USDA Natural Resources
Conservation Service

Ecological site F022BI120CA
Frigid Gravelly Sandy Loam Outwash-Stream Terraces

Accessed: 11/06/2024

General information

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

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 022B–Southern Cascade Mountains

Site concept:
Landform: (1) Outwash terrace, (2) Stream terrace
Elevation (feet): 5,240-6,760
Slope (percent): 2-30
Water Table Depth (inches): 16-80
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: North, South, East
Mean annual precipitation (inches): 45.0-91.0
Primary precipitation: Winter months in the form of snow
Mean annual temperature: 41 to 43 degrees F (5 to 6.1 degrees C)
Restrictive layer: Silica-cemented duripan occurs at varying depths from 20 to 60 inches or more
Temperature Regime: Frigid
Moisture Regime: Xeric/Aquic
Parent Materials: Glacial outwash or alluvium from volcanic rocks
Surface Texture: (1) Gravelly medial sandy loam,
Surface Fragments <=3" (% Cover): 20-35
Surface Fragments > 3" (% Cover): 0-5

Soil Depth (inches): 20-60+
Vegetation: White fir (*Abies concolor*)-Sierra lodgepole pine (*Pinus contorta* ssp. murrayana) forest; incense cedar (*Calocedrus decurrens*) is fairly common, with an occasional Jeffrey pine (*Pinus jeffreyi*) and sugar pine (*Pinus lambertiana*). This forest has a grassy understory dominated by blue wild-rye (*Elymus glaucus*) in some areas, but has very sparse cover in other areas. Common species are Columbia needlegrass (*Achnatherum nelsonii*), western needlegrass (*Achnatherum occidentale*), California brome (*Bromus carinatus*), Ross' sedge (*Carex rossii*), naked buckwheat (*Eriogonum nudum*), spreading groundsmoke (*Gayophytum diffusum*), white hawkweed (*Hieracium albiflorum*), and silverleaf phacelia (*Phacelia hastata*).
Notes: This ecological site occurs on outwash terraces and stream terraces.

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.)

Associated sites

F022BI110CA	**Frigid Humic Loamy Gentle Slopes** This is a white fir-mixed conifer forest found on drier positions.
R022BI202CA	**Frigid Alluvial Flat** This is a meadow ecological site which this forest often fringes.
R022BI210CA	**Frigid Loamy Flood Plains** This is a riparian site associated with Hot Springs Creek.
R022BI211CA	**Spring Complex** This spring complex is often found intermingled with this forest site.

Similar sites

F022BI117CA	**Frigid Coarse Glaciolacustrine Gentle Slopes** This is a California red fir-Sierra lodgepole pine forest found at higher elevations.
F022BI123CA	**Frigid Flat Outwash Terraces** This is a white fir-Sierra lodgepole pine forest found in drier conditions.
F022BI126CA	**Cold Frigid Tephra Over Moraine Slopes** This is a Sierra lodgepole pine forest that is replaced by Jeffrey pine and ponderosa pine over time without disturbance.
F022BI125CA	**Cold Frigid Tephra Over Outwash Plains Or Lake Terraces** This is a Sierra lodgepole pine forest found in cold air drainages and basins.

Table 1. Dominant plant species

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

Physiographic features

This ecological site occurs on outwash terraces and stream terraces at elevations of 5,240 to 6,760 in feet. Slopes range from 2 to 30 percent. The site has a fluctuating water table, which may extend from 16 to 80 inches below the surface.

Table 2. Representative physiographic features

Landforms	(1) Outwash terrace (2) Stream terrace

Flooding frequency	None
Ponding frequency	None
Elevation	5,240–6,760 ft
Slope	2–30%
Water table depth	16–80 in
Aspect	N, E, S

Climatic features

This ecological site receives most of its annual precipitation in the winter months in the form of snow. The mean annual precipitation ranges from 45 to 91 inches (1,143 to 2,311 mm) and the mean annual temperature ranges from 41 to 43 degrees F (5 to 6.1 degrees C). The frost free (>32F) season is 70 to 90 days. The freeze free (>28F) season is 85 to 200 days.

There are no representative climate stations for this site.

Table 3. Representative climatic features

Frost-free period (average)	90 days
Freeze-free period (average)	200 days
Precipitation total (average)	91 in

Influencing water features

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

Soil features

This site is associated with the Aquic Haploxerands and the Humic Haploxerands, stream terrace soil components. The Aquic Haploxerands are moderately deep, somewhat poorly drained soils, which formed in glacial outwash from volcanic rocks. They have a gravelly medial sandy loam surface texture and gravelly fine sandy loam subsurface textures with about 5 percent cobbles. Redoximorphic features are present below 16 inches, indicating periods of water saturation. A root restrictive, silica-cemented duripan occurs at varying depths from 20 to 40 inches.

The Humic Haploxerands, stream terrace soils are very deep, moderately well and well drained soils, formed in ash-influenced alluvium from volcanic rocks. These soils are on stream terraces along Hot Springs Creek and the North Fork of Bailey Creek, where the stream gradients decrease and allow lateral deposition. They have a gravelly medial sandy loam surface texture. Percent rock fragments increase with depth. The subsurface textures, listed by increasing depth, are gravelly medial coarse sandy loam, extremely stony medial coarse sandy loam, extremely stony medial loamy coarse sand, and ashy stones. The lower horizons have 83-89 percent sub-rounded, stream deposited, rock fragments.

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

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

Map Unit Component / Component %
125 Humic Haploxerands, stream terrace /55
164 Aquic Haploxerands /20
165 Humic Haploxerands, stream terrace / 5
166 Aquic Haploxerands /50

Table 4. Representative soil features

Family particle size	(1) Sandy
Drainage class	Somewhat poorly drained to well drained
Permeability class	Rapid to very slow
Soil depth	20 in
Surface fragment cover <=3"	20–35%
Surface fragment cover >3"	0–5%
Available water capacity (0-40in)	0.75–7.35 in
Soil reaction (1:1 water) (0-40in)	4.5–7.3
Subsurface fragment volume <=3" (Depth not specified)	20–60%
Subsurface fragment volume >3" (Depth not specified)	5–89%

Ecological dynamics

This ecological site is associated with a white fir (*Abies concolor*)-Sierra lodgepole pine (*Pinus contorta* ssp. murrayana) forest. Incense cedar (*Calocedrus decurrens*) is fairly common, with an occasional Jeffrey pine (*Pinus jeffreyi*) and sugar pine (*Pinus lambertiana*). This forest has a grassy understory dominated by blue wild-rye (*Elymus glaucus*) in some areas, but has very sparse cover in other areas. Common species are Columbia needlegrass (*Achnatherum nelsonii*), western needlegrass (*Achnatherum occidentale*), California brome (*Bromus carinatus*), Ross' sedge (*Carex rossii*), naked buckwheat (*Eriogonum nudum*), spreading groundsmoke (*Gayophytum diffusum*), white hawkweed (*Hieracium albiflorum*), and silverleaf phacelia (*Phacelia hastata*).

This ecological site is located on stream terraces with very deep soils and outwash terraces with a root restrictive duripan between 20 to 40 inches below the surface. These soils have a seasonal water table. The Aquic Haploxerands, situated in the upper basin of a large valley, accumulate water from snowmelt, springs, and groundwater flow. The duripan impedes downward infiltration of water so the water moves laterally across gentle slopes. From December to June, a fluctuating water table may be anywhere between the duripan and 16 inches below the surface. The water table eventually drops below 80 inches in the drier months. The Humic Haploxerands, stream terrace component has a seasonal water table that is associated with the hydrology of the adjacent stream channel. Ground water flows through the coarse textured horizons and may, in some areas, mingle with surface flow from the stream. The water table is about 40 inches below the surface during snowmelt, gradually dropping to below 80 inches in the drier months. Shallow seasonal water tables and root restrictive layers are often associated with Sierra lodgepole pine forests due to the exclusion of other conifers. However, the conditions at this site are not extreme enough to exclude other conifers.

Sierra lodgepole pine can be long-lived. The overstory trees cored for this site index data were between 120 to 160 years old. Sierra lodgepole pine does not usually gain much in girth with age, and older trees averaged 19 to 23 inches in diameter. The roots of Sierra lodgepole pine are generally shallow. Trees will produce taproots that may atrophy or grow horizontally in cases of high water tables or root restrictive layers. Sierra lodgepole pine grows tall and narrow, with short branches and 1.2 to 2.4 inch needles in fascicles of two. Although its thin bark and shallow roots make it susceptible to fire, Sierra lodgepole pine is the only non-serotinous lodgepole pine. Therefore it does not need fire to open its cones to release seeds. Sierra lodgepole pine is a pioneer species after fire or other canopy disturbances.

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 needles ranging from 1.2 to 2.8 inches 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). White fir is a shade-tolerant conifer and is able to establish in the understory of

Sierra lodgepole pine. If it continues to grow and reproduce in the understory, it will eventually dominate the forest in the absence of disturbance. White fir has thin bark and low live crown heights, which make it susceptible to fire.

Sierra lodgepole pine has a complex disturbance regime which includes cyclic beetle infestations and fire. Fire studies in the lodgepole pine forest of the Caribou Wilderness report a fire return interval of 67 years between 1735 and 1929. Even low intensity fires resulted in high mortality rates of the lodgepole pine (Taylor and Solem, 1995). Sierra lodgepole pine regenerates prolifically after fire and evenly aged stands are formed. The mountain pine beetle (Dendroctonus ponderosae) is a natural pest that can kill a significant portion of the larger trees in a stand. Infestations can last for several years and often return in 20 to 40 year cycles (Cope, 1993). After an outbreak the forest may be dominated by standing dead trees. These trees eventually fall, creating layers of overlapping logs. Fuel loads are high, but the downed logs burn slowly and at a low intensity. Even low intensity fire causes damage to 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 or white fir regeneration. Over time these gaps break up the uniformity of the 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 for north facing slopes than for south facing slopes, and fire intensity increases from the lower slope to the upper slope positions. Their study also indicates a slightly later burn season in the Southern Cascades than in the Sierra Nevada. 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 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 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 the past, 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 to affect this site, but several other pathogens have the potential to cause mortality or diminished productivity. Most of these pathogens represent natural cycles of regulation and can 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)

Other pathogens that affect Sierra lodgepole pine include other insects such as the pine engraver (Ips pini), weevil (Magdalis gentiles), lodgepole terminal weevil (Pissodes terminalis), Warren's collar weevil (Hylobius warreni), pine needle scale (Chionaspis pinifoliae), black pineleaf scale (Nuculaspis californica), the spruce spider mite (Oligonychus ununguis), lodgepole sawfly (Neodiprion burkei), lodgepole needle miner (Coleotechnites milleri), sugar pine tortrix (Choristoneura lambertiana), pine tube moth (Argyrotaenia pinatubana), 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 can also 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).

Pathogens that affect white fir are the dwarf mistletoe (*Arceuthobium abietinum* f. sp. concoloris), Cytospora canker

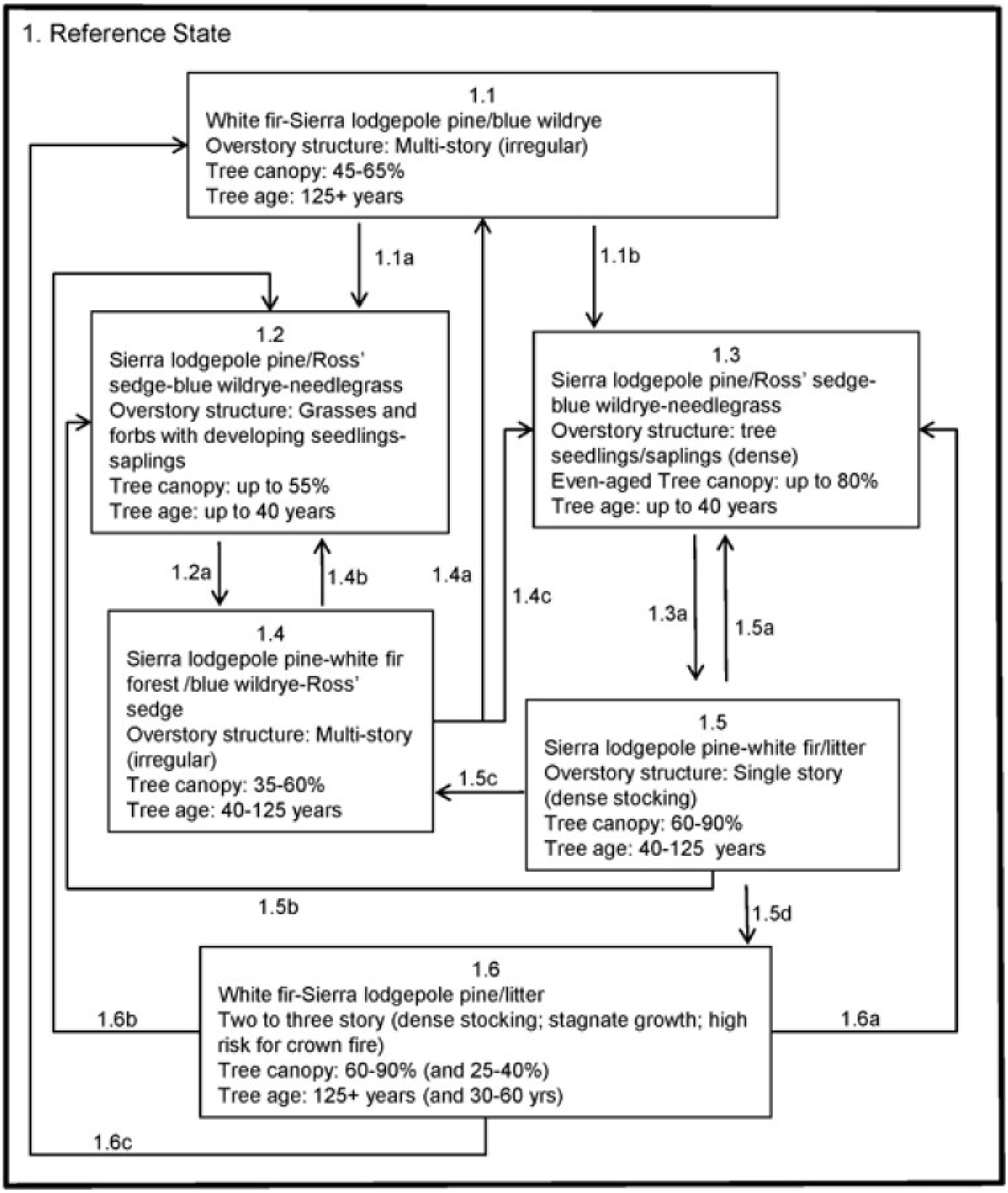
(Cytospora abietis), broom rust (Melampsorella caryophyllacearum), annosus root disease (Heterobasidium annosum), armillaria root disease (Armillaria sp.), trunk rot (Echinodontium tinctorium) and the fir engraver (Scotylus ventralis). The most threatening of these is the combination of the fir engraver 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 F022BI120CA
Abies concolor-Pinus contorta var. murrayana/Elymus glaucus
(White fir-Sierra lodgepole pine/blue wildrye)



State 1
Reference

Community 1.1
White fir-Sierra lodgepole pine/blue wildrye

This mature white fir-Sierra lodgepole pine forest develops with small scale disturbances that create gaps in the canopy. These gaps (single tree fall to 0.25 acre in size) provide suitable sites for Sierra lodgepole pine regeneration and, over time, create an uneven forest structure and composition. Several age classes of Sierra lodgepole pine and white fir are present. The tallest overstory Sierra lodgepole pines provide a seed source for gap areas. Jeffrey pine (*Pinus jeffreyi*), incense cedar (*Calocedrus decurrens*), and sugar pine (*Pinus lambertiana*) of various ages are also present with low cover. A low or moderate intensity surface fire would cause high mortality to all ages of Sierra lodgepole pine and to young white fir, although some mature white fir may survive. This would open the forest and shift the species composition. An open forest allows more sunlight through the canopy, enhancing the establishment and survival of shade-intolerant Jeffrey pine and sugar pine. With low to moderate understory burns, Sierra lodgepole pine will decline in composition, and a white fir-mixed conifer forest may develop.

Community 1.2
Sierra lodgepole pine/Ross sedge-blue wildrye-needlegrass

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

Community 1.3
Sierra lodgepole pine/Ross sedge-blue wildrye-needlegrass

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

Community 1.4
Sierra lodgepole pine-white fir forest /blue wildrye-Ross sedge

This forest is multi-aged with an irregular canopy distribution due to small scale or patchy disturbances. Mountain pine beetle infestations create the most significant canopy openings. After a pest infestation, patches of the stand die, leaving gaps for lodgepole pine regeneration. Low intensity fire is often fatal to mature lodgepole pine, so even low severity fire can be a stand replacing event. The event of fire creating small gaps is uncommon; however low intensity smoldering fires have been documented which spread through downed trees after a mountain pine beetle infestation. Although minor damage to the live trees was noted, some with fire scars were rendered more susceptible to the next mountain pine beetle attack. Shallow roots make lodgepole pine susceptible to wind throw, which also creates canopy gaps. White fir has established in the understory, and is co-dominant to Sierra lodgepole pine in some areas. White fir is multi-aged and has a patchy distribution due to stand disturbances.

Community 1.5
Sierra lodgepole pine-white fir/litter

This dense Sierra lodgepole pine-white fir forest develops after dense seedling establishment and the absence of canopy disturbance. This forest has an even-aged upper canopy of Sierra lodgepole pine, 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. White fir is established in the understory, and eventually becomes co-dominant to the Sierra lodgepole pine. There is almost no Sierra lodgepole pine regeneration due to the lack of openings in the forest. Understory production and cover decreases due to the lack of sunlight. The potential for a severe pest infestation or disease is high because the trees are stressed from competition for sunlight, water, and nutrients. The close proximity of the trees will enable the pathogens to spread quickly. Severe fire is likely during this phase because of the high accumulation of fuels on the forest floor.

Community 1.6
White fir-Sierra lodgepole pine/litter

The dense white fir-Sierra lodgepole pine forest develops with the continued exclusion of fire and lack of other disturbances, allowing the tree densities to increase to unhealthy levels. Competition for water and sunlight continues and tree health and vigor decreases. Sierra lodgepole pine persists in the understory of the 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.

Forest overstory. White fir dominates the overstory with 20 to 50 percent cover. The cover of Sierra lodgepole pine is about 20 percent, but the trees are dying so their canopy is declining. Total canopy cover ranges from 60 to 90 percent. The overstory canopy is about 100 to 120 feet tall, with several understory canopies of white fir. There is an occasional Jeffrey pine, incense cedar, and sugar pine in the overstory.

Forest understory. Understory cover and production is low and quite variable due high canopy cover and thick accumulations of litter and debris on the forest floor. White fir and incense cedar saplings and seedlings are common. Other species are western needlegrass (Achnatherum occidentale), Ross' sedge (Carex rossii), squirreltail (Elymus elymoides), blue wildrye (Elymus glaucus), naked buckwheat (Eriogonum nudum), white hawkweed (Hieracium albiflorum), and spike trisetum (Trisetum spicatum).

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	0	63	180
Tree	3	17	44
Forb	0	3	10
Shrub/Vine	0	4	10
Total	**3**	**87**	**244**

Pathway 1.1a
Community 1.1 to 1.2

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

Pathway 1.2b
Community 1.1 to 1.3

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

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 1.6). Trees are generally healthy and few gaps are created from tree mortality in this young forest.

Pathway 1.4a
Community 1.4 to 1.1

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

Pathway 1.4b
Community 1.4 to 1.2

This pathway is triggered by a high mortality fire which initiates an 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 a dense Sierra lodgepole pine regeneration (Community Phase 1.3) provided there is ample cones and seed and optimum germination of seeds.

Pathway 1.5b
Community 1.5 to 1.2

This pathway is triggered by a high mortality fire which leads to open Sierra 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. A 67-year fire return interval does not allow for later succession community phase (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 which leads to dense Sierra lodgepole pine regeneration (Community Phase 1.3) provided there is ample presence of cones and seed and optimum germination of seeds.

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 and, with continued small scale disturbances, can eventually develop into Community 1.1.

Pathway 1.5d
Community 1.5 to 1.6

With time and growth in the absence of disturbance, the stand remains evenly aged and dense. White fir has established in the understory and become increasingly prevalent in the canopy, creating a dense white fir-Sierra lodgepole pine forest (Community Phase 1.6).

Pathway 1.6c
Community 1.6 to 1.1

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

Pathway 1.6b
Community 1.6 to 1.2

Depending on cone and seed conditions, a severe fire would initiate open Sierra lodgepole pine regeneration (Community 1.2).

Pathway 1.6a
Community 1.6 to 1.3

Depending on cone and seed conditions, a severe fire would initiate dense Sierra lodgepole pine regeneration (Community Phase 1.3) based on ample presence of cones and seed and optimum germination of seeds.

Additional community tables

Table 6. Community 1.6 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Tree					
0	**Tree (understory only)**			3–44	
	white fir	ABCO	*Abies concolor*	3–25	1–5
	incense cedar	CADE27	*Calocedrus decurrens*	0–10	0–2
	Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0–5	0–2
	Jeffrey pine	PIJE	*Pinus jeffreyi*	0–2	0–1
	sugar pine	PILA	*Pinus lambertiana*	0–2	0–1
Shrub/Vine					
0	**Shrub**			0–10	
	naked buckwheat	ERNU3	*Eriogonum nudum*	0–10	0–5
Grass/Grasslike					
0	**Grass/Grasslike**			0–180	
	blue wildrye	ELGL	*Elymus glaucus*	0–60	0–10
	Ross' sedge	CARO5	*Carex rossii*	0–50	0–10
	squirreltail	ELEL5	*Elymus elymoides*	0–30	0–7
	western needlegrass	ACOC3	*Achnatherum occidentale*	0–25	0–8
	spike trisetum	TRSP2	*Trisetum spicatum*	0–15	0–5
Forb					
0	**Forb**			0–10	
	white hawkweed	HIAL2	*Hieracium albiflorum*	0–10	0–3

Table 7. Community 1.6 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
white fir	ABCO	*Abies concolor*	Native	–	40–50	–	–
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	20–30	–	–
incense cedar	CADE27	*Calocedrus decurrens*	Native	–	0–4	–	–
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	0–3	–	–
sugar pine	PILA	*Pinus lambertiana*	Native	–	0–3	–	–

Table 8. Community 1.6 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
Ross' sedge	CARO5	*Carex rossii*	Native	–	0–10
blue wildrye	ELGL	*Elymus glaucus*	Native	–	0–10
western needlegrass	ACOC3	*Achnatherum occidentale*	Native	–	0–8
squirreltail	ELEL5	*Elymus elymoides*	Native	–	0–7
spike trisetum	TRSP2	*Trisetum spicatum*	Native	–	0–5
Forb/Herb					
white hawkweed	HIAL2	*Hieracium albiflorum*	Native	–	0–3
Shrub/Subshrub					
naked buckwheat	ERNU3	*Eriogonum nudum*	Native	–	0–5
Tree					
white fir	ABCO	*Abies concolor*	Native	–	1–5
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	0–2
incense cedar	CADE27	*Calocedrus decurrens*	Native	–	0–2
Jeffrey pine	PIJE	*Pinus jeffreyi*	Native	–	0–1
sugar pine	PILA	*Pinus lambertiana*	Native	–	0–1

Animal community

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

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 shrub lands provide different habitats and forage. Deer and bear can heavily browse 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 birds 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).

Recreational uses

This area is suitable for hiking trails and wildlife viewing.

Wood products

Sierra lodgepole pine wood is used for framing, paneling, trim, posts, and other construction material. 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).

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).

Incense cedar wood is resistant to decay, making it very desirable for exterior use. This wood is used as mud sills, window sashes, sheathing under stucco or brick veneer construction, greenhouse benches, fencing, poles and trellises. It is also widely used for exterior and interior siding. Much of the top quality incense cedar is used in the manufacture of pencils (Habeck, 2008).

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).

Other information

Additional information on the common white fir pathogens:

White fir dwarf mistletoe (*Arceuthobium abietinum* f. sp. concoloris) is a parasitic plant common in the survey area as evident by witches brooms, top kill, stem cankers and swellings. The vegetative shoots of the dwarf mistletoe are often present from spring to fall. A fungus (Cytospora abietis) kills the branches that are infected with dwarf mistletoe. The reduced vigor makes the tree more susceptible to bark beetle and other diseases. The mistletoe cankers produce cracks in the bark that create entry points for other diseases such as heart rots (Burns and Honkala, 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.). This disease can damage tree growth by reducing crown development. Mortality is less common in mature trees than in younger regeneration trees. Secondary infection is possible from heart rots entering through openings in the infected areas (Burns and Honkala, 1990).

Annosus root rot (Heterobasidion annosum) can affect large acres of fir forest. It spreads from infected roots to healthy roots. It slowly decays the roots, the root collar and the stem butt for many years, causing structural weaknesses and making the tree vulnerable to wind throw. Annosus root rot can also be spread aerially, infecting freshly cut stumps or other fresh tree wounds. Painting borax on the 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 white fir directly, but it weakens the tree and makes it easier for bark beetles (Scolytus spp.) to infest the tree (Burns and Honkala, 1990).

The fir engraver beetle (Scolytus ventralis) can cause extensive damage to white fir forests. Outbreaks can cause mortality to several acres of trees. It can reach epidemic levels when the trees are stressed due to drought, annosus root rot, dwarf mistletoe, or from fire damage.

Additional information on 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 and Honkala, 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 a pine engraver (Ips pini) infestation 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).

Additional information about the mountain pine beetle, which can affect sugar pine, as well as other pines:

The mountain pine beetle (Dendroctonus ponderosae) creates pitch tubes on the bark at the point of entry. Boring dust is evident at the base of the tree. These beetles feed on the phloem layer in the inner bark of the tree, eventually girdling the tree. A blue stain fungus is inoculated into the tree by the beetles and reduces the flow of water. These beetles generally infest trees that are weakened by drought or other stresses and usually kill the tree. The engraver beetles (Ips spp.) are a secondary bark beetle, coming in after the mountain pine beetle. They eat the inner bark of the tree and inoculate the blue stain fungus as mentioned above, but the trees have a lower mortality rate. These beetles can be distinguished by their feeding patterns in the wood, and by the shape of the adults.

SITE INDEX DOCUMENTATION:

Alexander (1966) and Schumacher (1926) were used to determine forest site productivity for Sierra lodgepole pine and white fir, respectively. Low to High values of Site index and CMAI (culmination of mean annual increment) give an indication of the range of inherent productivity of this ecological site. Site index relates to height of dominant trees over a set period of time and CMAI relates to the average annual growth of wood fiber in the boles/trunks of trees. Site index and CMAI listed in the Forest Site Productivity section are in units of feet and cubic feet/acre/year, respectively. Both site index and CMAI are estimates; on-site investigation is recommended for specific forest management units for each soil classified to this ecological site. The historical and actual basal area of trees within a growing stand will greatly influence CMAI.

Conifer trees appropriate for site index measurement typically occur in community phase 1.4 and the older stands in community phases 1.2 and 1.3.

Table 9. Representative site productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age Of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
white fir	*ABCO*	59	59	124	124	70	030	–	
white fir	*ABCO*	59	59	124	124	–	–	100TA	Alexander, Robert R. 1966. Site indexes for Lodgepole pine, with corrections for stand density: instructions for field use. USDA, Forest Service. Rocky Mountain Forest and Range Experiment Station Research Paper RM-24.
Sierra lodgepole pine	*PICOM*	94	94	111	111	100	520	–	
Sierra lodgepole pine	*PICOM*	94	94	83	83	–	–	100TA	Alexander, Robert R. 1966. Site indexes for Lodgepole pine, with corrections for stand density: instructions for field use. USDA, Forest Service. Rocky Mountain Forest and Range Experiment Station Research Paper RM-24.

Inventory data references

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

789347- type location

Type locality

Location 1: Plumas County, CA	
Township/Range/Section	T30 N R5 E S21
UTM zone	N
UTM northing	4477934
UTM easting	633873
General legal description	The type location is about 1 mile west of Drakesbad in Lassen Volcanic National Park.

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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):**

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

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12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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

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

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

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

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17. **Perennial plant reproductive capability:**
