lodgepole pine forests provide food, cover and habitat for a variety of species. These forests have high productivity in the understory with abundant forage for wildlife. They are often located near water bodies and open meadows, which increases the wildlife activity in these forests. Thirty-one mammals and almost fifty bird species have been documented to use Sierra lodgepole pine forests. Snags and downed logs are important for cavity-nesting birds and mammals. Other animals forage on the Sierra lodgepole pine needles and consume the seeds (Cope, 1993).

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. The California red fir cones are cut and cached by squirrels (Cope, 1993).

Recreational uses

This area may suitable for trails and camping, as long as the nearby watercourses, meadows and wildlife are not affected.

Wood products

Sierra lodgepole pine wood is used for framing, paneling, trim, posts, and other construction products. The forests are often uniform is size, which makes harvesting easier. The wood tends to be light and straight grained with consistent texture (Cope 1993).

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).

Other information

Addtional information on 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) and Alexander (1966) were used to determine forest site productivity for California red fir and lodgepole 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 phase 1.4 and the older community stands 1.2 and 1.3. They are selected according to guidance listed in the site index publications.

Table 9. 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	–	–	100TA	Alexander, Robert R. 1966. Site indexes for Lodgepole pine, with corrections for stand density: instructions for field use. USDA, Forest Service. Rocky Mountain Forest and Range Experiment Station Research Paper RM-24.
Sierra lodgepole pine	*PICOM*	82	94	91	111	100	520	–	
Sierra lodgepole pine	*PICOM*	82	94	71	83	–	–	100TA	Alexander, Robert R. 1966. Site indexes for Lodgepole pine, with corrections for stand density: instructions for field use. USDA, Forest Service. Rocky Mountain Forest and Range Experiment Station Research Paper RM-24.

Inventory data references

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

789193
789225- site location

Type locality

Location 1: Shasta County, CA	
Township/Range/Section	T31 N R5 E S33
UTM zone	N
UTM northing	4484467
UTM easting	633249
General legal description	The type location is about 0.47 miles north-northwest of Summit Lake, in Lassen Volcanic National Park.

Other references

Agee, James K.1994. The Lodgepole Pine Series in Fire and Weather Disturbances in Terrestrial Ecosystems of the Eastern Cascades. From volume III: Assessment. USDA, Forest Service, Pacific Northwest Research Station. Gen. Tech. Report.

Alexander, Robert R. 1966. Site indexes for Lodgepole pine, with corrections for stand density: instructions for field use. USDA, Forest Service. Rocky Mountain Forest and Range Experiment Station Research Paper RM-24. NASIS ID 520

Amman, Gene D., McGregor, Mark D., Dolph Robert E. 1990. Mountain Pine Beetle: Forest Insect and Disease Leaflet 2. USDA, Forest Service, Pacific Northwest Region, Portland OR.

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.

Carroll, Allan L.; Taylor, Steve W.; Régnière, Jacques; and Safranyik, Les. 2003. Effects of Climate Change on Range Expansion by the Mountain Pine Beetle in British Columbia. Mountain Pine Beetle Symposium: Challenges and Solutions. October 30-31, 2003, Kelowna, British Columbia. T.L. Shore, J.E. Brooks, and J.E. Stone (editors). Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Information Report BC-X-399, Victoria, BC. 298 p.

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].
Cope, Amy, B. 1993. *Pinus contorta* var. murrayana. In: fire Effects Information Systems, U.S. department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Science Laboratory (Producer).
http://www.fs.fed.us/database/feis/

Lotan, James, E. and Critchfield, William B., 1990. *Pinus contorta*: Lodgepole Pine In: Burns, Russel M., Honkala, Barbara H. eds. Silvics of North America, Vol 1. Conifers.

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.

Meyer, Walter H. 1961. Yield of even-aged stands of ponderosa pine. USDA Technical Bulletin 630. (Revised

1961). NASIS ID 600

Millar, Constance I.; Westfall, Robert D.; Delany, Diane L.; King, John C.; and Graumlich, Lisa J., 2004. Response of Subalpine Conifers in the Sierra Nevada, California, U.S.A., to 20th Century Warming and Decadal Climate Variability. Arctic, Antarctic, and Alpine Research, Vol. 36, No. 2, 2004, pp. 181–200.

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; Smith, Mark; Beck, Tom; Kermeen, Brian; Hance, Wayne; and Robertson, Steve; 1992. Ecological Characteristics of Old Growth Lodgepole Pine in California. USDA, Forest Service.

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., 1990. Tree Invasion in Meadows of Lassen Volcanic National Park, California. Professional Geographer, 42(4), 1990, pp. 457- 470.

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:**

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

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

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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:

---

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):**

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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:**
