USDA Natural Resources Conservation Service

Ecological site F022BI105CA
Frigid Sandy Loam Debris Flow On Stream Terraces

Accessed: 04/25/2024

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) Stream terrace
Elevation (feet): 6,120-6,350
Slope (percent): 0-8
Water Table Depth (inches): 10 to 60
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: No Influence on this site
Mean annual precipitation (inches): 45.0-61.0
Primary precipitation: Snow from November to April
Mean annual temperature: 41 to 44 degrees F (5 to 6.6 degrees C)
Restrictive Layer: None
Temperature Regime: Frigid
Moisture Regime: Xeric
Parent Material: 1915 eruption debris deposited over preexisting alluvial soil
Surface Texture: (1) Ashy very fine sandy loam
Surface Fragments <=3" (% Cover): 0-20
Surface Fragments > 3" (% Cover): 0-10

Soil Depth (inches): > 60
Vegetation: Quaking aspen (*Populus tremuloides*) and Sierra lodgepole pine (*Pinus contorta* var. murrayana); Sierra lodgepole pine is encroaching upon the aspen.
Notes: Primarily located along Hat Creek in Lassen Volcanic National Park.

Classification relationships

Forest Alliance = *Pinus contorta* ssp. murrayana – Lodgepole pine forest; Association = (no matching species). (Sawyer, John O., Keeler-Wolf, Todd, and Evens, Julie M. 2009. A Manual of California Vegetation. 2nd ed. California Native Plant Society Press. Sacramento, California.)

Associated sites

F022BI106CA	**Frigid Debris Flow Gentle Slopes** This ecological site is associated with debris deposits in the Devastated Area and is drier.
F022BI123CA	**Frigid Flat Outwash Terraces** This is a white fir- Sierra lodgepole pine ecological site, found in topographically higher positions.
R022BI213CA	**Frigid Sandy Flood Plains** This riparian ecological site is found along the stream channel.

Similar sites

F022BI125CA	**Cold Frigid Tephra Over Outwash Plains Or Lake Terraces** This is a drier Sierra lodgepole pine site, with a grassy understory.
F022BI108CA	**Frigid Moist Sandy Lake Or Stream Terraces** This is a wet Sierra lodgepole pine site, which lacks aspen.

Table 1. Dominant plant species

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

Physiographic features

This ecological site is found along Hat Creek on low stream terraces between 6,120 and 6,350 feet in elevation. Slopes range from 0 to 8 percent. This site has a water table that fluctuates from 10 inches below the surface to below 60 inches.

Table 2. Representative physiographic features

Landforms	(1) Stream terrace
Flooding frequency	None
Ponding frequency	None
Elevation	6,120–6,350 ft
Slope	0–8%
Water table depth	10–60 in
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 45 to 61 inches (1,143 to 1,549 mm). The mean annual temperature ranges from

41 to 44 degrees F (5 to 6.6 degrees C). The frost free (>32 degrees F) season is 60 to 85 days. 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 approximately 6 miles east of this site and 400 feet higher in elevation. The average annual snow depth (at the Manzanita Lake climate station) reaches its peak depth of 25 inches in February. Snow is normally melted by June and does not begin to accumulate again until November.

Table 3. Representative climatic features

Frost-free period (average)	85 days
Freeze-free period (average)	202 days
Precipitation total (average)	61 in

Influencing water features

This ecological site is not influenced by wetland or riparian water features, but it is found on stream terraces.

Soil features

This ecological site is associated with the Vitrandic Xerofluvents debris flows soil component. This component is very deep and somewhat poorly drained, with low AWC in the upper 60 inches of soil. 10 to 50 inches of debris from the 1915 eruption of Lassen Peak is deposited over the preexisting alluvial soil There are a few inches of fresh organic material over several C horizons and one buried A horizon. The upper C horizons have ashy very fine sandy loam textures. This material is from reworked debris material that overlays the coarser textured initial debris material. The initial debris material in the lower C horizons has ashy loamy coarse sand textures and gravel increases with depth, from 6 to 60 percent. The buried A horizon has a very gravelly ashy fine sandy loam texture.

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

Map unit Component / Component %
138 Vitrandic Xerofluvents, debris flows / 80

Table 4. Representative soil features

Surface texture	(1) Ashy very fine sandy loam
Family particle size	(1) Sandy
Drainage class	Somewhat poorly drained
Permeability class	Moderate
Soil depth	60 in
Surface fragment cover <=3"	0–20%
Surface fragment cover >3"	0–10%
Available water capacity (0-40in)	1.06–7.43 in
Soil reaction (1:1 water) (0-40in)	5.6–7.3
Subsurface fragment volume <=3" (Depth not specified)	0–45%
Subsurface fragment volume >3" (Depth not specified)	0–5%

Ecological dynamics

This ecological site is characterized by the presence of quaking aspen (*Populus tremuloides*) and Sierra lodgepole pine (*Pinus contorta* var. murrayana). It is primarily located along Hat Creek in Lassen Volcanic National Park. Sierra lodgepole pine is encroaching upon the aspen throughout this area.

The 1915 eruption of Lassen Peak buried this area with 10 to 50 inches of coarse debris material. After deposition, the water that was held in the debris drained out and caused flooding and erosion across the valley. To varying degrees, these disturbances buried and removed the preexisting vegetation. As a consequence the valley bottom opened for colonization by pioneer plant species. Quaking aspen and Sierra lodgepole pine are both shade intolerant species that regenerate well after disturbances. It is not documented, but the presence, distribution, and age of the aspen and Sierra lodgepole pine indicate that they may have established concurrently after the debris flow. Proximity to Sierra lodgepole pine and aspen seed sources, or surviving aspen roots, would affect the distribution of aspen and lodgepole pine across the valley. Aspen grow taller more quickly than Sierra lodgepole pine and may have initially been more dominant. After aspen reaches its maximum height however, Sierra lodgepole pine will continue to grow and eventually dominate the aspen canopy. Hat Creek may have braided through the original debris deposits until it developed its current channel. If aspen were already established nearby, suckers could shoot up in the abandoned channel before lodgepole pine could compete, which could account for some of the pure aspen stands.

Quaking aspen is unique because of its clonal growth characteristics. This is best seen in fall when separate patches of trees will exhibit different colors of yellow, gold, and orange. The different colors represent the different genetic clones, which respond differently to stress factors and seasonal changes. It is commonly believed that aspen was a pioneer on glacial outwash plains after the glaciers retreated. The fresh glacial outwash would have provided the ideal substrate of deep, exposed moist soils for aspen seedling development. Genetic studies have indicated that aspen rarely reproduce from seed and may not have produced many new seedlings since the last major ice age. Although aspen doesn't regenerate often from seed, it spreads prolifically by root sprouts called suckers. The suckers are part of a clone. Although clones tend to be either male or female, some are hermaphrodites. The clones regenerate after sudden canopy removal caused by disturbances such as fire, disease or insect infestations. Without fire or other disturbances, aspen stands fail to produce suckers because of hormonal inhibitors. The movement of the hormone that suppresses suckering is reduced when the tree canopy is killed or stressed, which allows another hormone to stimulate suckering (Bartos, 2001). Young aspen clones and mature trees grow best in full sunlight. Aspen trees can to live to be 150 years or older, but often aspen stands tend to deteriorate after 80 to 100 years without disturbance. One report documents a male aspen clone in Utah that covers 17.2 acres and has 47,000 stems. They estimate the age of this clone to be 1 million years old (Howard, 1996; Mitton and Grant, 1996).

Aspen stands can be seral to conifer or stable climax communities depending on the site characteristics. This site is a seral aspen site because of the ability of Sierra lodgepole pine to establish in the area. While stable aspen stands tend to be associated with Mollisols exhibiting pachic, argic or boralfic characteristics, which have high organic matter content and relatively high pH ranges, the soils of the seral stands tend to be associated more often with typic Alfisols, some with mollic characteristics but with lower organic matter content and lower pH ranges. The soils associated with this seral aspen site are Vitrandic Xerofluvents, debris flows. These soils are young and poorly developed, composed of relatively fresh debris flow material. They have not developed an A horizon and have only a few inches of fresh organic matter on the surface. The buried soil encountered at about 50 inches has an Ab horizon with a very gravelly ashy fine sandy loam texture. High water tables often inhibit conifer encroachment and allow aspen to remain as a stable climax species. This site has a seasonally high water table at 10 inches but it lowers though-out the season and does not inhibit Sierra lodgepole pine.

Although soil morphology changes and is different for conifer and aspen forests, the changes do not seem to be significant enough to preclude either species from this site. (Bartos and Amacher, 1998). Soils under stable aspen sites tend to have higher pH values than those for conifer soils, and organic matter occurs within the soil profile rather than being concentrated at or above the surface as in conifer sites.

Water use may be less in aspen sites than for coniferous sites, creating the potential for more runoff and free water in aspen dominated forests.

Grazing by ungulates can severely impact regeneration of aspen, but at this time grazing does not seem to have a significant impact in Lassen Volcanic National Park.

Sierra lodgepole pine is a long lived conifer that commonly attains heights of 90 to 100 feet, with an average dbh of 16.5 inches. It has 1.2 to 2.4 inch long needles in bundles of two. The cones are non-serotinous, meaning that they release their seeds without fire. Older trees can be prolific, reliable seed producers, with good seed crops occurring every 1 to 3 years. Cones first appear between the ages of 4 and 8. Although usually seral to more shade tolerant conifers such as red fir and white fir, Sierra lodgepole pine forms an edaphic climax in cold pockets and wet areas typified by this site.

The historic fire regime for aspen is poorly understood. Pure seral aspen stands unsuitable for conifer encroachment are generally considered fire safe corridors and may not experience a canopy fire for 300 years. The seral aspen stands are self-perpetuating. When the overstory dies back from disease or natural senescence, the aspen will regenerate in the openings because there is no competition from conifers. When conifers encroach into an aspen stand, fuel loads accumulate and the potential for a canopy fire increases.

Different plant pathogens and pests can kill or severely impact the health of aspen, including several fungal stem canker diseases. The more common and serious cankers are the sooty-bark canker (Encoelia pruinosa), black canker (Ceratocystis fimbriata), Cryptosphaeria (Cryptosphaeria populina) and Cytospora canker (Cytospora chrysosperma). These stem cankers enter the aspen through wounds in the bark, creating abnormal growth and often blackish cankers. The sooty-bark canker and the Cryptosphaeria canker fungi can kill a tree in just one to ten years while others may never kill the tree. These fungi are a natural part of the aspen ecology and essential in bringing death to older trees and creating a new cycle of regeneration (Johnson et al.).

White trunk rot fungus (Phellinus tremulae) decays the base of the aspen tree, reducing wood quality and weakening the structure of the tree. This rot tends to infest older trees, making them susceptible to wind throw. The white truck rot fungus develops hoof shaped conks that can aid in identification of infected trees (Ostry et al., 1983).

Other pathogens are the root diseases like Armillaria spp., which can weaken the tree and often cause wind throw. Various boring insects and beetles also attack aspen but generally do not kill the tree. Attacks can lead to secondary infections by stem cankers when holes are created in the aspen bark. Foliage diseases such as ink-spot (Ciborina whetzelii) and defoliating insects such as aspen tortrix (Choristoneura conflictana) and western tent caterpillar (Malacosoma californicum) generally do not kill aspen trees unless severe infestations continue for several years. Again, all of these diseases and pests are parts of the natural cycle of aspen ecology (Shepperd et al., 2001).

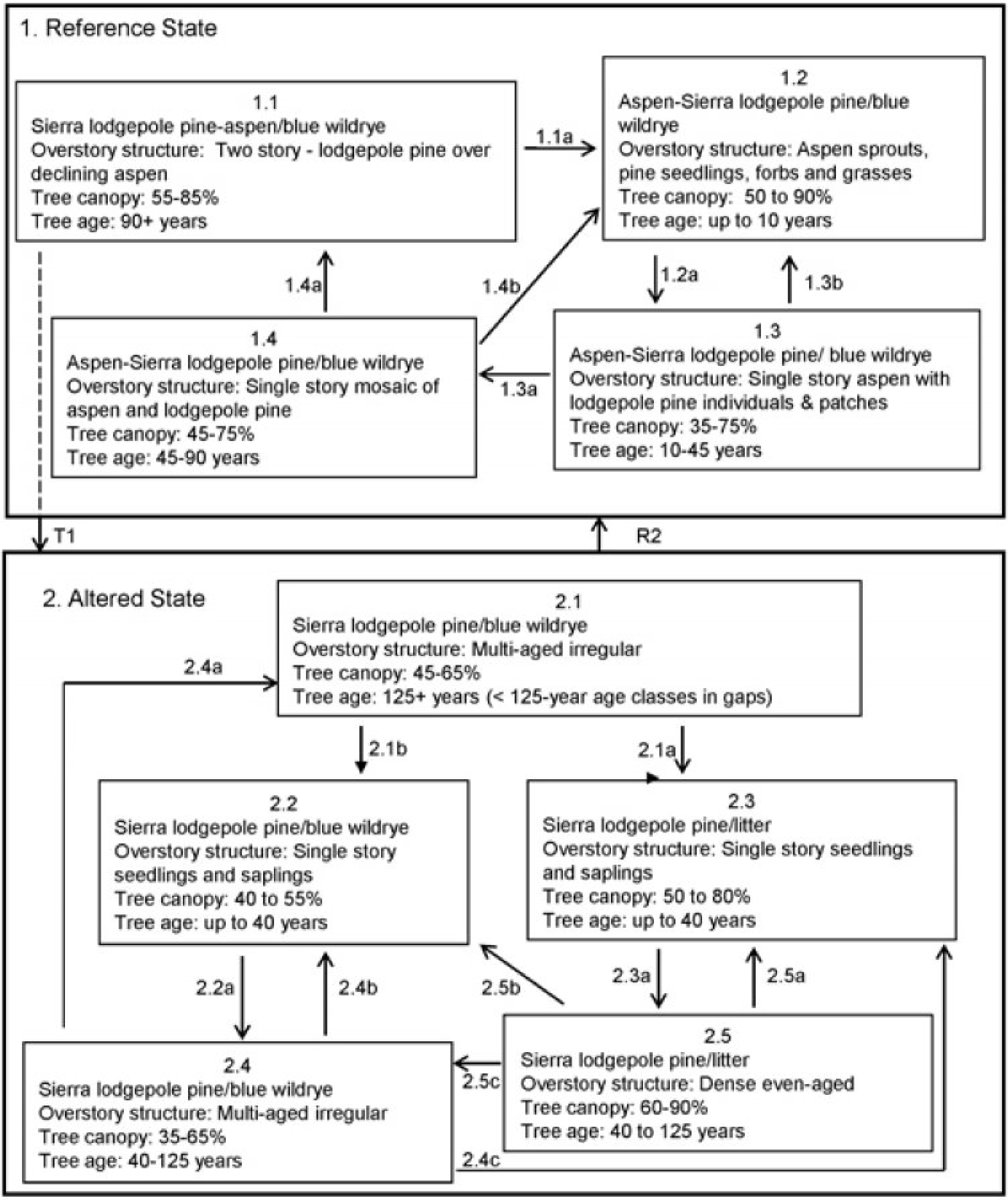
The major pathogens that affect Sierra lodgepole pine are Annosus root disease (Heterobasidion annosum) Lodgepole pine dwarf mistletoe (*Arceuthobium americanum*) and the mountain pine beetle (Dendroctonus ponderosae).

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 F022BI105CA
Pinus contorta var. murrayana-Populus tremuloides/Elymus glaucus
(Sierra lodgepole pine -quaking aspen/blue wildrye)



State 1
Reference

Community 1.1

Sierra lodgepole pine-aspen/blue wildrye

This is the reference community phase for this ecological site. Most of the ecological site is presently in this community phase as there has been very little disturbance since the debris flow of 1915. A dense forest of 80 to 90 year old Sierra lodgepole pine is present with a grassy understory. Areas of bark beetle infestations and wind throw have created small gaps within the dense forests. These gaps may allow for regeneration of Sierra lodgepole pine and stimulate aspen suckers. In order for the aspen suckers to survive, the gaps would have to have a low recruitment of lodgepole pine seedlings and be large enough to allow for direct sunlight to reach the aspen through the surrounding canopy. These gaps break up the uniformity of the forest overtime, but are probably not sufficient for healthy aspen regeneration. The mature aspen and young suckers occur in the denser areas of the forest as well, but are crowded and overshadowed by lodgepole pine. Aspen stands begin to deteriorate after about 80 years due to the build up of pathogens. Without sudden canopy disturbance there will not be a flush of aspen suckers and Sierra lodgepole pine may fill in the decaying aspen stand rather than younger aspen. Fossorial animal activity enhances germination of lodgepole pine under the decaying aspen canopy. Nearby in Pine Creek, Sierra lodgepole pine and white fir are established within the aspen stand. The young aspen suckers have a powdery mildew on their leaves caused by a fungi (Uncinula adunca) and a disease, most likely shepherd’s crook (Venturia macularis), is causing a blackening and wilting of the twigs and foliage of the young shoots. These are natural pathogens, but wetter than normal springs and/or increased shade from the conifer canopy may increase the rate of infection and reduce overall vigor of the aspens (Smith, et, 2006).

Forest overstory. Sierra lodgepole pine dominates this forest with up to 80 percent canopy cover. Trees are 85 to 100 feet tall with 15 to 20 inch dbh. Basal area ranges from 120 to 190 ft2/ acre. The height for the quaking aspen ranges from 80 to 90 feet. There is much standing dead and downed trees from both species.

Forest understory. The understory is dominated by grasses such as blue wildrye (Elymus glaucus), western needlegrass (Achnatherum occidentale), squirreltail (Elymus elymoides) and California brome (Bromus carinatus). Other common species include yarrow (Achillea millefolium), sedges (Carex spp.), spreading groundsmoke (Gayophytum diffusum), whitestem gooseberry (Ribes inerme) and Gray's licorice-root (Ligusticum grayi), with diverse other low cover plants. Quaking aspen (Populus tremuloides) sprouts are few and unhealthy.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	22	110	260
Tree	2	50	110
Shrub/Vine	0	10	65
Forb	3	20	45
Total	**27**	**190**	**480**

Table 6. Ground cover

Tree foliar cover	30-65%
Shrub/vine/liana foliar cover	0-10%
Grass/grasslike foliar cover	15-65%
Forb foliar cover	1-15%
Non-vascular plants	0%
Biological crusts	0%
Litter	85-95%
Surface fragments >0.25" and <=3"	0-2%
Surface fragments >3"	0-2%
Bedrock	0%
Water	0%
Bare ground	0-15%

Community 1.2
Aspen-Sierra lodgepole pine/blue wildrye

After a canopy replacing event such as fire, disease or insect infestation, young aspen suckers will sprout prolifically from the surviving roots. Very dense root mats are possible, which may suppress growth of other plants for a short period. Many of the young suckers will die during this time but overall canopy cover will remain high. Sierra lodgepole pine is a pioneer species and will also regenerate prolifically after fire via wind dispersed seed or from seeds stored in the soil. Seedling mortality will ordinarily be high during this phase, but young dog hair thickets can develop that will begin to self-thin and open up. The presence of aspen or Sierra lodgepole pine seems to be dependent upon the nearness and health of aspen roots after a disturbance and the proximity of a Sierra lodgepole pine seed source. After a fire, the cover of grasses and forbs will remain high since many of these species will re-sprout or germinate from seed. Disturbance dependent sun-loving annual and perennial forbs may have a short lived presence after a fire. Fires are not frequent in aspen stands because of the high moisture content associated with these areas. Some reports indicate that the fire frequency for aspen stands is similar or longer than for the surrounding forest, however. In this case, the surrounding forest would be comprised of white fir, Jeffrey pine or red fir. The natural fire intervals in these forests range from 5 to 65 years (Bekker and Tayler, 2001; Bancroft, 1979; Taylor et al., 1991).

Community 1.3
Aspen-Sierra lodgepole pine/blue wildrye

This is a healthy young aspen forest that quickly transitions to a mature aspen grove within 30 to 40 years. The understory is lush and diverse with patches of aspen suckers in areas of disturbance. Sierra lodgepole pine has established patches of forest on the upper stream terraces. The Sierra lodgepole pines are dense and overcrowded, in the absence of disturbance. The aspen and Sierra lodgepole pine forests form a patch-work across the flats. In areas where Sierra lodgepole pine and aspen co-exist they may have equal dominance in the upper canopy during this phase.

Community 1.4
Aspen-Sierra lodgepole pine/blue wildrye

This aspen forest tends to have a single canopy with 45 to 75 percent cover. Several clones may be present as well as suckers in the understory and a lush understory of grasses and forbs. Sierra lodgepole pine is present throughout this area, generally in-filling from the perimeter of the aspen stand or in the understory of the aspen. The Sierra lodgepole pine becomes taller than the aspens, casting shade upon the aspen canopy and reducing their vigor and growth. White fir is occasionally present.

Pathway 1.1a
Community 1.1 to 1.2

In the event of a severe canopy fire or a clear-cut and prescribed burn, the old growth forest would return to the aspen regeneration community (Community 1.2). The overstory Sierra lodgepole pine will succumb to these fires because of their thin bark and shallow root systems (Kocher, 2005). A variable amount of Sierra lodgepole pine regeneration will co-develop with the aspen.

Pathway 1.2a
Community 1.2 to 1.3

With time and growth, Community 1.2 progresses to Community 1.3, the young aspen and Sierra lodgepole pine forest.

Pathway 1.3b
Community 1.3 to 1.2

In the event of a canopy fire or high mortality pest attack, this community would return to Community 1.2.

Pathway 1.3a
Community 1.3 to 1.4

This is the natural pathway for this community, which evolves with small patches 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 would normally have removed portions of the tree canopy. This pathway leads to the aspen-lodgepole pine forest (Community 1.4).

Pathway 1.4a
Community 1.4 to 1.1

In the absence of canopy disturbance a Sierra lodgepole pine dominated forest will develop with few aspen (Community 1.1).

Pathway 1.4b
Community 1.4 to 1.2

Natural disturbances such as fire, flood or disease remove the overstory canopy of aspen and Sierra lodgepole pine, allowing for regeneration (Community 1.2).

State 2
Altered

State 2 develops due to a long period with-out canopy disturbance, so when disturbance finally comes during this state Sierra lodgepole pine will dominate and aspen will be absent in the regeneration community. Without canopy disturbance, mature aspen die out in the shade of the Sierra lodgepole pine. The hormones required to induce suckering are not activated and, denied the sunlight needed for photosynthesis, the aspen roots eventually die. If there is not a nearby aspen seed source, it is eventually eliminated from the area. After a long period of rest, and elimination of aspen, Sierra lodgepole pine reproduces prolifically from seed after canopy removal. The actual time it takes to cross this threshold is unknown but possibly ranges from 200 to 300 years.

Community 2.1
Sierra lodgepole pine/blue wildrye

This mature Sierra lodgepole pine forest develops with small scale disturbances which 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 uneven forest structure and composition. Several age classes of Sierra lodgepole pine and white fir are present. Several Sierra lodgepole pines will persist in the tallest overstory and provide a seed source for gap areas. Mountain pine beetle (Dendroctonus ponderosae) epidemics are common in older Sierra lodgepole pine forests. Epidemics often occur in 20 to 40 years cycles and may last for 5 to 7 years. 1/3 to 2/3 of large trees in the forest can be killed during a severe infestation. After an outbreak, there are many standing dead trees, which gradually fall and create high amounts of down wood. Fine fuels from recently killed trees (dead needles and twigs both on the ground and remaining on trees) increase the probability of high mortality fire from ignition sources for several years. Sierra lodgepole pine will succumb to these fires because of their thin bark and shallow root systems. After death of the lodgepole overstory from fire or pest attack, watersheds can release up to 30 percent more water (Cope, 1993).

Community 2.2
Sierra lodgepole pine/blue wildrye

This community is dominated by grasses and Sierra lodgepole pine seedlings. 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 2.3
Sierra lodgepole pine/litter

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 which influence seedling density. Sierra lodgepole pine produces good seed crops every 1 to 3 years, and seeds are dispersed from late August to mid October. These seeds can be stored in the soil for several years, but tend to regenerate from wind dispersed seeds deposited after the fire. Therefore, the season of burn and timing in relation to seed crop cycles may affect seedling density. Smaller fires may have higher seedling density, due to the proximity of an available seed source. Fires leave bare soil and disturbed duff with open sunlight, which are ideal conditions for Sierra lodgepole pine seed germination. Seasonal precipitation patterns and air temperatures, during the season and germination, influence the survival of seedlings. As the seedlings develop they form dense thickets. The trees thin out there lower branches as they grow tall and thin. They self thin to some extent, but most trees persist even with limited sunlight on their canopy. Growth becomes stagnant, due to competition for light, water and nutrients. After a certain point in development Sierra lodgepole pine may not respond to competitive release from thinning, disease, or fire.

Community 2.4
Sierra lodgepole pine/blue wildrye

This forest is multi-aged with an irregular canopy distribution due to small scale or patchy disturbances. This community phase is common at this time. Mountain pine beetle infestations are the most significant disturbance that can create 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. So 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. Minor damage to the live trees was noted, but some with fire scars were more susceptible to mountain pine beetle attack. It does not seem that fire would ignite easily in the moist understory or in the nearby meadow until the end of summer. Shallow roots make lodgepole pine is susceptible to wind throw which also creates canopy gaps.

Community 2.5
Sierra lodgepole pine/litter

This dense Sierra lodgepole pine forest develops after dense seedling establishment and absence of canopy disturbance. This forest is even-aged with a high basal area of tall thin trees. The forest is stagnant. Only the upper crowns get sunlight, and the understory branches die back. The self-thinning process is slow and does not eliminate competition. There is almost no regeneration due to the lack of openings in the forest. Understory production and cover decreases due to the lack of sunlight. The potential for a severe pest infestation or disease is high because the trees are stressed from competition for sunlight, water, and nutrients. The close proximity of the trees 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.

Forest overstory. Dense, even-aged lodgepole pine with canopy ranging from 60-90 percent.

Forest understory. Little to no understory vegetation; litter predominates.

Table 7. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	0	35	183
Shrub/Vine	0	10	20
Tree	0	2	7
Forb	0	1	2
Total	**–**	**48**	**212**

Pathway 2.1b

Community 2.1 to 2.2

This pathway is created by a high mortality fire or forest infestation, followed by relatively open Sierra lodgepole pine seedling regeneration (Community 2.2).

Pathway 2.1a
Community 2.1 to 2.3

This pathway is created by a high mortality fire or forest infestation, followed by relatively dense Sierra lodgepole pine seedling regeneration (Community 2.3).

Pathway 2.2a
Community 2.2 to 2.4

With time and growth, with small scale canopy disturbances Community 2.2 progresses to the open Sierra lodgepole pine forest, Community 2.4.

Pathway 2.3a
Community 2.3 to 2.5

With time and growth, in the absence of disturbance, Community 2.3 progresses to the dense lodgepole pine forest, Community 2.5.

Pathway 2.4a
Community 2.4 to 2.1

With time and growth with small scale disturbances this forest continues to develop into a Sierra lodgepole pine forest (Community 2.1) with a multi-aged, complex forest structure.

Pathway 2.4b
Community 2.4 to 2.2

This pathway is triggered by a high mortality fire, which initiates open Sierra lodgepole pine regeneration (Community 2.2).

Pathway 2.4c
Community 2.4 to 2.3

This pathway is triggered by a high mortality fire, which initiates dense lodgepole pine regeneration (Community 2.3).

Pathway 2.5b
Community 2.5 to 2.2

This pathway is triggered by a high mortality fire, with appropriate conditions for open lodgepole pine regeneration (Community 2.2).

Pathway 2.5a
Community 2.5 to 2.3

This pathway is triggered by a high mortality fire, with appropriate conditions for dense lodgepole pine regeneration (Community 2.3).

Pathway 2.5c
Community 2.5 to 2.4

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 2.4) with several age classes, with continued small scale disturbances can eventually develop into Community 2.1.

Transition T1
State 1 to 2

The transition to State 2 may occur with the prolonged absence of fire or other disturbances, which would cause canopy mortality. If the lodgepole pine forest exists for a long enough period the aspen clones may completely die out and not regenerate after fire

Restoration pathway R2
State 2 to 1

Restoration of this site would be easiest after a natural disturbance, but considerable expense and maintenance would be needed. Aspen seed or seedlings would need to be reintroduced to the area while the Sierra lodgepole pine seedlings may need to be removed to eliminate competition.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Tree					
0	**Tree (understory only)**			2–110	
	quaking aspen	POTR5	*Populus tremuloides*	0–75	0–5
	Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	2–20	2–15
	white fir	ABCO	*Abies concolor*	0–15	0–5
Shrub/Vine					
0	**Shrub**			0–65	
	whitestem gooseberry	RIIN2	*Ribes inerme*	0–65	0–5
Grass/Grasslike					
0	**Grass/Grasslike**			22–260	
	blue wildrye	ELGL	*Elymus glaucus*	10–100	2–30
	sedge	CAREX	*Carex*	5–50	1–10
	squirreltail	ELEL5	*Elymus elymoides*	5–50	1–8
	western needlegrass	ACOC3	*Achnatherum occidentale*	2–30	1–5
	California brome	BRCA5	*Bromus carinatus*	0–30	0–5
Forb					
0	**Forb**			3–45	
	Gray's licorice-root	LIGR	*Ligusticum grayi*	2–35	1–8
	spreading groundsmoke	GADI2	*Gayophytum diffusum*	0–5	0–5
	common yarrow	ACMI2	*Achillea millefolium*	1–5	1–3

Table 9. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	33–75	–	–
quaking aspen	POTR5	*Populus tremuloides*	Native	–	2–10	–	–
white fir	ABCO	*Abies concolor*	Native	–	–	–	–

Table 10. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
blue wildrye	ELGL	*Elymus glaucus*	Native	–	2–30
sedge	CAREX	*Carex*	Native	–	1–10
squirreltail	ELEL5	*Elymus elymoides*	Native	–	1–8
western needlegrass	ACOC3	*Achnatherum occidentale*	Native	–	1–5
California brome	BRCA5	*Bromus carinatus*	Native	–	0–5
Forb/Herb					
Gray's licorice-root	LIGR	*Ligusticum grayi*	Native	–	1–8
spreading groundsmoke	GADI2	*Gayophytum diffusum*	Native	–	0–5
common yarrow	ACMI2	*Achillea millefolium*	Native	–	1–3
Shrub/Subshrub					
whitestem gooseberry	RIIN2	*Ribes inerme*	Native	–	0–5
Tree					
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	2–15
quaking aspen	POTR5	*Populus tremuloides*	Native	–	0–5
white fir	ABCO	*Abies concolor*	Native	–	0–2

Table 11. Community 2.5 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Tree					
0	**Tree (understory only)**			0–7	
	Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0–5	0–2
	white fir	ABCO	*Abies concolor*	0–2	0–1
Shrub/Vine					
0	**Shrub**			0–20	
	whitestem gooseberry	RIIN2	*Ribes inerme*	0–20	0–2
Grass/Grasslike					
0	**Grass/Grasslike**			0–183	
	blue wildrye	ELGL	*Elymus glaucus*	0–170	0–15
	squirreltail	ELEL5	*Elymus elymoides*	0–10	0–2
	sedge	CAREX	*Carex*	0–3	0–1
Forb					
0	**Forb**			0–2	
	common yarrow	ACMI2	*Achillea millefolium*	0–1	0–1
	Lamarck's bedstraw	GADI	*Galium divaricatum*	0–1	0–1

Table 12. Community 2.5 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)	Diameter (In)	Basal Area (Square Ft/Acre)
Tree							
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	60–88	–	–
white fir	ABCO	*Abies concolor*	Native	–	0–2	–	–

Table 13. Community 2.5 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (Ft)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
blue wildrye	ELGL	*Elymus glaucus*	Native	0–1.5	0–15
squirreltail	ELEL5	*Elymus elymoides*	Native	0–1	0–2
sedge	CAREX	*Carex*	Native	0–0.9	0–1
Forb/Herb					
common yarrow	ACMI2	*Achillea millefolium*	Native	0–0.3	0–1
Lamarck's bedstraw	GADI	*Galium divaricatum*	Native	0–1	0–1
Shrub/Subshrub					
whitestem gooseberry	RIIN2	*Ribes inerme*	Native	0–1.5	0–2
Tree					
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	1–6	0–2
white fir	ABCO	*Abies concolor*	Native	0.3–6	0–1

Animal community

Several birds are found in aspen stands. Frequently associated specifically with aspen are warbling vireo (Vireo gilvus), Empidonax flycatcher (Empidonax spp.), house wren (Troglodytes troglodytes), and Oregon junco (Junco hyemalis thuberi). Several cavity nesting birds in this area include flickers (Colaptes spp.), woodpeckers (Picoides spp. and Melanerpes spp.), chickadees (Parus spp.), and nuthatches (Sitta spp.). Secondary colonizers like owls and sparrows also inhabit the cavities. Birds tend to be more frequent in aspen stands than in the neighboring conifer forest and seem to prefer the larger mature aspens (Shepperd et al. 2006). Deer browse the young aspen and other vegetation in the understory.

Recreational uses

This area is suitable for hiking trails and camping. It provides wildflower and wildlife viewing opportunities with a diversity not seen in the upland conifer forests. This site is generally on older stream terraces, so a stream is often nearby.

Wood products

Although aspen is not used commercially in this area, in the eastern US the wood is used primarily for particleboard, especially waferboard and oriented strand board, and for pulp. Aspen fibers can be used to make fine paper and its lumber is used for making boxes, crates, pallets and furniture (Howard, 1996).

Other information

Site index documentation:

Alexander (1966) was used to determine forest site productivity for Sierra lodgepole pine. 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.

Lodgepole pine trees appropriate for site index measurement typically occur in community phase 2.4 and older stands in community phase 2.2. They are selected according to guidance in Alexander (1966). Aspen site index and CMAI could be determined using Edminster (1985) and Baker (1925).

Table 14. Representative site productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age Of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
Sierra lodgepole pine	*PICOM*	92	92	81	81	100	520	–	

Inventory data references

The following NRCS vegetation plots represent this ecological site:

789227
789269- Type location
789270
789333
789370

Type locality

Location 1: Shasta County, CA	
Township/Range/Section	T31 N R5 E S20
UTM zone	N
UTM northing	4488590

UTM easting	631808
General legal description	The site location is about 450 feet west of Hat Creek, and approx. 2.25 miles northeast of Hat Lake in LVNP.

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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:**