Ecological site F022BI111CA
Cryic Gravelly Or Ashy Sandy Loam Gentle Slopes

Accessed: 09/24/2026

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.

MLRA notes

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

Site concept: Landform: (1) Mountain slope, (2) Moraine, (3) Lava flow Elevation (feet): 6,470-8,300 Slope (percent): 1-80, but generally 2 to 30 percent Water Table Depth (inches): n/a Flooding-Frequency: None Ponding-Frequency: None Aspect: North, East, West Mean annual precipitation (inches): 37.0-111.0 Primary precipitation: Winter months in the form of snow Mean annual temperature: 38 to 43 degrees F (3.3 to 6 degrees C) Restrictive Layer: Densic layer or Lithic contact Temperature Regime: Cryic Moisture Regime: Xeric Parent Materials: Tephra over, or mixed, with till from volcanic rocks Surface Texture: (1) Gravelly ashy sandy loam, (2) Ashy Sandy loam Surface Fragments =3" (% Cover): 17-40 Surface Fragments > 3" (% Cover): 0-50 Soil Depth (inches): 20-60+ Vegetation: The subalpine forest is dominated by California red fir (Abies magnifica) and mountain hemlock (Tsuga mertensiana). Notes: This ecological site is found on glaciated mountain slopes and lava flows, moraines, or on linear to concave positions on pyroclastic cones.

Classification relationships

Forest Alliance = Tsuga mertensiana – Mountain hemlock 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

F022BI104CA	**Cryic Coarse Loamy Colluvial Slopes** This is a mountain hemlock forest found at higher elevations and sheltered north slopes.
R022BI205CA	**Cirque Floor** This is a lupine dominated rangeland site found in cirque floors.
R022BI206CA	**Cryic Lacustrine Flat** This cryic meadow site is found in alluvial flats among the forest.
R022BI207CA	**Alpine Slopes** This sparsely vegetated alpine range site is found at higher elevations.
R022BI208CA	**Cryic Pyroclastic Cones** This rangeland site is found on the shoulders of cinder cones in the eastern side of the Park.

R022BI211CA	**Spring Complex** This site is associated with springs and seeps and is dominated by alders, forbs, and sedges.

Similar sites

F022BI115CA	**Frigid And Cryic Gravelly Slopes** This red fir-western white pine site merges with this site at lower elevations.

Table 1. Dominant plant species

Tree	(1) *Tsuga mertensiana* (2) *Abies magnifica*
Shrub	Not specified
Herbaceous	(1) *Lupinus obtusilobus* (2) *Eriogonum marifolium*

Physiographic features

This ecological site is found on glaciated mountain slopes and lava flows, moraines, or on linear to concave positions on pyroclastic cones. The range in elevation is from 6,470 to 8,300 feet. Slopes range from 1 to 80 percent however slopes of 2 to 30 percent are more common.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope (2) Moraine (3) Lava flow
Flooding frequency	None
Ponding frequency	None
Elevation	1,970 – 2,530 m
Slope	0 – 80 %
Aspect	N, E, W

Climatic features

This ecological site receives most of its annual precipitation during the winter months in the form of snow. The mean annual precipitation ranges from 67 to 111 inches (1,702 to 2,819 mm). Prism models indicate precipitation drops to 37 inches (940 mm) on the upper cinder cones on the eastern side of the Park. The mean annual temperature ranges from 38 to 41 degrees F (3.3 to 5 degrees C). The frost free (>32 degrees F) season is 50 to 85 days. The freeze free (>28 degrees F) season is 60 to 185 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)	190 days
Precipitation total (average)	2,820 mm

Influencing water features

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

Soil features

This ecological site is associated with the Shadowlake soil component, the Terracelake soil component and the Xeric Vitricryands, ash over cinders soil component.

The Shadowlake soils are deep, well drained soils that formed in tephra over, or mixed, with till from volcanic rocks. The surface texture is a gravelly ashy sandy loam. Subsurface textures are similar, but gravel content increases significantly with depth. The lower portion of the profile contains greater than 35 percent rock fragments. A densic layer is present at depths of 40 to 60 inches. These soils are classified as Ashy-skeletal, glassy Xeric Vitricryands. Permeability is rapid to moderately rapid in the upper horizons and very slow through the densic layer. AWC (available water capacity) is very low to low in the upper 60 inches of soil.

The Terracelake soils are moderately deep, well drained soils that formed in tephra over, or mixed, with colluvium and residuum from volcanic rock. The surface texture is a gravelly ashy sandy loam. Subsurface textures are similar, but gravel content increases significantly with depth. Just above the bedrock there is an extremely stony ashy sandy loam textured horizon. Depth to dacite bedrock varies from 20 to 40 inches. There is greater than 35 percent rock fragments throughout most of this soil profile. These soils are classified as Ashy-skeletal, amorphic Xeric Vitricryands. Permeability is rapid to moderately rapid in the upper horizons but impermeable through the bedrock. AWC is very low to moderate in the upper 60 inches of soil.

The Xeric Vitricryands, ash over cinders soils are very deep, well drained soils that formed in ash over colluvium from volcanic rocks. The surface texture is ashy sandy loam. Subsurface textures are similar, but gravel content increases significantly with depth. Below 45 inches the soil has 98 percent rock fragments with a gravel texture. Permeability is rapid to moderately rapid in the upper horizons and very rapid through the lower gravel horizon. AWC is very low to low.

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

Map Unit Component /Percent
115 Shadowlake /85
115 Terracelake /10
122 Xeric Vitricryands, ash over cinders /30
136 Terracelake /45
144 Shadowlake / 2
175 Shadowlake /75

Table 4. Representative soil features

Family particle size	(1) Sandy
Drainage class	Well drained

Permeability class	Rapid
Soil depth	50 cm
Surface fragment cover <=3"	20 – 40 %
Surface fragment cover >3"	0 – 50 %
Available water capacity (0-101.6cm)	0.71 – 13.64 cm
Soil reaction (1:1 water) (0-101.6cm)	5.6 – 7.3
Subsurface fragment volume <=3" (Depth not specified)	30 – 60 %
Subsurface fragment volume >3" (Depth not specified)	0 – 60 %

Ecological dynamics

This site is associated with moderately deep to very deep soils with greater than 35 percent rock fragments in most of the soil profile. The rock fragments are mostly gravels. The soils are well drained and have very low to moderate water holding capacity. Despite the droughty nature of the soil, this site receives relatively high precipitation and is cool, losing less water to evaporation. This area receives 67 to 110 inches of precipitation, mostly during the winter in the form of snow. The deep snow pack melts gradually and can persist into the early summer months. The soils remain moist due to cool summer air temperatures that are enhanced by high elevations, northern aspects, canopy shade, and cool air drainages coming down the mountain. As snow melts from this site, it continues to receive snow melt from even cooler sites upslope. This site is often found on wind-sheltered slopes and valleys which accumulate rather than divert wind blown snow and water melt-off. The frost-free growing season ranges from 2 to 3 months. The growing season begins approximately 2 weeks after snow melt and lasts until drought conditions set in. The length of the growing season is critical for seedling establishment and annual growth. Conifer species have a variety of variables that need to be met to initiate seasonal growth. Perhaps the most critical factor is a minimum soil and air temperature during the growing season. Conifer species found at lower elevations require warmer temperatures and longer frost free conditions for sustainable growth (Royce and Barbour, 2001).

This is a subalpine forest is dominated by California red fir (Abies magnifica) and mountain hemlock (Tsuga mertensiana). California red fir is a tall, long-lived conifer with short branches and a narrow crown. It produces single 0.8 to 1.4-inch needles that are distributed along the young branches. Firs produce upright cones that open and fall apart while still attached to the tree, so cones are not often seen on the forest floor unless cut by squirrels or chipmunks in fall. California red fir cones are about 9 inches long. California red fir is adapted to cold wet winters in areas with deep snow accumulation followed by warm summers. The young trees have thin bark and are very susceptible to fire, but as trees mature the bark thickens and fire resistance increases. It is shade tolerant and continues to reproduce under the forest canopy, therefore increasing in dominance in the absence of fire.

Mountain hemlock is a slow-growing native conifer. On this site it grows as a tall tree, with branches on the upper portion of the stem. In open areas the branches are low on the stem and, if touching the soil, may root by layering. It produces single needles, which tightly overlap the twig surfaces. The needles generally curve upward. Trees have a shallow wide-spreading root system. Mountain hemlock is shade tolerant and will reproduce in the understory. (Tesky, 1992). Reestablishment of mountain hemlock after a fire or other disturbance is often slow and, in some areas, it never regains its tree-like stature (Arno and Hammerly, 1984).

Western white pine is also a long-lived conifer with a narrow crown. It has 2 to 4-inch needles in bundles of 5. It produces a deep tap root and extensive lateral roots. Most of the lateral roots are within the upper 2 feet of soil. Young trees have thin bark and are very susceptible to fire due to damage to the cambial tissue. Mature trees develop thicker bark and have higher branches, making them less prone to mortality from fire (Griffith, 1992). Western white pine bark, when damaged by fire, can allow infestations of pathogens that can eventually kill the trees. It is shade intolerant and dependent upon canopy disturbances for regeneration and long-term survival.

Sierra lodgepole pine can be long-lived. Trees nearby were 180 to 200 years old and reached heights of 100 to 120 feet. Sierra lodgepole pine does not usually gain much in girth with time and older trees on this site averaged 20 to 24-inch diameters. Trees grow tall and narrow with short branches and 1.2 to 2.4-inch needles in fascicles of two. Its thin bark and shallow roots make it susceptible to fire. Sierra lodgepole pine is the only non-serotinous lodgepole pine. Therefore it does not need fire to open its cones to release seeds. The roots of Sierra lodgepole pine are generally shallow, which enable it to grow on this site. Sierra lodgepole pine produces a taproot that may atrophy or grow horizontally in cases of high water tables or root restrictive layers. It is shade intolerant and regenerates prolifically after fire or other canopy disturbances (Cope, 1993). Disturbance is needed to maintain Sierra lodgepole pine on this site.

Forest communities of this site have evolved with fire over the centuries. They are relatively slow growing and accumulate fuels slowly.”Therefore fire spreads across this site less frequently than lower elevation conifer forests. Fire ecology for this subalpine forest type is poorly studied. The point fire return interval for the red fir-western white pine forest on Prospect Peak ranges from 26 to 109 years, with a mean of 70 (Taylor, 2000). In the Caribou Wilderness the mean is 66 years (Taylor and Solem, 2001). In the Thousand Lakes Wilderness the point fire return interval ranges from 9 to 91 years, with a mean of 20 for red fir-mountain hemlock forests (Bekker and Taylor, 2001). Fire return intervals may be between 400 to 800 years in a pure mountain hemlock forest (Tesky, 1992). In a separate study, Beaty and Taylor report that fire return intervals are longer on north facing slopes than on south facing slopes. Stand-replacing fire is more common on upper slopes, while low to moderate intensity fires occur only along lower slopes. This is probably due to the tendency of fire to burn upslope, preheating the fuels as it goes. Large fires and multiple small fires in the same season are associated with dry and very dry years (Beaty and Taylor, 2001). This forest is fairly continuous and can become dense with heavy fuel accumulations. Severe fires are likely at certain stages of development. Since the fire frequency at this site is probably more common at the lower elevations than the upper elevations, where mountain hemlock becomes more prevalent than California red fir, the natural fire return interval may range from 20 years to longer than 100 years.

Evidence of fire suppression is evident in this forest type. Shade tolerant California red fir and mountain hemlock seedlings and saplings are common in the understory. Some areas are further along than others in understory development. As the canopy cover increases, the shade intolerant western white pine and Sierra lodgepole pine decline.

Tree pathogens and insect infestations can have significant impacts on the composition and structure of upper montane coniferous forests. Small infestations may affect just a few trees but large outbreaks can kill the dominant trees over large areas of forest, creating large canopy openings and stand regeneration. Most of these pathogens represent natural cycles of regulation that can push 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.

The major pathogens that affect California red fir in this area are red fir dwarf mistletoe (Arceuthobium abietinum f. sp. magnificae), fir broom rust (Melampsorella caryophyllacearum), annosus root rot (Heterobasidion annosum), and the fir engraver (Scolytus ventralis). Other diseases that can affect red fir are the heart rots, including yellow cap fungus (Pholiota limonella), Indian paint fungus (Echinodontium tinctorium), cone maggots (Earomyia spp.), several chalcids (Megastigmus spp.), and cone moths (Barbara spp. and Eucosma spp.) (Burns and Honkala, 1990).

Several pathogens affect mountain hemlock, but epidemics are rare. The major pathogens that affect mountain hemlock are laminated root rot (Phellinus weirii), such heart rots as Indian paint fungus (Echinodontium tinctorum), a number of needle diseases, snow mold (Herpotrichia nigra), and dwarf-mistletoe (Arceuthobium tsugense) (Tesky, 1992).

The mountain pine beetle (Dendroctonus ponderosae) is the most serious pest for Sierra lodgepole pine and outbreaks can kill acres forests. 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), spruce spider mite (Oligonychus ununguis), lodgepole sawfly (Neodiprion burkei), lodgepole needle miner (Coleotechnites milleri), sugar pine tortrix (Choristoneura lambertiana), pine tube moth (Argyrotaenia pinatubana), and pandora moth (Coloradia pandora). Ips commonly develops in logging slash, especially slash that is shaded and does not dry quickly. Prompt slash disposal is an effective control measure. Ips also can build-up in windthrows. Fungal diseases that affect lodgepole pine productivity include 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).

The major pathogen affecting western white pine is the white pine blister rust (Cronartium ribicola). It is a non-native disease that was introduced from Europe and Asia in the 1920s. Some strains of western white pine have shown resistance to the disease. Other pathogens that affect western white pine are the needle cast fungi (Lophodermella arcuata and L. nitens) and (Bifusella linearis). Wood decay is caused by red rot (Phellinus pini), red-brown butt rot (Phaeolus schweinitzii), annosus root disease (Heterobasidion annosum), and honey mushroom (Armillaria spp.). Significant insect pests include mountain pine beetle (Dendroctonus ponderosae), emarginate ips (Ips emarginatus), and ips beetle (Ips montanus) (Taylor and Halpern, 1991).

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

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
Tree					
0	**Tree (understory only)**			0-50	
	mountain hemlock	TSME	*Tsuga mertensiana*	0-22	0-5
	California red fir	ABMA	*Abies magnifica*	0-17	0-5
	western white pine	PIMO3	*Pinus monticola*	0-7	0-3
	Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0-4	0-2
Shrub/Vine					
0	**Shrub**			1-94	
	pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	0-90	0-20
	marumleaf buckwheat	ERMA4	*Eriogonum marifolium*	1-4	1-4
Grass/Grasslike					
0	**Grass/Grasslike**			6-53	
	western needlegrass	ACOC3	*Achnatherum occidentale*	6-28	2-10
	sedge	CAREX	*Carex*	0-17	0-5
	squirreltail	ELEL5	*Elymus elymoides*	0-8	0-2
Forb					
0	**Forb**			0-118	
	bluntlobe lupine	LUOB	*Lupinus obtusilobus*	0-110	0-14
	Mt. Hood pussypaws	CIUMU	*Cistanthe umbellata var. umbellata*	0-3	0-3
	pioneer rockcress	ARPL	*Arabis platysperma*	0-2	0-2
	Davis' knotweed	PODA	*Polygonum davisiae*	0-2	0-2

Table 6. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height M	Canopy Cover (%)	Diameter Cm	Basal Area (square M/hectare)
Tree							
California red fir	ABMA	*Abies magnifica*	Native	–	15-30	–	–
mountain hemlock	TSME	*Tsuga mertensiana*	Native	–	10-12	–	–
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	3-9	–	–
western white pine	PIMO3	*Pinus monticola*	Native	–	2-4	–	–

Table 7. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (m)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
western needlegrass	ACOC3	*Achnatherum occidentale*	Native	–	2-10
sedge	CAREX	*Carex*	Native	–	0-5
squirreltail	ELEL5	*Elymus elymoides*	Native	–	0-2
Forb/Herb					
bluntlobe lupine	LUOB	*Lupinus obtusilobus*	Native	–	0-14
Mt. Hood pussypaws	CIUMU	*Cistanthe umbellata var. umbellata*	Native	–	0-3
pioneer rockcress	ARPL	*Arabis platysperma*	Native	–	0-2
Davis' knotweed	PODA	*Polygonum davisiae*	Native	–	0-2
Shrub/Subshrub					
pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	Native	–	0-20
marumleaf buckwheat	ERMA4	*Eriogonum marifolium*	Native	–	1-4
Tree					
mountain hemlock	TSME	*Tsuga mertensiana*	Native	–	0-5
California red fir	ABMA	*Abies magnifica*	Native	–	0-5
western white pine	PIMO3	*Pinus monticola*	Native	–	0-3
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	0-2

Table 8. Community 1.2 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 9. Community 1.3 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 10. Community 1.4 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Table 11. Community 1.5 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)

Animal community

Animals that use California red fir forests include martin, fisher, wolverine, black bear, squirrel, chickadee, pileated woodpecker, great gray owl, Williamson's sapsucker, mountain beaver, and pocket gopher. Deer browse the leaves of these conifers in winter and the new growth in the spring. Birds forage for insects in the foliage of mature conifers. Spruce grouse feed on Sierra lodgepole pine needles during the winter (Cope, 1993). The California red fir cones are cut and cached by squirrels. Western white pine seeds are eaten by red squirrels and deer mice (Griffith, 1992). The seeds of Sierra lodgepole pine are eaten by squirrels, chipmunks, birds, and mice (Cope, 1993). Some birds consume mountain hemlock seeds. In some areas the understory provides decent forage (Tesky, 1992). The fruit of pinemat manzanita is eaten by black bear, deer, coyote, and various birds and rodents. After fire, young foliage is browsed by deer, but older foliage is not desirable. Grasses provide forage for deer and small rodents.

Recreational uses

This area is suitable for trails and provides scenic views.

Wood products

The wood from California red fir is straight-grained and light. California red fir is soft, but it is stronger than the wood of other firs and has a low specific gravity. The wood is used for fuel, coarse lumber, quality veneer, solid framing, plywood, printing paper and high-quality wrapping paper; it is the preferred wood for pulping (Cope, 1993). Western white pine wood is straight-grained, light, and highly valued. The wood is used to make window and door sashes, doors, paneling, dimension stock, matches, wood carvings and toothpicks (Griffin, 1992). Sierra lodgepole pine wood is used for framing, paneling, trim, posts, and other construction products. The forests are often uniform is size, which makes harvesting easier. The wood tends to be light, straight-grained and of consistent texture (Cope 1993). If harvested, mountain hemlock is usually sold with western hemlock. The wood is moderately strong and used as small lumber, pulp, interior finish, cabinetry, crates, flooring and ceilings (Tesky, 1992).

Other products

California red fir is used for Christmas trees (Cope, 1993). Native Americans chewed the resin of western white pine, wove baskets from the bark, concocted a poultice for dressing wounds from the pitch, and collected the cambium in the spring for food (Griffith, 1992). Cones of western white pine are collected for novelty items. The wood is good for carving. The tree is also planted as an ornamental (Griffin, 1992).

Other information

Additional information on forest pathogens: Red fir dwarf mistletoe (Arceuthobium abietinum f. sp. magnificae) is a parasitic plant commonly found 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. Infestation of the red fir dwarf mistletoe can cause reduced growth and vigor. The fungus (Cytospora abietis) kills those branches that are infected with dwarf mistletoe. Dwarf mistletoe will weaken trees by generating cankers that create entry points for diseases such as heart rots (Burns and Honkala, 1990) and other pathogens. Fir broom rust (Melampsorella caryophyllacearum) is a disease that causes dense witches brooms with stunted yellow needles. The infected branch sheds its needles in fall, leaving a barren dead-looking branch. The alternate host for this rust is the chickweeds (Stellaria spp. and Cerastium spp.) (Hagle et al., 2003). Fir broom rust can damage tree growth by reducing crown development. Mortality is less common in mature trees than in the younger regeneration trees. 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 windthrow. 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 red 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 (Scolytus ventralis) can cause extensive damage to red fir forests; outbreaks can cause mortality to several acres of trees. It can reach epidemic levels when trees are stressed due to drought, annosus root rot, dwarf mistletoe, or from fire damage. (Burns and Honkala, 1990). White pine blister rust (Cronartium ribicola) causes cankers on 5-needled pines and eventually kills most of the infected trees. Visible symptoms are swollen cankers with an abundance of pitch flowing down the branch or stem. The cankers can eventually girdle the tree, killing those portions above. Leaves on the upper portions turn red and fall (Hagle et al., 2003). Pruning cankers off infected stems has been shown to be beneficial. SITE INDEX DOCUMENTATION: Schumacher (1928) and Barnes (1962) were used to determine forest site productivity for red fir and mountain hemlock respectively. Barnes site curves and yield estimates for western hemlock were used to roughly approximate forest site productivity for mountain hemlock. Low to High values of Site index and CMAI (culmination of mean annual increment) give an indication of the range of inherent productivity of this ecological site. Site index relates to height of dominant trees over a set period of time and CMAI relates to the average annual growth of wood fiber in the boles/trunks of trees. Site index and CMAI listed in the Forest Site Productivity section are in units of feet and cubic feet/acre/year, respectively. Both site index and CMAI are estimates; on-site investigation is recommended for specific forest management units for each soil classified to this ecological site. The historical and actual basal area of trees within a growing stand will greatly influence CMAI. Conifer trees appropriate for site index measurement typically occur in community phases 1.3 and 1.4. They are selected according to guidance listed in the site index publications.

Table 12. Representative site productivity

Common Name	Symbol	Site Index Low	Site Index High	CMAI Low	CMAI High	Age Of CMAI	Site Index Curve Code	Site Index Curve Basis	Citation
California red fir	ABMA	40	42	135	142	140	050	50TA	Schumacher, Francis X. 1928. Yield, stand and volume tables for red fir in California. University of California Agricultural Experiment Station Bulletin 456.
California red fir	ABMA	40	42	135	142	–	–	–	
mountain hemlock	TSME	67	85	72	110	65	990	100TA	Barnes, George H. 1962. Yield of even-aged stands of western hemlock. USDA, Forest Service. Pacific Northwest Forest and Range Experiment Station Technical Bulletin 1273.
mountain hemlock	TSME	67	85	78	108	–	–	–	
Sierra lodgepole pine	PICOM	60	60	49	49	100	520	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 were used to describe this ecological site: 789150 789199 789262-site location 789274 789300 789327 789338 789372 789373 789375 789396

Type locality

Location 1: Shasta County, CA	
Township/Range/Section	T30 N R5 E S8
UTM zone	N
UTM northing	4482229
UTM easting	630656
General legal description	The type location is about 0.5 miles east of Shadow Lake in Lassen Volcanic National Park.

Other references

Arno, Stephen F. and Hammerly, Ramona p. 1984. Timberline, Mountain and Artic Forest Frontiers. The Mountaneers, Seattle, WA.
Alexander, Robert R. 1966. Site indexes for Lodgepole pine, with corrections for stand density: instructions for field use. USDA, Forest Service. Rocky Mountain Forest and Range Experiment Station Research Paper RM-24. NASIS ID 520

Amman, Gene D., McGregor, Mark D., Dolph Robert E. 1990. Mountain Pine Beetle: Forest Insect and Disease Leaflet 2. USDA, Forest Service, Pacific Northwest Region, Portland OR.

Barnes, George H. 1962. Yield of even-aged stands of western hemlock. USDA, Forest Service. Pacific Northwest Forest and Range Experiment Station Technical Bulletin 1273. NASIS ID 990

Beaty, Matthew and Taylor, Alan H. (2001). Spatial and Temporal Variation of Fire Regimes in a Mixed Conifer Forest Landscape, Southern Cascades, California, USA. Journal of Biogeography, 28, 955-966.

Bekker, Mathew F. and Taylor, Alan H. (2001). Gradient Analysis of Fire Regimes in Montane Forest of the Southern Cascade Range, Thousand Lakes Wilderness, California, USA. Plant Ecology 155: 15-23.

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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:**