USDA Natural Resources Conservation Service

Ecological site F022BI109CA
Frigid Deep Coarse Sandy Cinder Cone Or Shield Volcano 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: (1) Cinder cone, (2) Shield volcano
Elevation (feet): 6,240-8,200
Slope (percent): 10-60
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: South, East, West
Mean annual precipitation (inches): 27.0-57.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 41 and 44 degrees F (5 to 6.6 degrees C)
Restrictive Layer: Lithic bedrock
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Tephra from cinder cone volcanoes or in tephra over residuum from andesite
Surface Texture: (1) Very gravelly ashy coarse sand, (2) Ashy coarse sand
Surface Fragments <=3" (% Cover): 18-40
Surface Fragments > 3" (% Cover): 0-25

Soil Depth (inches): 40-60+
Vegetation: California red fir-Jeffrey pine (*Abies magnifica-Pinus jeffreyi* respectively) forest with pinemat manzanita (*Arctostaphylos nevadensis*) in the canopy openings. Western white pine (*Pinus monticola*) replaces Jeffrey pine at the upper elevations of this site.
Notes: This ecological site is located on cinder cone volcanoes or on the side slopes of shield volcanoes.

Classification relationships

Forest Alliance = *Abies magnifica* - Red fir forest; Associations = *Abies magnifica*/*Arctostaphylos nevadensis*. (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

F022BI114CA	**Frigid Very Deep Cinder Cone Or Shield Volcano Slopes** This site has similar vegetation but is more open because it associated with volcanic rubble.

Similar sites

F022BI115CA	**Frigid And Cryic Gravelly Slopes** This is a red fir-western white pine forest.
F022BI107CA	**Frigid Moderately Deep Slopes** This site is a red fir-white fir-Jeffrey pine forest.

Table 1. Dominant plant species

Tree	(1) *Abies magnifica* (2) *Pinus jeffreyi*
Shrub	Not specified
Herbaceous	(1) *Arctostaphylos nevadensis* (2) *Achnatherum occidentale*

Physiographic features

This ecological site is located on cinder cone volcanoes or on the side slopes of shield volcanoes. It is mapped from 6,240 to 8,200 feet in elevation but the majority of the site is found between 6,700 and 8,000 feet. Slopes range from 10 to 60 percent.

Table 2. Representative physiographic features

Landforms	(1) Cinder cone (2) Shield volcano
Flooding frequency	None
Ponding frequency	None
Elevation	6,240–8,200 ft
Slope	10–60%
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 between 27 and 57 inches (686 mm to 1,448 mm) and the mean annual temperature ranges between 41 and 44 degrees F (5 to 6.6 degrees C). The frost free (>32 degrees F) season is 50 to 85 days. The freeze free (>28 degrees F) 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)	57 in

Influencing water features

This site is not influenced by water features.

Soil features

This site is associated with the Ashbutte and Prospectpeak soil components. These soils are deep to very deep, and well drained to somewhat excessively drained. They formed in tephra from cinder cone volcanoes or in tephra over residuum from andesite. They have very low AWC. The surface textures are very gravelly ashy coarse sand and ashy coarse sand. They have coarse subsurface textures with extremely gravelly or stony modifiers. The Prospectpeak soils have a lithic contact between 40 to greater than 60 inches. Permeability is very rapid for the Ashbutte soils. The permeability of the Prospectpeak soils is very rapid to rapid through the upper horizons and very slow through bedrock.

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

Maunit Component Percent
102 Ashbutte 65
102 Prospectpeak 2
109 Prospectpeak 85
110 Prospectpeak 2

Table 4. Representative soil features

Family particle size	(1) Sandy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Very rapid to very slow
Soil depth	40 in
Surface fragment cover <=3"	18–40%
Surface fragment cover >3"	0–25%
Available water capacity (0-40in)	0.03–3.72 in
Soil reaction (1:1 water) (0-40in)	5.6–7.3
Subsurface fragment volume <=3" (Depth not specified)	20–80%
Subsurface fragment volume >3" (Depth not specified)	0–60%

Ecological dynamics

This site is represented by a California red fir-Jeffrey pine (*Abies magnifica-Pinus jeffreyi* respectively) forest with pinemat manzanita (*Arctostaphylos nevadensis*) in the canopy openings. Western white pine (*Pinus monticola*) replaces Jeffrey pine at the upper elevations of this site. In its natural condition this forest has relatively low canopy cover from large old growth California red fir and Jeffrey pine. The understory cover is moderate with a mix of shrubs, forbs and grasses.

The dominance of California red fir (*Abies magnifica*) in this forest type increases with elevation and northern aspects. 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 needles that are distributed along 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 the trees mature the bark thickens and fire resistance increases.

Jeffrey pine (*Pinus jeffreyi*) is commonly co-dominant with California red fir in this ecological site. Jeffrey pine produces 3 to 8 inch needles in bundles of three. The female seed cones range from 4.7 to 12 inches in length. Trees produce deep taproots and extensive lateral roots (Gucker, 2007) that are intolerant of wet conditions. Jeffrey pine looks similar to ponderosa pine but has a vanilla-like odor in the bark, which is not as yellow. They are shade intolerant and can be replaced over time by white fir or California red fir if fire is excluded from the system. Older Jeffrey pines are somewhat adapted to fire because their bark is thick enough to provide protection from moderate intensity fires. Additionally, their branches tend to thin along the lower portion of the tree trunk, leaving the crown 20 to 30 meters above the forest floor.

A study on conifer growth phenology in the Sierra Nevada describes the timing and growth period for several conifer species. The initial growth of California red fir is faster than its associated conifer species, then returns to a slower growth. Temperature is critical in initiating conifer growth after snowmelt. In the study, trees generally started 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 was unusually early, the trees did not begin annual growth until specific air temperatures were reached. It was hypothesized that heavy shrub cover delayed the start of annual growth because shade kept the soil from warming as fast as needed. The pines in the study began leader growth when the air temperatures reached -4 degrees C (24.8 degrees F), and the firs responded after temperatures reached 2 to 3 degrees C (35.6 to 37.4 degrees F). Pines have heavily insulated terminal buds, whereas the terminal buds of fir trees are less insulated and more susceptible to frost damage. The length of the leader growth is predetermined by growth conditions of the prior year. Primordia of fir needles and pine fascicles are developed the year before leader growth. The internode length between fir needles or pine fascicles is determinate, the leader length is determined by the number of primordia developed. It appears that some conifers will not start leader growth until a specific photoperiod (a ratio of light hours to dark hours during one 24 hour period) is met, even if the snow has melted and the temperatures are warm enough. 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, the growing season can be prolonged. Conifer growth ceases with the onset of drought conditions and the decline of water potentials (Royce and Barbour, 2001). This study shows that precipitation and soil and air temperatures are critical for annual growth, with each species having specific tolerance zones. This site is within the tolerance range of California red fir and Jeffrey pine. Western white pine finds appropriate conditions for growth at the upper elevations of this site, and white fir is adapted at the lower elevations.

This site receives 42 inches average annual precipitation, mostly in the form of snow in winter. As the snow melts it fills macropores in the soil with water. Soil characteristics such as depth and texture determine how much water the soil can hold and how long it will remain before filtering through, evaporating away, or being lost to evapotranspiration. The soils associated with this site have very low to low water holding capacities. Under the same climatic conditions, drought would come earlier to these soils than those with higher water holding capacities. As this site experiences early drought conditions, these trees have a short growing season.

In the year 2000 Alan Taylor published a report on the historic fire regimes of several forest types in relation to aspect on Prospect Peak. A large portion of this ecological site is located on the south and south-eastern side of Prospect Peak between the Jeffrey pine-white fir forests at the lower elevations and the red fir-western white pine forests at the upper elevations. In Taylor’s report fire regimes were determined by dating wood cross sections from fire scarred trees or by examining radial growth changes in tree cores. Between the years of 1546 and 1903, the point fire return interval for Jeffrey pine-white fir forests ranged from 15.5 to 38 years, with a mean of 29.8. The point fire return interval for red fir-western white pine forests between the years of 1685 and 1937 ranged from 26 to 109, with a mean of 70 (Taylor, 2000). Fire return intervals were shorter on the eastern slopes than on the southern and western slopes. Data was not analyzed for the northern slopes, which extend beyond the park boundary. Some of the variation in the fire return interval was attributed to the un-vegetated areas of Fantastic Lava Beds, Painted Dunes and Cinder Cone, which lie to the south. These formations do not provide fuel sources and act as a fire barrier. This red fir-Jeffrey pine ecological site probably has a fire return interval between the means listed above (30 to 70 years) or shorter, if on an eastern aspect. In a separate study, Beaty and Taylor report that fire return intervals are longer on north facing slopes than on south facing slopes. This report also states that 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). Fire size on Prospect Peak between the years of 1627 and 1904 ranged from 39 to 1537 ha, with a mean of 457 ha. The larger fires generally occurred in the Jeffrey pine forests (Taylor, 2000).

Taylor reports a significant drop in fire frequency and a corresponding increase in understory fuels and canopy cover after 1905. This change developed more quickly in the lower Jeffrey pine-white fir forests than in the upper elevation red fir-western white pine forests. Natural fire regimes reflect the time it takes for forests to naturally develop fuels sufficient to carry fire. At the upper elevations in a red fir dominated forest, fuel accumulation is slower, more compact, and the fuels remain moist for longer during the summer, thereby reducing the risk of fire. Red fir seedlings develop slower than white fir seedlings due to physiographic characteristics and climatic variables, so ladder fuels take longer to develop in red fir forests. If a natural fire regime is 70 years (as for red fir-western white pine forests) then the impact of missing 1 fire cycle in 100 years will be less significant than a forest with a 30 year fire regime that has missed 3 fire cycles. If fire cycles continue to be passed, stand density and fuel loads will increase to levels that put forests at risk of disease and severe canopy fire. The suppression of fire cycles can also create a change in species composition by allowing fire intolerant and shade tolerant firs to increase in cover and density, eventually out-competing fire tolerant and shade intolerant pines (Taylor and Solem, 2001).

Most of the forest within the present park boundary was never logged, but fire suppression has created a change in the stand structure and composition. With a natural fire regime an open forest and the presence of Jeffrey pine or western white pine is encouraged. Low to moderate intensity fires maintain an open forest, with patches of montane shrubs and forbs in the canopy openings. In the absence of fire, California red fir continues to regenerate in the understory, increasing forest density and fuels.

Tree pathogens and insect infestations can have significant impacts on the composition and structure of mid and upper montane coniferous forests. Small infestations may affect just a few trees but large outbreaks may kill the dominant trees over large areas of forest, creating large canopy openings and stand regeneration. Most of these pathogens are 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. Fuel loads are frequently high after outbreaks, creating ideal conditions for high intensity fires.

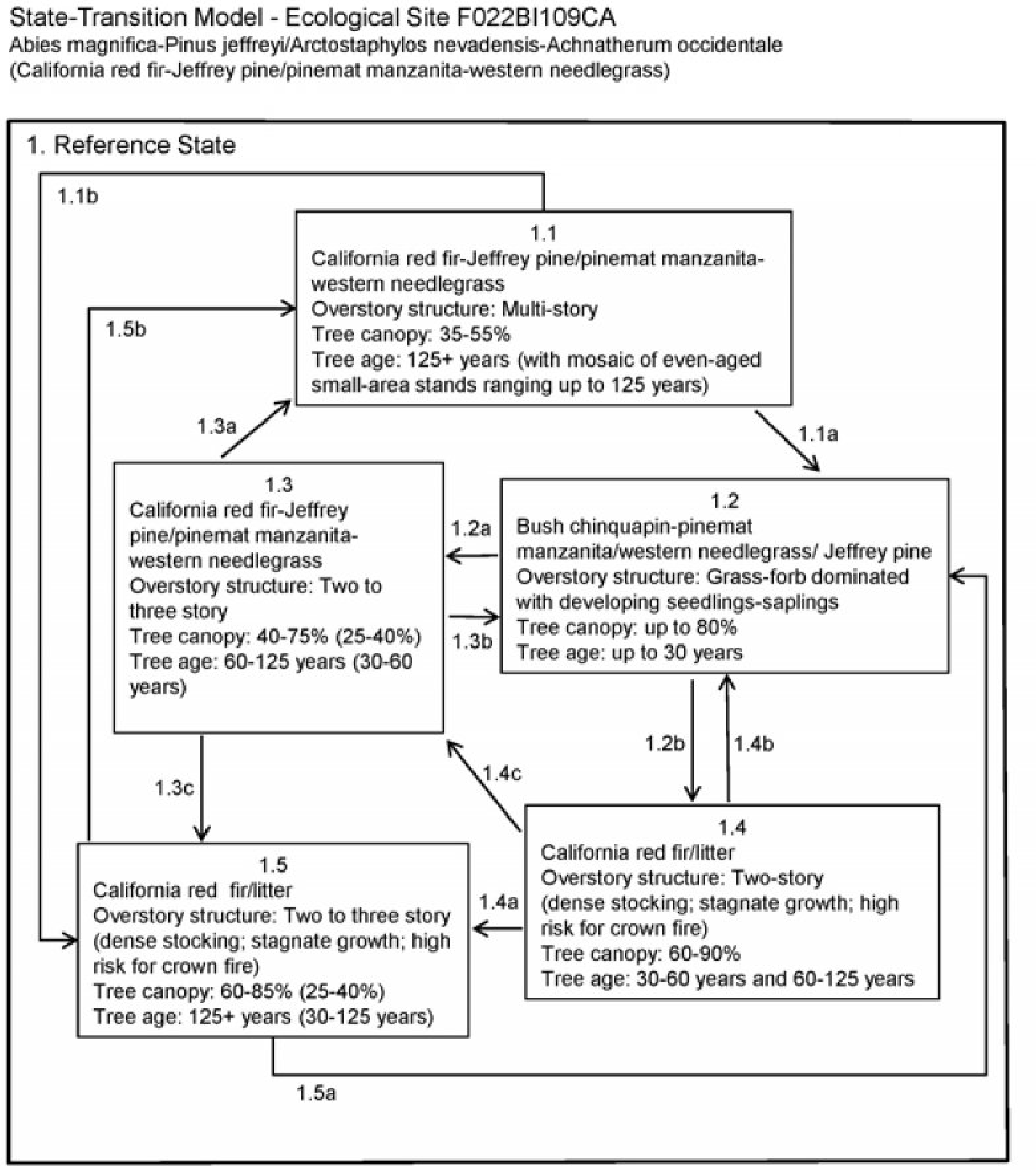
Jeffrey Pine is susceptible to several diseases and insect infestations, especially in periods of drought or when overcrowded. Pathogens that affect Jeffrey pine in this area are the dwarf mistletoe (Arceuthobium campylopodium), root disease (Phaeoleus schweinitzii), needle cast (Elytroderma deformans), 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).

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 (Heterobasidium 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-Jeffrey pine/pinemat manzanita-western needlegrass

This community phase is the interpretive plant community phase. It is difficult to find a site representative of the historic conditions because the density of understory fir has increased since the practice of fire suppression. Had there been a natural fire regime this community phase would likely represent a more open forest. This forest is presently dominated by mature California red fir and Jeffrey pine. Bush chinquapin (*Chrysolepis sempervirens*) and pinemat manzanita (*Arctostaphylos patula*) are present in canopy openings. Western white pine begins to replace Jeffrey pine at the upper elevations, and white fir replaces a portion of the red fir at the lower elevations. This community phase is maintained by low and moderate intensity fires that remove fire intolerant seedlings and saplings from the understory. Moderate intensity fires can kill some of the overstory trees as well, leaving canopy openings that are favorable for Jeffrey pine and shrub regeneration. Moderate intensity fires therefore breakup the uniformity of the older stands with pockets of young forests intermixed.

Forest overstory. This is an open forest dominated by California red fir. The canopy cover of red fir ranges from 18 to 40 percent. Jeffrey pine cover ranges from 1 to 18 percent. Combined canopy cover ranges from 35 to 55 percent. The main canopy trees are between 90 to 110 feet tall. Basal area ranges from 135 to 270 ft2/acre.

Forest understory. Since the forest canopy is fairly open, pinemat manzanita (Arctostaphylos nevadensis) and bush chinquapin (Chrysolepis sempervirens) are present with fair cover. Other common species are western needlegrass (Achnatherum occidentale), rockcress (Arabis spp.), little prince's pine (Chimaphila menziesii), mountain monardella (Monardella odoratissima), white vein shinleaf (Pyrola picta), and Sierra gooseberry (Ribes roezlii).

There is 1 to 3 percent cover from red fir and Jeffrey pine saplings.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	5	100	145
Tree	10	30	50
Grass/Grasslike	0	5	10
Forb	0	0	5
Total	**15**	**135**	**210**

Table 6. Ground cover

Tree foliar cover	35-55%
Shrub/vine/liana foliar cover	1-25%
Grass/grasslike foliar cover	0-3%
Forb foliar cover	0-8%
Non-vascular plants	0%
Biological crusts	0%
Litter	40-80%
Surface fragments >0.25" and <=3"	15-40%
Surface fragments >3"	0-25%
Bedrock	0%
Water	0%
Bare ground	2-10%

Community 1.2

Bush chinquapin-pinemat manzanita/western needlegrass/Jeffrey pine

This community phase develops when the majority of the overstory trees succumb to a high intensity canopy fire. There may be a few surviving overstory trees, which become an important seed source for regeneration. The mature Jeffrey pines have thicker bark and higher tree branches than California red fir and are more likely to survive a fire and supply seed for regeneration. Because Jeffrey pine seedlings germinate well in full sun and mineral soils after fire and California red fir prefers partial shade, Jeffrey pine has an advantage in this early phase of regeneration which assures their existence and prevalence in older stands. Bush chinquapin (*Chrysolepis sempervirens*) can resprout from the roots, root crown, or the stump after it has been top-killed by fire. It can also regenerate from seed, but there is little data about seed dormancy or storage. A flush of native perennial grasses and forbs is possible for the first several years after a burn. Pinemat manzanita does not sprout after fire but re-establishes from seed.

Community 1.3
California red fir-Jeffrey pine/pinemat manzanita-western needlegrass

This forest community phase develops with natural fire regimes, or with manual thinning and prescribed fires. Low to moderate intensity fires clear the understory and remove fuels before they reach hazardous levels, although severe high-intensity canopy fires are also possible. Since Jeffrey pine establishes early during stand regeneration, it has a fair percentage of cover in the upper canopy but has difficulty regenerating or growing well in the canopy understory. Its growth and presence is dependent upon fire or other disturbances to maintain an open forest structure with canopy openings.

Community 1.4
California red fir/litter

This community phase is defined by a dense canopy and a high basal area of California red fir developing in the understory, although there may be some Jeffrey pine in the understory as well. The upper canopy is dominated by California red fir and Jeffrey pine. Canopy cover ranges from 60 to 90 percent. The trees are becoming overcrowded with indications of disease and stress due to competition for water and nutrients. This stress makes the trees more susceptible to death from infestation and drought. Fire hazard is high 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 red fir-Jeffrey pine forest develops with the continued exclusion of fire and a subsequential increase in tree density in the understory layers. Competition for water and sunlight continues, and tree health and vigor decreases. Disease and mortality from diverse causes is common, leaving numerous snags and thick layers of down wood and debris. California red fir is heavily dominant in both the overstory and understory canopy layers. The understory vegetation is almost non-existent due to the lack of sunlight and deep accumulation of litter on the forest floor.

Pathway 1.1a
Community 1.1 to 1.2

In the event of a severe fire there may be significant tree mortality, leaving a relatively short duration scorched landscape with many standing dead trees. The community phase eventually infills mainly with shrubs and some trees (Community Phase 1.2).

Pathway 1.1b
Community 1.1 to 1.5

If fire is excluded from the old growth community phase, red fir will continue to regenerate in the understory, increasing tree density and shifting this community phase toward the closed red fir-Jeffrey pine forest(Community Phase 1.5).

Pathway 1.2a
Community 1.2 to 1.3

The natural pathway is to Community Phase 1.3, a young open red fir-white fir-Jeffrey pine forest. This pathway is followed with natural fire regime. Manual thinning with prescribed burns can imitate the natural cycle and lead to the same open community phase.

Pathway 1.2b
Community 1.2 to 1.4

An alternate pathway is created when fire is excluded from the system and leads to a young closed red fir-white 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 relatively frequent surface and moderate severity fires, and/or partial tree mortality from a pest outbreak. Manual thinning or prescribed burning can be implemented to replace the natural disturbances that keep this forest open. This pathway leads to the reference community phase 1.1.

Pathway 1.3b
Community 1.3 to 1.2

In the event of a canopy fire this community would return to Community Phase 1.2, forest regeneration.

Pathway 1.3c
Community 1.3 to 1.5

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

Pathway 1.4b
Community 1.4 to 1.2

At this point the density of ground fuels and ladder fuels formed in the mid-canopy create conditions for a high intensity canopy fire. A severe fire would initiate 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 the high fuels. Considerable management efforts would be needed to create the open forest conditions that should exist in this forest if it had developed with fire over time. Prescribed burns or manual treatments to thin out the white fir and other fuels in the understory could be implemented to shift this forest back to its natural state of an open red fir-Jeffrey pine 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 red fir-Jeffrey pine forest develops (Community Phase 1.5).

Pathway 1.5b
Community 1.5 to 1.1

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

Pathway 1.5a
Community 1.5 to 1.2

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

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Tree					
0	**Tree (understory only)**			10–50	
	California red fir	ABMA	*Abies magnifica*	10–30	1–3
	Jeffrey pine	PIJE	*Pinus jeffreyi*	0–20	0–2
Shrub/Vine					
0	**Shrub**			5–145	
	pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	5–65	1–15
	bush chinquapin	CHSE11	*Chrysolepis sempervirens*	0–45	0–10
	mountain monardella	MOOD	*Monardella odoratissima*	0–20	0–10
	whiteveined wintergreen	PYPI2	*Pyrola picta*	0–5	0–1
	Sierra gooseberry	RIRO	*Ribes roezlii*	0–5	0–1
	little prince's pine	CHME	*Chimaphila menziesii*	0–5	0–1
Grass/Grasslike					
0	**Grass/Grasslike**			0–10	
	western needlegrass	ACOC3	*Achnatherum occidentale*	0–10	0–3
Forb					
0	**Forb**			0–5	
	rockcress	ARABI2	*Arabis*	0–5	0–1

Table 8. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
California red fir	ABMA	*Abies magnifica*	Native	–	18–40	–	–
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	1–18	–	–

Table 9. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
western needlegrass	ACOC3	*Achnatherum occidentale*	Native	–	0–3
Forb/Herb					
rockcress	ARABI2	*Arabis*	Native	–	0–1
Shrub/Subshrub					
pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	Native	–	1–15
bush chinquapin	CHSE11	*Chrysolepis sempervirens*	Native	–	0–10
mountain monardella	MOOD	*Monardella odoratissima*	Native	–	0–4
whiteveined wintergreen	PYPI2	*Pyrola picta*	Native	–	0–1
Sierra gooseberry	RIRO	*Ribes roezlii*	Native	–	0–1
little prince's pine	CHME	*Chimaphila menziesii*	Native	–	0–1
Tree					
California red fir	ABMA	*Abies magnifica*	Native	–	1–3
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	0–2

Animal community

Red fir-Jeffrey pine forests provide browse, cover and nesting sites for a variety of wildlife species. The type and quality of the wildlife habitat varies with the community type. Mature open forests, closed dense forests, young forests and shrub lands each provide different habitats and forage for wildlife. Douglas squirrels cut and cache fir cones before the cones are fully mature. Cavity-nesting birds utilize holes in snags and dying trees for their nests, while ground nesting birds and animals find homes in the fallen trees. Deer and bear browse the leaves of these conifers in winter and the new growth in the spring. Porcupines eat the bark of fir and can kill saplings. Birds forage for insects in the foliage of mature conifers

Animals that use California red fir forests include: martin, fisher, wolverine, black bear, squirrels, chickadee, pileated woodpecker, great gray owl, Williamson's sapsucker, mountain beaver, and pocket gopher (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, deer mice, and yellow-pine chipmunks.

Recreational uses

This area is suitable for hiking trails.

Wood products

Jeffrey pine wood is used for lumber. No commercial distinction is made between ponderosa pine and Jeffrey pine lumber (Gucker, 2007).

The wood from California red fir is straight-grained and light. California red fir wood 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 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

Jeffrey pine pathogens:

Infections from western dwarf mistletoe (Arceuthobium campylopodium) cause witches brooms, reduced growth and tree mortality. Sticky seeds are spread in fall and infest nearby and understory trees. In years of severe drought dwarf mistletoe has induced 60 to 80 percent of the Jeffery pine mortality (Burns et al., 1990).

Jeffrey pine bark beetles (Dendroctonus jeffreyi) are native beetles that can only reproduce in Jeffrey pine. They are a natural cycle in maintaining forest health. They generally attack older weaker trees, but in times of drought or other disturbances such as lightning or fire, epidemic levels can break out and cause extensive damage to the forest. These beetles infest the lower stem and bole of the trees, usually after pine engraver (Ips pini) infestations in the upper portion of the tree. The beetles slowly destroy the cambium, inhibiting the flow of nutrients. A sign of infestation is the changing color of the pine needles from green to yellow or reddish brown, beginning from the top down (Hagle et al., 2003; Smith, 1971).

Forest Pathogens that affect Red fir:

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) spreads from infected roots to healthy roots and can affect large acres of fir forest. 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 bring about extensive damage to red fir forests with outbreaks causing mortality to several acres of trees. Epidemic levels of damage can be reached when the trees are stressed from drought, annosus root rot, dwarf mistletoe, or fire (Burns, et al., 1990).

Site index documentation:

Schumacher (1928) and Meyer (1961) were used to determine forest site productivity for red fir 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 phases 1.3. 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*	37	50	126	171	140	050	–	
California red fir	*ABMA*	37	50	126	171	–	–	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*	75	78	62	66	45	600	–	
Jeffrey pine	*PIJE*	75	78	62	65	–	–	100TA	Meyer, Walter H. 1961. Yield of even-aged stands of ponderosa pine. USDA Technical Bulletin 630. (1938 version revised in 1961).

Inventory data references

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

789112- site location
789121
789201
789119- closed red fir forest

Type locality

Location 1: Shasta County, CA	
Township/Range/Section	T31 N R6 E S8
UTM zone	N
UTM northing	4491713
UTM easting	641717
General legal description	The type location is about 1 mile north-northwest of Cinder Cone on the eastern slope of Prospect Peak.

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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):**

---

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:**
