Ecological site F022BI126CA
Cold Frigid Tephra Over Moraine Slopes

Accessed: 05/12/2025

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: Ground moraine
Elevation (feet): 6100-6900
Slope (percent): 1-30
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: No Influence on this site
Mean annual precipitation (inches): 39.0-57.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 41 and 44 degrees F (5 and 6.6 degrees C)
Restrictive Layer: Dense till is encountered between 20 to 40 inches
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Tephra over till from volcanic rocks
Surface Texture: Very gravelly ashy sandy loam
Surface Fragments <=3" (% Cover): 35-65
Surface Fragments > 3" (% Cover): 3-30

Soil Depth (inches): 20-40
Vegetation: The heavy dominance of lodgepole pine here is mostly in response to a high fire frequency. The root restrictive layer and cold air drainage may slow the establishment of other conifers, but does not exclude them.
Notes: This site contains approximately 7 inches of tephra over glacial till. The tephra deposits are from the eruption of the Chaos Crags, over 1,000 years ago. A root restrictive layer of dense till is present 20 to 40 inches below the surface.

Classification relationships

Forest Alliance = *Pinus jeffreyi* - Jeffrey pine forest; Association = (no matching species). (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

F022BI107CA	**Frigid Moderately Deep Slopes** This is a red fir-white fir forest found at higher elevations.
F022BI108CA	**Frigid Moist Sandy Lake Or Stream Terraces** This is a wet lodgepole site found on lake and stream terraces.
F022BI125CA	**Cold Frigid Tephra Over Outwash Plains Or Lake Terraces** This lodgepole forest is found on outwash without Jeffrey pine.

Similar sites

F022BI117CA	**Frigid Coarse Glaciolacustrine Gentle Slopes** This is a California red fir-Sierra lodgepole pine site found at higher elevations.
F022BI123CA	**Frigid Flat Outwash Terraces** This is a white fir- Sierra lodgepole pine site, with some aspen.
F022BI120CA	**Frigid Gravelly Sandy Loam Outwash-Stream Terraces** This is a white fir-Sierra lodgepole pine site found in wetter conditions.
F022BI105CA	**Frigid Sandy Loam Debris Flow On Stream Terraces** This is a Sierra lodgepole pine-quaking aspen site.

Table 1. Dominant plant species

Tree	(1) *Pinus jeffreyi* (2) *Pinus contorta var. murrayana*
Shrub	Not specified
Herbaceous	(1) *Monardella odoratissima*

Physiographic features

This ecological site occurs on ground moraines between 6,100 feet to 6,900 feet in elevation. Slopes range from 1 to 30 percent.

Table 2. Representative physiographic features

Landforms	(1) Ground moraine
Flooding frequency	None
Ponding frequency	None
Elevation	1,859–2,103 m
Slope	1–30%
Aspect	Aspect is not a significant factor

Climatic features

This ecological site receives most of its annual precipitation during the winter months in the form of snow. The mean annual precipitation ranges from 39 to 57 inches (991 to 1,448 mm) and the mean annual temperature is between 41 and 44 degrees F (5 and 6.6 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. The nearest one is Manzanita Lake.

Table 3. Representative climatic features

Frost-free period (average)	85 days
Freeze-free period (average)	190 days
Precipitation total (average)	1,448 mm

Influencing water features

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

Soil features

This ecological site is associated with the Badgerflat soil series. Moderately deep and well-drained, these soils formed in tephra over till from volcanic rocks. Surface textures are a very gravelly ashy sandy loam, with sandy subsurface textures containing greater than 35 percent rock fragments. Dense till is encountered between 20 to 40 inches. Permeability is moderately rapid to rapid through the upper horizons, and slow to very slow through the dense till.

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

Map Unit Component/ Component %
100 Badgerflat/ 2
145 Badgerflat/ 2
172 Badgerflat/ 90
173 Badgerflat/ 2

Table 4. Representative soil features

Family particle size	(1) Sandy
Drainage class	Well drained
Permeability class	Rapid to very slow
Soil depth	51–102 cm
Surface fragment cover <=3"	35–65%
Surface fragment cover >3"	3–30%
Available water capacity (0-101.6cm)	2.29–5.21 cm
Soil reaction (1:1 water) (0-101.6cm)	6.1–7.3
Subsurface fragment volume <=3" (Depth not specified)	20–50%
Subsurface fragment volume >3" (Depth not specified)	0–55%

Ecological dynamics

This site contains approximately 7 inches of tephra over glacial till. The tephra deposits are from the eruption of the Chaos Crags, over 1,000 years ago. A root restrictive layer of dense till is present 20 to 40 inches below the surface. The heavy dominance of lodgepole pine here is mostly in response to a high fire frequency. The root restrictive layer and cold air drainage may slow the establishment of other conifers, but does not exclude them.

In 2009, this ecological site is mainly dominated by a Sierra lodgepole pine (*Pinus contorta* var. murrayana) forest, with scattered cover from large Jeffrey pine (*Pinus jeffreyi*) and ponderosa pine (*Pinus ponderosa*). Western needlegrass (*Achnatherum occidentale*), squirreltail (*Elymus elymoides*), narrowleaf lupine (*Lupinus angustifolius*), mountain monardella (*Monardella odoratissima*), and woolly mule-ears (*Wyethia mollis*) are common in the understory.

Sierra lodgepole pine can be long-lived exceeding 150 years old. The overstory trees cored to obtain representative site index data were between 100 to 130 years old. Sierra lodgepole pine does not usually gain much in girth with time and, at this site, older trees averaged 20 to 24 inch diameters. It grows tall and narrow with short branches and 1.2 to 2.4 inch needles in fascicles of two. Its thin bark and shallow roots make it susceptible to fire; it is the only non-serotinous lodgepole pine however, and does not need fire to open its cones to release seeds. The roots of Sierra lodgepole pine are generally shallow. Taproots are known to atrophy or grow horizontally in cases of high water tables or root restrictive layers, which enable them to grown on this site.

Jeffrey pine is a relatively large and long-lived tree. It can attain heights of 200 feet and live for 400 to 500 years or more. It produces 3 to 8 inch needles in bundles of three. The female seed cones range in size from 4.7 to 12 inches. Jeffrey pine produces a deep taproot and extensive lateral roots (Gucker, 2007) that are intolerant of wet conditions. Trees look similar to ponderosa pine but have a vanilla-like odor in the bark, which is not as yellow as the ponderosa pine. Ponderosa pine will grow on this site, but with limited distribution and cover. Jeffrey pine is shade-intolerant and can be replaced over time by white fir if fire is excluded from the system. Mature Jeffrey pines are somewhat adapted to fire because their thicker bark can offer protection from moderate intensity flames. Additionally, the branches of Jeffrey pine tend to thin along lower portions of the tree trunk, leaving the crown 65 to 100 feet above the forest floor.

White fir is a large long-lived tree in this area. It commonly reaches 300 to 400 years in age and heights of 120 to 140 feet. It produces single needles 1.2 to 2.8 inches long that are distributed along young branches. Because the female seed cones open and fall apart while still attached to the tree, cones are not often seen on the forest floor. White fir tends to develop a shallow root system that can graft to other white fir roots and spread root rots (Zouhar, 2001). White fir is a shade-tolerant conifer and is able to establish in the understory of Sierra lodgepole pine on this site. If it continues to grow and reproduce in the understory in the absence of disturbance, it will gradually dominate the forest. In the past, the natural fire regime kept forests from developing into the later successional stages dominated by white or red fir (Taylor, and Solem, 2001). White fir and Sierra lodgepole pine are both relatively fire intolerant species that tend to have high mortality rates after fire.

Sierra lodgepole pine has a complex disturbance regime that 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 result in high mortality rates for the lodgepole pine (Taylor and Solem, 1995). Sierra lodgepole pine regenerates prolifically after fire, forming evenly aged stands. 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. The low intensity fire causes damage to the live trees however, making them more susceptible to the next beetle attack. Pine beetle infestations, wind throw and other small scale disturbances create gaps for Sierra lodgepole pine, Jeffrey pine or ponderosa pine regeneration. Over time these gaps will break up the uniformity of evenly aged stands that formed after the last large fire event.

Fire regime studies, using tree rings and fire scars, report historic median fire return intervals in Jeffrey pine-white fir forests of 14, 18.8, and 70 years (Bekker and Taylor; Skinner and Chang; Taylor and Solem, respectively). Beaty and Taylor report that fire frequency and intensity is additionally associated with slope position, aspect, and climatic fluctuations. Fire return intervals are longer on north facing slopes than on south facing slopes. Stand replacing fire is more common on upper slopes, while low to moderate intensity fires occur only along lower slopes. This is probably due to the tendency of fire to burn upslope, preheating the fuels as it goes (Beaty and Taylor, 2001). In July and August, thunderstorms are common in Lassen Volcanic National Park and the summer drought conditions begin, initiating the fire season. Large fires and multiple small fires in the same season are associated with dry and very dry years (Beaty and Taylor, 2001). Prior to fire suppression, this ecological site would not have developed as often into the later successional stages dominated by white fir, and therefore the Sierra lodgepole pine forest may have been more extensive (Taylor, and Solem, 2001).

The mountain pine beetle is the most significant forest pathogen affecting this site, but several other pathogens have potential to cause mortality or diminish productivity. Most of these pathogens are natural cycles of regulation that push 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), the weevil (Magdalis gentiles), the lodgepole terminal weevil (Pissodes terminalis), the Warren's collar weevil (Hylobius warreni), the pine needle scale (Chionaspis pinifoliae), the black pineleaf scale (Nuculaspis californica), the spruce spider mite (Oligonychus ununguis), the lodgepole sawfly (Neodiprion burkei), the lodgepole needle miner (Coleotechnites milleri), the sugar pine tortrix (Choristoneura lambertiana), the 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).

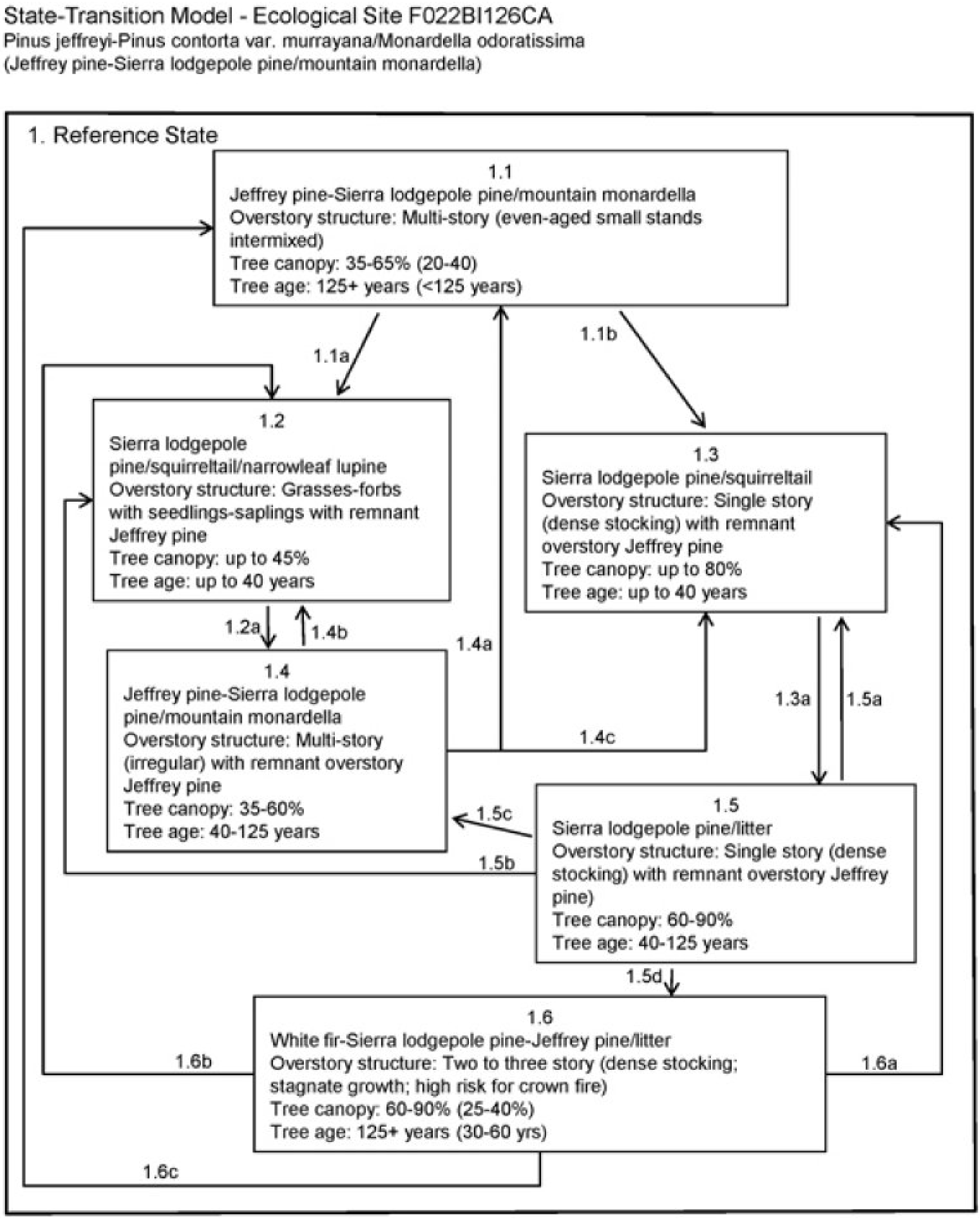
Jeffrey Pine is susceptible to several diseases and insect infestations, especially in periods of drought or when overcrowded. Pathogens that affect Jeffrey pine in this area are dwarf mistletoe (Arceuthobium campylopodium), root disease (Phaeoleus schweinitzii), needle cast (Elytroderma deformans), Jeffrey pine bark beetle, (Dendroctonus jeffreyi), Red turpentine beetle (D. valens), and pine engravers (Ips species). The most threatening of these are the dwarf mistletoe and the Jeffrey pine bark beetle (Bohne, 2006; Jenkinson, 1990).

Pathogens that affect white fir are the dwarf mistletoe (*Arceuthobium abietinum* f. sp. concoloris), Cytospora canker (Cytospora abietis), broom rust (Melamsporella caryophyllacearum), annosus root disease (Heterobasidium annosum), armillaria root disease (Armillaria sp.), trunk rot (Echinodontium tinctorium) and the fir engraver (Scotylus ventralis). The most threatening of these is the combination of the fir engraver and annosus root disease. These pathogens can kill large areas of white fir (Bohne, 2006; Laacke, 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
Jeffrey pine-Sierra lodgepole pine/mountain monardella

This mature Jeffrey pine-Sierra lodgepole pine forest develops with small scale disturbances that create gaps in the canopy. These gaps (single tree-fall to 0.25 acres in size) provide suitable sites for Sierra lodgepole pine, Jeffrey pine and ponderosa pine regeneration. Over time with continual disturbances, an uneven forest structure with varying age classes of pines develops. Taller overstory Sierra lodgepole pine that persist provide a seed source for gap areas. Low intensity understory burns cause high mortality in the understory trees and portions of the overstory lodgepole pine, opening the canopy.

Community 1.2
Sierra lodgepole pine/squirreltail/narrowleaf lupine

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. Depending upon fire severity, a portion of the Jeffrey pine and ponderosa pine will survive and provide an important seed source for regeneration. This site generally has less than 500 stems per acre and will grow into a relatively open forest. Seedlings can develop into pole-sized trees with up to 55 percent canopy cover. Grasses and forbs will increase in cover for several years.

Community 1.3
Sierra lodgepole pine/squirreltail

This regeneration community phase is defined by dense Sierra lodgepole pine seedlings. It seems to be the least common path for this ecological site. Depending upon fire severity, a portion of Jeffrey pine and ponderosa pine survive the fire. They provide an important seed source for regeneration. Fires leave bare soil and disturbed duff in open sunlight, which are ideal conditions for Sierra lodgepole pine, Jeffrey pine and ponderosa pine seed germination. Sierra lodgepole pine tends to reproduce more prolifically just after fire than either Jeffrey pine or ponderosa pine. It can form dense, almost impenetrable stands. More research is needed to determine the cause of dense versus open seedling establishment, and appropriate indicators need to be defined to distinguish between 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. Many variables influence seedling density. Sierra lodgepole pine will produce 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, however seedlings tend to regenerate from wind dispersed seeds after fire. Therefore, the season and timing of a burn in relation to seed crop cycles may affect seedling density. Smaller fires may produce higher seedling densities, due to the proximity of available seed sources. Seasonal precipitation patterns and air temperatures during germination influence seedling survival. Dense thickets are formed as the seedlings develop. As the trees grow taller they thin their lower branches. Most trees persist even with limited sunlight on their canopies. Growth becomes stagnant when chronic competition for light, water and nutrients exists. After a certain point of stagnation, Sierra lodgepole pine may not respond to competitive release from thinning, disease, or fire.

Community 1.4
Jeffrey pine-Sierra lodgepole pine/mountain monardella

This forest is multi-aged with an irregular canopy distribution due to small scale or patchy disturbances. In 2009, this is the common community phase. There are scattered large Jeffrey pine trees, which survived the last fire. The relatively open Sierra lodgepole pine canopy is 20 to 30 feet below the Jeffrey pine. Sierra lodgepole pine, Jeffrey pine and ponderosa pine seedlings are present in open areas. There may be an occasional white fir in the understory. The two most significant forest disturbances leading to the creation of canopy gaps are provided by mountain pine beetle infestations and fire. After a pest infestation, patches of a stand die and leave gaps for lodgepole pine regeneration. Low intensity fire is often fatal to mature lodgepole pine and even a low severity fire can be a stand replacing event; however low intensity smoldering fires have been documented that had spread through downed trees after mountain pine beetle infestations. Although damage to live trees appeared minor, those with fire scars were rendered more susceptible to the next mountain pine beetle attack. Canopy gaps may also be created by wind throw, a susceptibility of Sierra lodgepole pine due to its shallow root system.

Forest overstory. Total tree canopy cover ranges from 35 to 60 percent, dominated by Sierra lodgepole pine.

Large Jeffrey pines provide 2 to 10 percent cover. The older Jeffrey pines are probably over 200 years old. The younger strata of Sierra lodgepole pine from the area of this photo are 110 to 120 years old and 100 to 120 feet tall. The data represents an advanced stage within this community. Basal areas range from 65 to 150 ft2/acre.

Forest understory. The understory is diverse with a fair amount of cover and production. Recent fires and other disturbances have kept the canopy open and removed litter from the forest floor, allowing forbs and grasses to develop. Common plants are western needlegrass (Achnatherum occidentale), smooth brome (Bromus inermis), carex (Carex spp.), Ross' sedge (Carex rossii), squirreltail (Elymus elymoides), rubber rabbitbrush (Ericameria nauseosa ssp. nauseosa var. speciosa), sulphur-flower buckwheat (Eriogonum umbellatum), spreading groundsmoke (Gayophytum diffusum), California stickseed (Hackelia californica), narrowleaf lupine (Lupinus angustifolius), mountain monardella (Monardella odoratissima), silverleaf phacelia (Phacelia hastata), wax currant (Ribes cereum), lettuce wirelettuce (Stephanomeria lactucina), goosefoot violet (Viola purpurea) and woolly mule-ears (Wyethia mollis).

There is approximately 3 percent cover from Sierra lodgepole pine saplings.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	11	41	253
Forb	19	131	249
Grass/Grasslike	3	46	94
Tree	–	37	59
Total	**33**	**255**	**655**

Table 6. Ground cover

Tree foliar cover	35-65%
Shrub/vine/liana foliar cover	0-2%
Grass/grasslike foliar cover	3-20%
Forb foliar cover	4-45%
Non-vascular plants	0%
Biological crusts	0%
Litter	50-90%
Surface fragments >0.25" and <=3"	35-65%
Surface fragments >3"	3-30%
Bedrock	0%
Water	0%
Bare ground	2-8%

Community 1.5
Sierra lodgepole pine/litter

This dense Sierra lodgepole pine forest develops after dense seedling establishment and absence of canopy disturbance. This 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 enables pathogens to spread quickly. Severe fire is likely during this phase because of the high accumulation of fuels on the forest floor. Mature Jeffrey pine and ponderosa pine that survived the last fire stand above the dense Sierra lodgepole pine canopy. A lower cover of younger Jeffrey pine and ponderosa pine may exist among the Sierra lodgepole pine canopy. White fir establishes in the understory.

Community 1.6
White fir-Sierra lodgepole pine-Jeffrey pine/litter

The white fir-mixed conifer forest develops with the continued exclusion of fire or other disturbances. Shade-tolerant white fir has continued to regenerate under the Sierra lodgepole pine canopy. Jeffrey pine and ponderosa pine remain present in the upper canopy and, to some extent, in the lower Sierra lodgepole pine canopy. Without canopy disturbances, the lodgepole pine remains evenly aged and dense, limiting regeneration of the shade-intolerant pines. Competition for water and sunlight continues and tree health and vigor decreases. Sierra lodgepole pine persists in the understory of the white 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, followed by relatively dense Sierra lodgepole pine seedling regeneration (Community Phase 1.3) provided by ample cones and seed and favorable 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 a Jeffrey pine-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 lodgepole pine regeneration (Community Phase 1.3) provided by ample cones and seeds and favorable seed germination.

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). Pathways 1.5a and 1.5b are 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 successional community phases (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), i.e. ample cones and seeds and favorable seed germination.

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. White fir, which has established in the understory, becomes increasingly prevalent in the canopy and creates a white fir-mixed conifer 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, which break up the uniformity and density of this forest. With continued disturbances the open multi-aged Jeffrey pine-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 Phase 1.2).

Pathway 1.6a
Community 1.6 to 1.3

A severe fire would initiate dense lodgepole pine regeneration (Community Phase 1.3) provided there are ample cones and seed and favorable seed germination.

Additional community tables

Table 7. Community 1.4 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
0	**Tree (understory only)**			0–59	
	Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0–39	0–7
	Jeffrey pine	PIJE	*Pinus jeffreyi*	0–11	0–2
	ponderosa pine	PIPO	*Pinus ponderosa*	0–6	0–1
	white fir	ABCO	*Abies concolor*	0–3	0–1
Shrub/Vine					
0	**Shrub**			11–253	
	mountain monardella	MOOD	*Monardella odoratissima*	11–224	2–20
	rubber rabbitbrush	ERNAS2	*Ericameria nauseosa ssp. nauseosa var. speciosa*	0–16	0–2
	wax currant	RICE	*Ribes cereum*	0–11	0–2
	sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	0–2	0–2
Grass/Grasslike					
0	**Grass/Grasslike**			3–94	
	squirreltail	ELEL5	*Elymus elymoides*	11–67	2–10
	western needlegrass	ACOC3	*Achnatherum occidentale*	3–13	1–4
	smooth brome	BRIN2	*Bromus inermis*	0–6	0–2
	Ross' sedge	CARO5	*Carex rossii*	0–4	0–2
	sedge	CAREX	*Carex*	0–3	0–2
Forb					
0	**Forb**			19–249	
	woolly mule-ears	WYMO	*Wyethia mollis*	8–115	1–15
	narrowleaf lupine	LUAN4	*Lupinus angustifolius*	11–90	1–8
	California stickseed	HACA	*Hackelia californica*	0–28	0–5
	lettuce wirelettuce	STLA	*Stephanomeria lactucina*	0–10	0–6
	silverleaf phacelia	PHHA	*Phacelia hastata*	0–3	0–2
	spreading groundsmoke	GADI2	*Gayophytum diffusum*	0–1	0–1
	goosefoot violet	VIPU4	*Viola purpurea*	0–1	0–1

Table 8. Community 1.4 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	–	32–45	–	–
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	2–10	–	–
ponderosa pine	PIPO	*Pinus ponderosa*	Native	–	1–5	–	–

Table 9. Community 1.4 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
squirreltail	ELEL5	*Elymus elymoides*	Native	–	2–10
western needlegrass	ACOC3	*Achnatherum occidentale*	Native	–	1–4
smooth brome	BRIN2	*Bromus inermis*	Native	–	0–2
sedge	CAREX	*Carex*	Native	–	0–2
Ross' sedge	CARO5	*Carex rossii*	Native	–	0–2
Forb/Herb					
woolly mule-ears	WYMO	*Wyethia mollis*	Native	–	1–15
narrowleaf lupine	LUAN4	*Lupinus angustifolius*	Native	–	1–8
lettuce wirelettuce	STLA	*Stephanomeria lactucina*	Native	–	0–6
California stickseed	HACA	*Hackelia californica*	Native	–	0–5
silverleaf phacelia	PHHA	*Phacelia hastata*	Native	–	0–2
spreading groundsmoke	GADI2	*Gayophytum diffusum*	Native	–	0–1
goosefoot violet	VIPU4	*Viola purpurea*	Native	–	0–1
Shrub/Subshrub					
mountain monardella	MOOD	*Monardella odoratissima*	Native	–	2–20
wax currant	RICE	*Ribes cereum*	Native	–	0–2
rubber rabbitbrush	ERNAS2	*Ericameria nauseosa ssp. nauseosa var. speciosa*	Native	–	0–2
sulphur-flower buckwheat	ERUM	*Eriogonum umbellatum*	Native	–	0–2
Tree					
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	0–7
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	0–2
ponderosa pine	PIPO	*Pinus ponderosa*	Native	–	0–1
white fir	ABCO	*Abies concolor*	Native	–	0–1

Animal community

Sierra lodgepole pine forests provide food, cover and habitat for a variety of species. There are 31 mammals and almost 50 bird species documented in Sierra lodgepole pine forests. Snags and downed logs are important for cavity-nesting birds and mammals. Other animals feed on the Sierra lodgepole pine needles and consume the seeds (Cope, 1993).

American black bears, a diversity of small mammals and bird species, as well as insects, amphibians, and reptiles utilize Jeffrey pine for habitat or use the seeds and needles for food. Animals that eat the seeds include California quail, northern flickers, American crows, Clark's nutcrackers, western gray squirrels, Douglas's squirrels, California ground squirrels, Heermann's kangaroo rats, deer mice, yellow-pine chipmunks, least chipmunks, Colorado chipmunks, lodgepole chipmunks, and Townsend's chipmunks (Gucker, 2007).

Recreational uses

This area is suitable for trails and camping.

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).

Ponderosa pine wood is used for dimensional lumber, molding, mill work, cabinents, doors and window (Habeck, 1992).

Jeffrey pine wood is used for lumber. No commercial distinction is made between ponderosa pine and Jeffrey pine lumber.

Other products

Jeffrey pine seeds are edible. Native Americans used Jeffrey pine sap as a remedy for pulmonary disorders. Later, heptane was distilled from the sap and sold as a treatment for pulmonary problems and tuberculosis. Jeffrey pine heptane was also utilized in developing the octane scale used to rate petroleum for automobiles (Gucker, 2007).

Other information

SITE INDEX DOCUMENTATION:

Alexander (1966) and Meyer (1961) were used to determine forest site productivity for lodgepole pine and Jeffrey 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 1.5. 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
Sierra lodgepole pine	*PICOM*	85	85	96	96	100	520	–	
Sierra lodgepole pine	*PICOM*	85	85	74	74	–	–	100TA	Meyer, Walter H. 1961. Yield of even-aged stands of ponderosa pine. USDA Technical Bulletin 630. (1938 version revised in 1961).
Jeffrey pine	*PIJE*	69	69	54	54	–	–	100TA	Meyer, Walter H. 1961. Yield of even-aged stands of ponderosa pine. USDA Technical Bulletin 630. (1938 version revised in 1961).
Jeffrey pine	*PIJE*	69	69	54	54	51	600	–	

Inventory data references

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

789353-type location
789354
789368
789393
789394

Type locality

Location 1: Shasta County, CA	
Township/Range/Section	T31 N R5 E S10
UTM zone	N
UTM northing	4490982
UTM easting	635029
General legal description	The type location is about 1.3 miles west northwest from the western edge of Soap 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. *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/

Habeck, R. J. 1992. *Pinus ponderosa* var. ponderosa. 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/ [2010, January 23].

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. 1926.Yield, stand, and volume tables for white fir in the California pine region. University of California Agricultural Experiment Station Bulletin 407. NASIS ID 030

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:**

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:

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:**