USDA Natural Resources Conservation Service

Ecological site F022BI103CA
Frigid Tephra Over Slopes And Flats

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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) Mountain slope, (2) Moraine, (3) Outwash plain
Elevation (feet): 5,460-7,490
Slope (percent): 1-90, but generally 1 to 60
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: No Influence on this site
Mean annual precipitation (inches): 37-93, but average is 41Primary Precipitation: Snow from November to April
Mean annual temperature: 40 to 45 degrees F (6 to 7 degrees C)
Restrictive Layer: Densic layer or duripan in the moderately deep and deep soils
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Materials: Tephra deposits over colluvium, glacial till or glacial outwash
Surface Texture: (1) Loamy coarse sand, (2) Ashy Loamy coarse sand, (3)Ashy Sandy loam
Surface Fragments <=3" (% Cover): 1-55
Surface Fragments > 3" (% Cover): 0-30
Soil Depth (inches): 20-60+

Vegetation: Mid-montane coniferous forest dominated by white fir (*Abies concolor*) and Jeffrey pine (*Pinus jeffreyi*); cover of montane shrubs such as greenleaf manzanita (*Arctostaphylos patula*), snowbrush ceanothus (*Ceanothus velutinus*), and sierra chinquapin (Chysolepis sempervirons) can be high in canopy openings; scattered grasses are found under the forest canopy.
Notes: Northwest portion of Lassen Volcanic National Park.

Classification relationships

Forest Alliance = *Abies concolor* - White fir 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.)

Similar sites

F022BI110CA	**Frigid Humic Loamy Gentle Slopes** This is a white fir mixed conifer forest found on the east side of the park. This site has more conifer diversity and lacks the heavy shrub component.
F022BI119CA	**Low Precip Frigid Sandy Moraine Slopes** This is a white fir Jeffery pine site found on the slopes above Buttelake. This site has more Jeffrey pine and fewer shrubs.

Table 1. Dominant plant species

Tree	(1) *Abies concolor* (2) *Pinus jeffreyi*
Shrub	(1) *Arctostaphylos patula* (2) *Ceanothus velutinus*
Herbaceous	Not specified

Physiographic features

This ecological site is found on several geomorphic features and positions including unglaciated volcanic mountain slopes, moraines, and outwash plains. It is found between 5,460 feet and 7,490 feet in elevation on all aspects. This site is generally found on 1 to 60 percent slopes, but can be found on slopes up to 90 percent.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope (2) Moraine (3) Outwash plain
Flooding frequency	None
Ponding frequency	None
Elevation	1,664–2,283 m
Slope	1–60%
Aspect	Aspect is not a significant factor

Climatic features

This ecological site receives most of its annual precipitation in the form of snow from November to April. The mean annual precipitation ranges from 37 to 93 inches (584 to 1,092 mm), but the average is 41 inches (1,041.4 mm). The mean annual temperature ranges from 40 to 45 degrees F (6 to 7 degrees C). The frost free (>32 degrees F) season is 60 to 90 days in the soil survey, and 31 to 132 days as recorded at the Manzanita Lake Climate Station. The freeze free (>28 degrees F) season is 79 to 202 days (MZL).

The information in the tables below is from the Manzanita Lake Climate Station, which is located toward the lower elevation of this ecological site. The average annual snow depth (as recorded at the Manzanita Lake climate station) reaches its peak depth of 25 inches in February. Snow normally melts by June and does not begin to accumulate again until November.

Table 3. Representative climatic features

Frost-free period (average)	132 days
Freeze-free period (average)	202 days
Precipitation total (average)	1,803 mm

Influencing water features

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

Soil features

This ecological site is associated with several soil components. The soil components can be grouped into five soil subgroups: Typic Haploxerands, Humic Haploxerands, Typic Vitrixerands, Humic Vitrixerands, and Vitrandic Xerorthents. Most of these soils have developed in tephra deposits over colluvium, glacial till or glacial outwash. A few have developed in avalanche debris (from the 1914 to 1917 eruptions of Lassen Peak) over till. These soils range from moderately deep to very deep. A densic layer (or in one case a duripan) is encountered in the moderately deep and deep soils. These soils are well drained to excessively drained. Surface textures include loamy coarse sand, ashy loamy coarse sand, ashy sandy loam, ashy sand, sandy loam, and fine sandy loam, with coarse subsurface textures. Permeability is generally rapid, but is very low through densic layers. Available water capacity (AWC) is very low to low.

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

Map Unit Component Comp %
141 Humic Haploxerands 40
141 Typic Haploxerands 35
142 Cragwash 85
145 Sueredo 85
146 Sueredo 90
147 Summertown 85
153 Typic Vitrixerands 50
153 Vitrandic Xerorthents, moraine 45
154 Typic Vitrixerands 45
154 Vitrandic Xerorthents, moraine 35
157 Typic Vitrixerands, very deep 90
159 Typic Vitrixerands, bouldery 40
159 Typic Vitrixerands, tephra over colluvium 35
162 Humic Haploxerands, outwash 95
169 Sueredo 50

This site is associated with several minor components in additional mapunits.

Table 4. Representative soil features

Surface texture	(1) Loamy coarse sand (2) Ashy loamy coarse sand (3) Ashy sandy loam
Family particle size	(1) Sandy
Drainage class	Well drained to excessively drained
Permeability class	Rapid to very slow

Soil depth	51 cm
Surface fragment cover <=3"	1–55%
Surface fragment cover >3"	0–30%
Available water capacity (0-101.6cm)	3.05–10.16 cm
Soil reaction (1:1 water) (0-101.6cm)	5.1–7.3
Subsurface fragment volume <=3" (Depth not specified)	10–60%
Subsurface fragment volume >3" (Depth not specified)	10–40%

Ecological dynamics

This ecological site is found in the northwest portion of Lassen Volcanic National Park. The interpretive plant community is mid-montane coniferous forest dominated by white fir (*Abies concolor*) and Jeffrey pine (*Pinus jeffreyi*). The cover of montane shrubs such as greenleaf manzanita (*Arctostaphylos patula*), snowbrush ceanothus (*Ceanothus velutinus*), and sierra chinquapin (Chysolepis sempervirons) can be high in canopy openings. Scattered grasses are found under the forest canopy.

White fir is a large long lived tree in this area. It commonly reaches heights of 120 to 140 feet and can live for 300 to 400 years. It produces single needles1.2 to 2.8 inches long that are distributed along the 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).

Jeffrey pine is also a relatively large and long lived tree, attaining heights of 200 feet and living 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 long. Jeffrey pine produces a deep taproot 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. Ponderosa pine (*Pinus ponderosa*) is also present within this area. Jeffrey pine is shade intolerant and can be replaced over time by white fir if fire is excluded from the system. Older trees are somewhat adapted to fire as the bark is thick enough to provide protection from moderate intensity fires. Also, the branches of Jeffrey pine tend to thin out along the lower portion of the tree trunk, leaving the crown 20 to 30 meters above the forest floor.

Several factors combine to create a habitat suitable for white fir and Jeffrey pine growth. A study on conifer growth phenology in the Southern Sierra Nevada describes the environmental factors that affect the initiation and seasonal growth of several conifer species. Jeffrey pine and white fir are included within this study. 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 the shade kept the soil from warming as fast. 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, therefore 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, it can prolong the growing season. Conifer growth ceases with the onset of drought conditions and the decline of water potentials (Royce and Barbour, 2001).

This site receives 41 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. These trees have a short growing season due to early drought conditions. Site index data collected for this ecological site indicate better growth rates in low lying areas on glacial outwash, where water is available for a longer period of time during the growing season.

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. Historically, with a natural fire regime, this forest was most likely dominated by large Jeffrey pine in the overstory with a minor component of white fir and/or ponderosa pine. 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, white fir continues to regenerate in the understory, increasing forest density and fuels. Today the forest is multilayered, dense and shady, dominated by white fir. Vegetation on the forest floor is almost nonexistent.

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 south facing slopes, and fire intensity increased from the lower slopes to the upper slope positions. Their study also indicates a slightly later burn season in the Southern Cascades than in the Sierra Nevada. The fire scars in the Southern Cascade are primarily found at the annual tree ring boundary, indicating the trees were dormant at the time of the fire, whereas in the Sierra Nevada fires scars are often found in the late-season wood. This timing shift may be due to the timing of summer drought conditions, which begin earlier in the south. 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). Beaty and Taylor report 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 (Beaty and Taylor, 2001). After a stand replacing fire, evenly aged forests are formed. The current management practice of fire suppression has shifted forest density and composition. Fire suppression creates a change in species composition by allowing the fire intolerant and shade tolerant firs to increase in cover and density, eventually out-competing the fire tolerant and shade intolerant pines (Taylor and Solem, 2001).

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, (Dedroctonus 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).

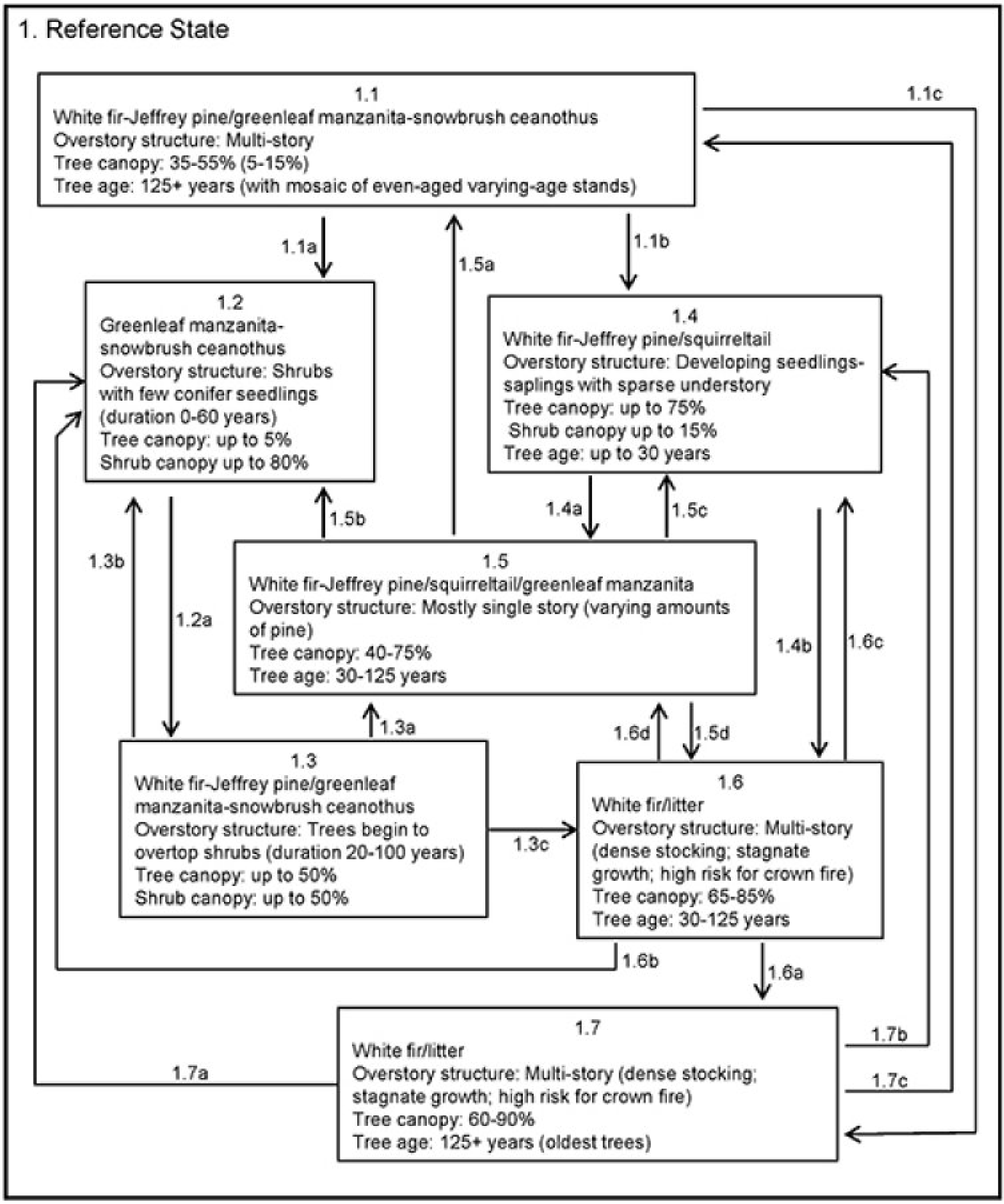
Pathogens that affect white fir are the dwarf mistletoe (*Arceuthobium abietinum* f. sp. concoloris), Cytospora canker (Cytospora abietis), broom rust (Melamsporlla caryophyllacearum), annosus root disease (Heterobasidium annosum), armillaria root disease (Armillaria sp.), trunk rot (Echinodontium tinctorium) 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-Transition Model - Ecological Site No. F022BI103CA
Abies concolor-Pinus jeffreyi/Arctostaphylos patula-Ceanothus velutinus
(White fir-Jeffrey pine/greenleaf manzanita-snowbrush ceanothus)



State 1
Reference

Community 1.1
White fir-Jeffrey pine/greenleaf manzanita-snowbrush ceanothus

This community phase is the interpretive plant community phase and is similar to the historic plant community phase. It is dominated by mature white fir and Jeffrey pine, with a few ponderosa pines in some areas. Montane shrubs such as greenleaf manzanita (*Arctostaphylos patula*) and snowbrush ceanothus (*Ceanothus velutinus*) are present in canopy openings. 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. The moderate intensity fires therefore breakup the uniformity of the older stands with pockets of young forests intermixed.

Forest overstory. The upper canopy is a mix of Jeffrey pine and white fir, with an occasional ponderosa pine. White fir is in the understory. Canopy heights range from 90 to 120 feet, with diameters ranging from 25 to 35 inches at breast height. The largest and oldest trees were not measured. Basal area for this community type ranged from 110 to 270 ft2/ acre with an average of 190 ft2/acre.

Forest understory. The understory is generally sparse, although there is more cover and diversity in canopy openings. Common grasses are western needlegrass (Achnatherum occidentale), squirreltail (Elymus elymoides), and California brome (Bromus carinatus). Greenleaf manzanita (Arctostaphylos patula) and snowbrush ceanothus (Ceanothus velutinus) were present in areas providing adequate sunlight. Other plants frequently encountered include pioneer rockcress (Arabis platysperma), carex (Carex spp.), spreading groundsmoke (Gayophytum diffusum), white hawkweed (Hieracium albiflorum) pinewoods lousewort (Pedicularis semibarbata), whitevein shinleaf (Pyrola picta), and lettuce wirelettuce (Stephanomeria lactucina).

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	28	265	568
Grass/Grasslike	–	44	96
Tree	–	22	45
Forb	–	7	16
Total	**28**	**338**	**725**

Table 6. Ground cover

Tree foliar cover	35-55%
Shrub/vine/liana foliar cover	0-15%
Grass/grasslike foliar cover	0-30%
Forb foliar cover	0-37%
Non-vascular plants	0%
Biological crusts	0%
Litter	75-100%
Surface fragments >0.25" and <=3"	0-10%
Surface fragments >3"	0-15%
Bedrock	0%
Water	0%
Bare ground	0-5%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	0-5%	0-6%
>0.15 <= 0.3	–	–	0-16%	0-5%
>0.3 <= 0.6	–	–	–	0-26%
>0.6 <= 1.4	0-2%	1-15%	–	–
>1.4 <= 4	0-2%	–	–	–
>4 <= 12	0-5%	–	–	–
>12 <= 24	5-8%	–	–	–
>24 <= 37	30-45%	–	–	–
>37	0-2%	–	–	–

Community 1.2
Greenleaf manzanita-snowbrush ceanothus

When large fires burn into the forest canopy and kill the majority of the overstory trees, a montane shrub community thrives in the new openings. Even if shrubs were not present at the time of a fire, their seeds may be stored in the soil. Greenleaf manzanita and snowbrush ceanothus seeds can lie dormant in the soil for several hundred years, until the heat from a fire scarifies the seed coat and initiates germination. These seeds also require light and cold stratification for germination. If present at the time of a fire, snowbrush ceanothus, bush chinquapin, and bittercherry can resprout. Hauser (2007) states that greenleaf manzanita does not resprout after fire in this area. The size and the intensity of a burn may influence the shrub expression. Shrubs were found associated with large burn size, whereas trees were not able to establish across the landscape (Royce and Barbour, 2001). The intensity of burn may affect the scarification of seeds. Shrubs can prevail in areas prone to frequent fire, such as ridges and wind tunnels. Greenleaf manzanita is a strong competitor for water. It continues to deplete water after conifer species have gone dormant for the drought season. This competition for water and sunlight between the shrubs and conifer seedlings can delay the establishment of a forest (Royce and Barbour, 2001). The shrub community phase can be perpetuated by frequent fire or other disturbances.

Forest overstory. There may be select overstory trees that survive a canopy fire. These trees are crucial for seedling recruitment, shade, and litter accumulation. The overstory trees can be completely absent or provide up to 10 percent canopy cover.

Forest understory. Greenleaf manzanita (Arctostaphylos patula), snowbrush ceanothus (Ceanothus velutinus), Sierra chinquapin (Chrysolepis sempervirens), and bitter cherry (Prunus emarginata) can form dense shrublands with up to 90 percent cover. Grasses and forbs are not common at this time. Young Jeffrey pine and white fir seedlings are present but may have difficulty competing with the shrubs for sunlight.

Table 8. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	460	1149	2354
Tree	–	11	39
Total	**460**	**1160**	**2393**

Table 9. Ground cover

Tree foliar cover	0-10%
Shrub/vine/liana foliar cover	35-80%
Grass/grasslike foliar cover	0-5%
Forb foliar cover	0-1%
Non-vascular plants	0%

Biological crusts	0%
Litter	20-100%
Surface fragments >0.25" and <=3"	0-5%
Surface fragments >3"	0-5%
Bedrock	0%
Water	0%
Bare ground	0-15%

Community 1.3
White fir-Jeffrey pine/greenleaf manzanita-snowbrush ceanothus

This community phase develops as the white fir and Jeffrey pine trees gain dominance over the shrubs. The trees have either been able to establish in the openings in the shrubs or are encroaching upon them from the edges of the shrub field. This is a slow process and could take up to 100 years. As the shade from the tree canopy increases, the shrubs reduce leaf production and eventually become twiggy skeletons of the former shrubs.

Forest overstory. White fir and Jeffrey pine cover ranges from 25 to 55 percent. Trees may be 85 feet tall, with a wide range of heights in the understory due to the slow establishment of conifers through the shrub layer.

Forest understory. Greenleaf manzanita (Arctostaphylos patula), snowbrush ceanothus (Ceanothus velutinus), Sierra chinquapin (Chrysolepis sempervirens), and bitter cherry (Prunus emarginata) are present but are beginning to die under the forest canopy.

Table 10. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	17	835	1851
Tree	2	45	90
Grass/Grasslike	–	1	2
Total	**19**	**881**	**1943**

Community 1.4
White fir-Jeffrey pine/squirreltail

This community phase is dominated by white fir and Jeffrey pine seedlings and saplings, with a few scattered grasses, forbs and shrubs. It is not clearly understood why, but sometimes the shrubland community phase does not develop after a fire and regeneration begins directly with forest development. The most likely reason for the lack of shrubs in some areas is a deficiency of a seed bank, which may be tied to the fire history of the area.

Forest overstory. There may be a few surviving overstory trees, crucial for seed recruitment. A small patch of a severe burn is visible in this photo. Jeffrey pine seedlings are establishing well after the fire.

Forest understory. Other than the Jeffrey pine seedlings, squirreltail (Elymus elymoides) is the only significant understory species in our plot.

Table 11. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	–	56	224
Tree	2	11	34
Shrub/Vine	–	–	1
Total	**2**	**67**	**259**

Community 1.5
White fir-Jeffrey pine/squirreltail/greenleaf manzanita

This forest community phase develops with the natural fire regime, 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 possible. Jeffrey pine has difficulty regenerating and growing well in the understory of the canopy. The presence of Jeffrey pine is dependent upon fire or other disturbances to maintain an open forest structure with canopy openings.

Community 1.6
White fir/litter

This community phase is defined by a dense canopy and high basal area of white fir. Canopy cover ranges from 65 to 85 percent. The trees are overcrowded and often diseased and stressed due to the competition for water and nutrients. This stress makes the trees more susceptible to death from disease and drought. Fire hazard is high in this community due to the deep accumulation of litter, the standing dead and down trees, and dense multi-layered structure of the forest.

Community 1.7
White fir/litter

The mature closed white fir forest develops with the continued exclusion of fire, allowing the tree density to increase to unhealthy levels. Competition for water and sunlight continues and tree health and vigor decreases.

Forest overstory. This forest is very dense with multiple layers of white fir. Jeffrey pine has, for the most part, been shaded out and is not regenerating under the dense canopy. There is a thick layer litter and piles of debris from dead trees and branches. The suppressed trees are slowly dying, adding to the fuels. Large dead snags are present. There may be a high incidence of disease.

Forest understory. Understory cover is almost absent except for a few prince's pines (Chimaphila spp.) and whitevein shinleafs (Pyrola picta).

Table 12. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Shrub/Vine	–	11	22
Tree	2	4	19
Total	**2**	**15**	**41**

Table 13. Ground cover

Tree foliar cover	60-90%
Shrub/vine/liana foliar cover	0-1%
Grass/grasslike foliar cover	0-1%
Forb foliar cover	0-1%
Non-vascular plants	0%

Biological crusts	0%
Litter	80-100%
Surface fragments >0.25" and <=3"	0-1%
Surface fragments >3"	0-5%
Bedrock	0%
Water	0%
Bare ground	0-1%

Pathway 1.1a
Community 1.1 to 1.2

In the event of a severe fire there may be significant tree mortality, leaving a charred landscape with many standing dead trees. Growth of shrubs fills in relatively quickly leading to community phase 1.2.

Pathway 1.1b
Community 1.1 to 1.4

In the event of a severe fire there may be significant tree mortality, leaving a charred landscape with many standing dead trees. Eventually there is infill of trees and sparse understory (community phase 1.4).

Pathway 1.1c
Community 1.1 to 1.7

If fire is excluded from the old growth community, white fir continues to regenerate in the understory, increasing tree density and shifting this community toward a closed white fir community (phase 1.7).

Pathway 1.2a
Community 1.2 to 1.3

The natural pathway is to community phase 1.3, the white fir- Jeffrey pine forest with shrubs. This pathway is followed with time and establishes the tree canopy over the shrubs.

Pathway 1.3b
Community 1.3 to 1.2

A high intensity severe fire has a high likelihood of leading to the shrubland regeneration community (Community phase 1.2).

Pathway 1.3a
Community 1.3 to 1.5

This pathway leads to community phase 1.5, the young open white fir- Jeffrey pine forest. This pathway is created with time by the dominance of the trees over the shrubs. Low to moderate intensity fires may occur to clear the understory of dead brush, young seedlings and saplings.

Pathway 1.3c
Community 1.3 to 1.6

This pathway is created when fire is excluded from the system and leads to the young closed white fir forest (Community phase 1.6).

Pathway 1.4a
Community 1.4 to 1.5

The natural pathway is to community phase 1.5, the young open 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.

Pathway 1.4b
Community 1.4 to 1.6

An alternate pathway is created when fire is excluded from the system, which leads to the young closed white fir forest (Community phase 1.6).

Pathway 1.5a
Community 1.5 to 1.1

This is the natural pathway for this community, 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 (Community phase 1.1).

Pathway 1.5b
Community 1.5 to 1.2

A severe canopy fire could initiate shrubland regeneration (Community phase 1.2) depending on shrub species/seed presence.

Pathway 1.5c
Community 1.5 to 1.4

A severe canopy fire could initiate white fir and Jeffrey pine forest regeneration (Community phase 1.4).

Pathway 1.5d
Community 1.5 to 1.6

If fire does not occur, the density of the forest increases. This favors white fir over Jeffrey pine. The increased density shifts this community toward the closed white fir community (Community phase 1.6).

Pathway 1.6b
Community 1.6 to 1.2

At this point, the density of ground fuels and the ladder fuels formed in the mid canopy create conditions for a high intensity canopy fire. A severe fire would initiate stand regeneration and create the shrubland community (Community phase 1.2) provided shrub species/seed is present.

Pathway 1.6c
Community 1.6 to 1.4

At this point, the density of ground fuels and the ladder fuels formed in the mid canopy create conditions for a high intensity canopy fire. A severe fire would initiate stand regeneration and create the white fir and Jeffrey pine regeneration (Community phase 1.4).

Pathway 1.6d
Community 1.6 to 1.5

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 had it developed with fire over time. Manual treatment to thin out the white fir and fuels in the understory, and/or prescribed burns, could be implemented to shift this forest back to an open white fir-Jeffrey pine forest (Community phase 1.5). A partial mortality disease or pest infestation could also create a shift towards Community phase 1.5.

Pathway 1.6a
Community 1.6 to 1.7

If fire continues to be excluded from this system the mature closed white fir forest community develops (Community 1.7).

Pathway 1.7c
Community 1.7 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 had it developed with fire over time. Manual treatment to thin out the understory trees and fuels, and/or prescribed burns, could be implemented to shift this forest back to an open white fir-Jeffrey pine community (Community phase 1.1). A partial mortality disease or pest infestation could also create a shift towards Community phase 1.1.

Conservation practices

Prescribed Burning
Firebreak
Access Control
Access Road
Upland Wildlife Habitat Management
Forest Trails and Landings
Forest Stand Improvement
Fuel Break
Woody Residue Treatment

Pathway 1.7a
Community 1.7 to 1.2

At this point a severe fire is likely and would initiate stand regeneration, which can create a shrubland community (Community phase 1.2) provided shrub species/seed is present.

Pathway 1.7b
Community 1.7 to 1.4

At this point a severe fire is likely and would initiate stand regeneration, which can create the white fir and Jeffrey pine regeneration community (phase 1.4).

Additional community tables

Table 14. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
0	**Tree (understory only)**			0–45	
	white fir	ABCO	*Abies concolor*	0–34	0–2
	Jeffrey pine	PIJE	*Pinus jeffreyi*	0–11	0–4
	ponderosa pine	PIPO	*Pinus ponderosa*	–	0
Shrub/Vine					
0	**Shrub**			28–568	
	greenleaf manzanita	ARPA6	*Arctostaphylos patula*	28–224	1–7
	snowbrush ceanothus	CEVE	*Ceanothus velutinus*	0–168	0–8
	mountain monardella	MOOD	*Monardella odoratissima*	0–135	0–20
	slender penstemon	PEGR4	*Penstemon gracilentus*	0–34	0–6
	whiteveined wintergreen	PYPI2	*Pyrola picta*	0–6	0–2
	granite prickly phlox	LIPU11	*Linanthus pungens*	0–2	0–1
Grass/Grasslike					
0	**Grass/Grasslike**			0–96	
	squirreltail	ELEL5	*Elymus elymoides*	0–40	0–9
	western needlegrass	ACOC3	*Achnatherum occidentale*	0–34	0–7
	sedge	CAREX	*Carex*	0–22	0–5
Forb					
0	**Forb**			0–16	
	spreading groundsmoke	GADI2	*Gayophytum diffusum*	0–6	0–2
	pioneer rockcress	ARPL	*Arabis platysperma*	0–6	0–1
	pinewoods lousewort	PESE2	*Pedicularis semibarbata*	0–4	0–1

Table 15. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	25–33	–	–
white fir	ABCO	*Abies concolor*	Native	–	10–20	–	–
ponderosa pine	PIPO	*Pinus ponderosa*	Native	–	0–2	–	–

Table 16. 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	–	0–9
western needlegrass	ACOC3	*Achnatherum occidentale*	Native	–	0–7
sedge	CAREX	*Carex*	Native	–	0–5
Forb/Herb					
spreading groundsmoke	GADI2	*Gayophytum diffusum*	Native	–	0–2
pioneer rockcress	ARPL	*Arabis platysperma*	Native	–	0–1
pinewoods lousewort	PESE2	*Pedicularis semibarbata*	Native	–	0–1
Shrub/Subshrub					
mountain monardella	MOOD	*Monardella odoratissima*	Native	–	0–20
snowbrush ceanothus	CEVE	*Ceanothus velutinus*	Native	–	0–8
greenleaf manzanita	ARPA6	*Arctostaphylos patula*	Native	–	1–7
slender penstemon	PEGR4	*Penstemon gracilentus*	Native	–	0–6
whiteveined wintergreen	PYPI2	*Pyrola picta*	Native	–	0–2
granite prickly phlox	LIPU11	*Linanthus pungens*	Native	–	0–1

Table 17. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
0	**Tree**			0–39	
	white fir	ABCO	*Abies concolor*	0–28	0–5
	Jeffrey pine	PIJE	*Pinus jeffreyi*	0–11	0–5
Shrub/Vine					
0	**Shrub**			460–2354	
	snowbrush ceanothus	CEVE	*Ceanothus velutinus*	112–841	5–35
	greenleaf manzanita	ARPA6	*Arctostaphylos patula*	280–729	20–55
	bush chinquapin	CHSE11	*Chrysolepis sempervirens*	67–392	5–30
	bitter cherry	PREM	*Prunus emarginata*	0–392	0–15

Table 18. Community 1.2 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	0–6	–	–
white fir	ABCO	*Abies concolor*	Native	–	0–4	–	–

Table 19. Community 1.2 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Shrub/Subshrub					
greenleaf manzanita	ARPA6	*Arctostaphylos patula*	Native	–	20–55
snowbrush ceanothus	CEVE	*Ceanothus velutinus*	Native	–	5–35
bush chinquapin	CHSE11	*Chrysolepis sempervirens*	Native	–	5–30
bitter cherry	PREM	*Prunus emarginata*	Native	–	0–15
Tree					
white fir	ABCO	*Abies concolor*	Native	–	0–5
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	0–5

Table 20. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
0	**Tree (understory only)**			2–90	
	white fir	ABCO	*Abies concolor*	2–67	1–10
	Jeffrey pine	PIJE	*Pinus jeffreyi*	0–22	0–8
Shrub/Vine					
0	**Shrub**			17–1851	
	snowbrush ceanothus	CEVE	*Ceanothus velutinus*	6–841	1–20
	greenleaf manzanita	ARPA6	*Arctostaphylos patula*	6–616	1–25
	bitter cherry	PREM	*Prunus emarginata*	0–224	0–10
	bush chinquapin	CHSE11	*Chrysolepis sempervirens*	6–168	1–20
	whiteveined wintergreen	PYPI2	*Pyrola picta*	0–1	0–1
Grass/Grasslike					
0	**Grass/Grasslike**			0–2	
	sedge	CAREX	*Carex*	0–2	0–1

Table 21. Community 1.3 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
white fir	ABCO	*Abies concolor*	Native	–	10–30	–	–
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	5–20	–	–

Table 22. Community 1.3 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
sedge	CAREX	*Carex*	Native	–	0–1
Shrub/Subshrub					
greenleaf manzanita	ARPA6	*Arctostaphylos patula*	Native	–	1–25
snowbrush ceanothus	CEVE	*Ceanothus velutinus*	Native	–	1–20
bush chinquapin	CHSE11	*Chrysolepis sempervirens*	Native	–	1–20
bitter cherry	PREM	*Prunus emarginata*	Native	–	0–10
whiteveined wintergreen	PYPI2	*Pyrola picta*	Native	–	0–1
Tree					
white fir	ABCO	*Abies concolor*	Native	–	1–10
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	0–8

Table 23. Community 1.4 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
0	**Tree (understory only)**			2–34	
	Jeffrey pine	PIJE	*Pinus jeffreyi*	2–17	3–20
	white fir	ABCO	*Abies concolor*	0–17	0–3
Shrub/Vine					
0	**Shrub**			0–1	
	spurry buckwheat	ERSP6	*Eriogonum spergulinum*	0–1	0–1
Grass/Grasslike					
0	**Grass/Grasslike**			0–224	
	squirreltail	ELEL5	*Elymus elymoides*	0–224	0–35

Table 24. Community 1.4 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	2–4	–	–
white fir	ABCO	*Abies concolor*	Native	–	1–3	–	–

Table 25. 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	–	0–35
Shrub/Subshrub					
spurry buckwheat	ERSP6	*Eriogonum spergulinum*	Native	–	0–1

Table 26. Community 1.7 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
0	**Tree (understory only)**			2–19	
	white fir	ABCO	*Abies concolor*	2–17	1–8
	Jeffrey pine	PIJE	*Pinus jeffreyi*	0–2	0–1
Shrub/Vine					
1	**Shrub/Vine**			0–22	
	prince's pine	CHIMA	*Chimaphila*	0–11	0–2
	whiteveined wintergreen	PYPI2	*Pyrola picta*	0–11	0–2

Table 27. Community 1.7 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
white fir	ABCO	*Abies concolor*	Native	–	60–88	–	–
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	0–2	–	–

Table 28. Community 1.7 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Shrub/Subshrub					
prince's pine	CHIMA	*Chimaphila*	Native	–	0–2
whiteveined wintergreen	PYPI2	*Pyrola picta*	Native	–	0–2
Tree					
white fir	ABCO	*Abies concolor*	Native	–	1–8
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	0–2

Animal community

White fir 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 white fir forests, young forests, and shrublands provide different habitats and forage for wildlife. Deer and bear can heavily browse the young white fir shoots. Porcupines eat the bark of white fir and can kill saplings. Rodents feed on the cambial tissue. Young seedlings and seeds are eaten by animals as well. Douglas squirrels cut and cache white fir cones before the cones are fully mature.

There are about 33 species of mammals commonly present in the white fir forest type in California and, of these, 7 are generally associated with mature forests. About 123 species of birds are found in the white fir forest type of California and southern Oregon, about 50 of which are associated primarily with mature forests. Many of these bird use mature white fir trees and snags for foraging, roosting, nesting and/or breeding. Included are bald eagle, California spotted owl, brown creeper, pileated woodpecker, white-headed woodpecker, and, when near lakes or streams, osprey. Reptiles in white fir forests are represented by 17 species, mostly at lower elevations, 8 of which are associated with mature forests (Zouhar, 2001).

Although the leaves of the montane shrubs are not a highly desired browse, their berries and seeds are eaten in large quantities. Greenleaf manzanita berries and seeds are eaten in large quantities by bears and other wildlife. Bush chinquapin seeds are a staple food for several birds and rodents. Huckleberry oak acorns are eaten by small mammals.

Recreational uses

This area is pleasant with shade and has small streams and lakes nearby, supporting a variety of wildlife. It is suitable for hiking trails and campgrounds (in flatter areas).

Wood products

White fir wood is used for framing, plywood and, sometimes, pulpwood. The heartwood of white fir decays rapidly if not properly preserved. White fir wood has a low specific gravity and heat production, hence it provides poor firewood compared to other conifers (Zouhar, 2001).

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

Other products

Jeffrey pine seeds are edible. Jeffrey pine sap was used by Native Americans to treat pulmonary disorders, and later heptane was distilled from the sap and sold to treat pulmonary problems and tuberculosis. Jeffrey pine heptane was also used to develop the octane scale used to rate petroleum used in automobiles (Gucker, 2007).
The fruits of greenleaf manzanita can be eaten whole or made into cider and jelly. The Native Americans brewed the berries into tea to treat poison-oak (Toxicodendron diversilobum). The leaves were used to make remedies for several diseases (Hauser, 2007). Bush chinquapin seeds are edible raw or roaster and were part of the Native American diet (Howard, 1992).

Other information

Site index documentation:

Schumacher (1926) and Meyer (1961) were used to determine forest site productivity for white 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.

Trees appropriate for site index measurement typically occur in stands of community phases 1.5 and 1.6. White fir and Jeffrey pine site trees are selected according to guidance in Schumacher (1926) and Meyer (1961), respectively.

Site index for white fir was variable across this area, ranging from 55 to 131 (Schumacher, 1926). Shrub competition, overcrowding and disease lowered site index. Low lying areas or areas near streams had higher site index due to the availability of water. Please refer to the Lassen Volcanic National Park Soil Survey for detailed site index information by soil component.

Table 29. 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
white fir	*ABCO*	55	131	109	305	70	030	–	
Jeffrey pine	*PIJE*	81	109	71	120	40	600	–	

Inventory data references

There are 28 vegetation plots that were used to describe this ecological site. These plots represent the following community types:

1.1- Mature open white fir Jeffrey pine forest
144
197

240

1.2 and 1.3 - Shrubland and Shrubland with trees
123
125
126
222- Typic Vitrixerands, very deep modal
237- Summertown modal pit
341
386

1.6 and 1.7- Dense white fir forest
138- Typic Vitrixerands, Tephra over Colluvium modal pit
213- Typic Haploxerands modal pit
264
271
277
278- Humic Haploxerands,Outwash- modal pit
329
340
352
365-burn
366-burn
371
381
L357- Cragwash, modal pit
L358- Sueredo modal- Site location

1.4- Forest regeneration
214

Plots not assigned to community type:
131- Typic Vitrixerands, Bouldery modal pit
132
143

Type locality

Location 1: Shasta County, CA	
Township/Range/Section	T31 N R4 E S10
UTM zone	N
UTM northing	4490409
UTM easting	626602
General legal description	This site is just east of the Lassen Park Road, about .82 miles southeast of Lost Creek Organizational Campground.

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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:**

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:**