Natural Resources
Conservation Service

Ecological site F022AC007CA
North-Facing Cryic Loamy Mountain Slopes

Accessed: 05/06/2024

General information

Approved. An approved ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model, enough information to identify the ecological site, and full documentation for all ecosystem states contained in the state and transition model.

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): 022A–Sierra Nevada and Tehachapi Mountains

MLRA 22A
Major Land Resource Area 22A, Sierra Nevada Mountains, is located predominantly in California and a small section of western Nevada. The area lies completely within the Sierra Nevada Section of the Cascade-Sierra Mountains Province. The Sierra Nevada range has a gentle western slope, and a very abrupt eastern slope. The Sierra Nevada consists of hilly to steep mountains and occasional flatter mountain valleys. Elevation ranges between 1,500 and 9,000 ft throughout most of the range, but peaks often exceed 12,000 ft. The highest point in the continental US occurs in this MLRA (Mount Whitney, 14,494 ft). Most of the Sierra Nevada is dominated by granitic rock of the Mesozoic age, known as the Sierra Nevada Batholith. The northern half is flanked on the west by a metamorphic belt, which consists of highly metamorphosed sedimentary and volcanic rocks. Additionally, glacial activity of the Pleistocene has played a major role in shaping Sierra Nevada features, including cirques, arêtes, and glacial deposits and moraines. Average annual precipitation ranges from 20 to 80 inches in most of the area, with increases along elevational and south-north gradients. Soil temperature regime ranges from mesic, frigid, and cryic. Due to the extreme elevational range found within this MLRA, Land Resource Units (LRUs) were designated to group the MLRA into similar land units.

LRU "C" Northern Sierra Subalpine: Elevations are typically between 7,800 and 9,800 feet. The frost free period is between 30 and 90 days, MAAT is between 35 and 44 degrees, MAP is between 45 and 65 inches. Soils are typically cryic, but frigid soils may occur at lower elevations on southern aspects. Forests are dominated by whitebark pine (Pinus albicaulis), Sierra lodgepole pine (*Pinus contorta* spp. murrayana), mountain hemlock (*Tsuga mertensiana*) and/or California red fir (*Abies magnifica*).

Classification relationships

Forest Alliance = *Tsuga mertensiana* – Mountain hemlock forest; Association =tentatively *Tsuga mertensiana-Pinus contorta* ssp. murrayana-*Pinus monticola*. (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.)

Ecological site concept

This site occurs on moderate to steep subalpine, north-facing mountain slopes typically between 7,600 and 9,000 feet. Slopes are typically between 15 and 70 percent. At these high elevations snow persists late into the season, and the growing season is short. Soils are andic, and are moderately deep over paralithic andesitic tuff with medial skeletal textures. Fertile loamy soils support a relatively productive subalpine forest dominated by mountain hemlock (*Tsuga mertensiana*), western white pine (*Pinus monticola*), Sierra lodgepole pine (*Pinus contorta* var. murrayana) and California red fir (*Abies magnifica*). The understory is generally sparse with scattered grasses and forbs.

Associated sites

F022AC006CA	**Moderately Deep Cryic Sandy Till** Occurs on adjacent south-facing slopes with moderately deep, loamy-skeletal soils over dense till, derived primarily from volcanic parent material. Vegetation is an open Sierra lodgepole pine forest (Pinus contorta var. murrayana) with red fir (Abies magnifica) and western white pine (Pinus monticola).
F022AX101CA	**Moist Colluvial Headwater System** Occurs on adjacent headwater swales and first order streams. A complex of vegetation community types is present, and quaking aspen (Populus tremuloides) is a characteristic species.
R022AA200CA	**Alpine Scree** Occurs at higher elevations, above treeline, on windswept alpine slopes and ridges with very shallow to moderately deep, sandy skeletal granitic soils. The sparse vegetation consists of dwarf forbs and grasses.
R022AC202CA	**Shallow Andesite Ridge** Occurs on adjacent slopes with loamy shallow soils over andesitic bedrock. The vegetation is a low productivity shrubland dominated by low sagebrush (Artemisia arbuscula).
R022AC204CA	**Cryic, Umbric Or Andic Slopes** Occurs on adjacent mountain slopes with andic soils or a thick umbric epipedon. Mountain big sagebrush (Artemisia tridentata ssp. vaseyana) and antelope bitterbrush (Purshia tridentata) dominate with a productive herbaceous community.

Similar sites

F022AC005CA	**Cryic Sheltered, Moist Sandy Mountain Slopes** This site occurs on deep sandy skeletal granitic soils. The overstory vegetation is similar, but the understory is generally more productive and dense, with purple mountainheath (Phyllodoce breweri) and rose meadowsweet (Spiraea splendens) frequently dominant in the understory.
F022AC002CA	**Cryic Sandy North Apsect Mountain Slopes** This site occurs in more exposed positions at higher elevations near treeline. Mountain hemlock (Tsuga mertensiana) dominates with whitebark pine (Pinus albicaulis), and there is very little understory vegetation.

Table 1. Dominant plant species

Tree	(1) *Tsuga mertensiana* (2) *Abies magnifica*
Shrub	Not specified
Herbaceous	(1) *Eucephalus breweri*

Physiographic features

This ecological site is found on mountain slopes ranging from 9 to 70 percent, but typically above 15 percent. Aspects are generally north, east, and northeast. Elevations range from 6,910 to 9,000 feet, but are typically above 7,600 feet. Runoff class is high to very high.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope
Flooding frequency	None
Ponding frequency	None
Elevation	2,106–2,743 m
Slope	9–70%
Aspect	N, NE, E

Climatic features

The average annual precipitation ranges from 29 to 67 inches, mostly in the form of snow in the winter months (November through April). The average annual air temperature ranges from 36 to 42 degrees Fahrenheit. The frost-free (>32F) season is 25 to 75 days, and the freeze-free (>28F) season is 60 to 100 days.

Maximum and minimum monthly climate data for this ESD were generated using PRISM data (PRISM Climate Group, Oregon State University, http://prism.oregonstate.edu, created 4 Feb 2004.) and the ArcGIS ESD extract tool.

Table 3. Representative climatic features

Frost-free period (average)	50 days
Freeze-free period (average)	80 days
Precipitation total (average)	1,219 mm

Influencing water features

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

Soil features

The soils associated with this ecological site are moderately deep and formed in colluvium over residuum weathered from andesitic tuff and tuff breccia. These soils are well drained with moderately rapid permeability. The soil moisture regime is xeric and the soil temperature regime is cryic. Surface rock fragments smaller than 3 inches in diameter range from 0 to 35 percent and larger fragments range from 0 to 5 percent. Surface textures are medial gravelly sandy loam and very gravelly peaty coarse sandy loam. Partially and highly decomposed organic matter may overly the mineral horizons (Oi and Oa horizons). Subsurface textures are very gravelly and extremely cobbly coarse sandy loam, cobbly sandy loam, and very stony medial sandy loam. Subsurface rock fragments smaller than 3 inches in diameter range from 30 to 31 percent by volume, and larger fragments range from 20 to 40 percent (for a depth of 0 to 40 inches). The soils that are correlated to this ecological site are the Sky soils (Medial-skeletal, amorphic Humic Xeric Vitricryands), and the Fishsnooze soils (Loamy-skeletal, isotic Xeric Humicryepts).

This ecological site has been correlated with the following mapunits and soil components in the Tahoe Basin soil survey area (CA693):

Area_sym ; Musym ; MUname ; Compname ; Local_phase ; Comp_pct

9161 ; Sky gravelly sandy loam, 9 to 30 percent slopes ; Sky ; ; 80
9162 ; Sky gravelly sandy loam, 30 to 50 percent slopes ; Sky ; ; 80
9163 ; Sky gravelly sandy loam, 50 to 70 percent slopes ; Sky ; ; 80
9164 ; Sky-Melody complex, 9 to 30 percent slopes ; Sky ; ; 50
9165 ; Sky-Melody complex, 30 to 50 percent slopes ; Sky ; ; 50
9166 ; Sky-Melody Complex, 50 To 70 Percent Slopes ; Sky ; ; 50
9111 ; Florand-Lostridge-Fishsnooze association, 15 to 50 percent slopes ; Fishsnooze ; ; 15
9141 ; Melody-Rock Outcrop complex, 9 to 30 percent slopes ; Sky ; ; 10
9142 ; Melody-Rock Outcrop complex, 30 to 50 percent slopes ; Sky ; ; 10
9143 ; Melody-Rock outcrop complex, 50 to 70 percent slopes ; Sky ; ; 10
9121 ; Watsonlake gravelly sandy loam, 5 to 15 percent slopes, rubbly ; Sky ; ; 5
9171 ; Mountrose-Wardcreek-Melody complex, 50 to 70 percent slopes ; Sky ; ; 5
9431 ; Sofgran-Klauspeak-Temo association, 15 to 50 percent slopes ; Xeric humicryepts ; ; 3
7151 ; Jorge very cobbly fine sandy loam, 5 to 15 percent slopes, rubbly ; Sky ; ; 2
7152 ; Jorge very cobbly fine sandy loam, 15 to 30 percent slopes, rubbly ; Sky ; ; 2
7153 ; Jorge very cobbly fine sandy loam, 30 to 50 percent slopes, rubbly ; Sky ; ; 2
9122 ; Watsonlake gravelly sandy loam, 15 to 30 percent slopes, rubbly ; Sky ; ; 2
9123 ; Watsonlake gravelly sandy loam, 30 to 50 percent slopes, rubbly ; Sky ; ; 2

Table 4. Representative soil features

Parent material	(1) Colluvium–andesite (2) Residuum–tuff breccia
Surface texture	(1) Medial sandy loam (2) Very gravelly coarse sandy loam
Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Moderately rapid
Soil depth	51–102 cm
Surface fragment cover <=3"	0–35%
Surface fragment cover >3"	0–5%
Available water capacity (0-101.6cm)	5.08–8.13 cm
Soil reaction (1:1 water) (0-101.6cm)	4.5–6
Subsurface fragment volume <=3" (Depth not specified)	30–31%
Subsurface fragment volume >3" (Depth not specified)	20–41%

Ecological dynamics

Abiotic factors
This site occurs on moderate to steep subalpine, north-facing mountain slopes at elevations of approximately 7,000 to 9,000 feet. At these high elevations snow persists late into the season, and the growing season is short. Soils are andic, and are moderately deep over paralithic andesitic tuff with medial skeletal textures. Fertile loamy soils support a relatively productive subalpine forest dominated by mountain hemlock (*Tsuga mertensiana*), western white pine (*Pinus monticola*), Sierra lodgepole pine (*Pinus contorta* var. murrayana) and California red fir (*Abies magnifica*). The understory is generally sparse with scattered grasses and forbs.

Ecological/disturbance factors
Fire and fire suppression, climate fluctuations and climate warming, and pathogen outbreaks are the primary disturbances impacting this ecological site. The high-elevation, poor access landscape that this site occurs in

largely escaped the widespread clear-cutting of the Comstock era in the Lake Tahoe Basin (Elliot-Fisk et al. 1996).

The natural fire return interval (FRI) in this forest is relatively long. A Tahoe Basin study estimated an FRI of 55 years for subalpine mountain hemlock – red fir forests (Taylor et al. 2012). Safford (2014) estimated a mean minimum FRI of 100 years and a mean max Fri of 420 years for subalpine forests in California. Studies from other subalpine mountain hemlock systems have estimated an FRI ranging from 45 to over 700 years (Dickman and Cook 1989, Bekker and Taylor 2010, Mallek et al. 2013). Fire ignitions tend to be fewer and fire severity lower in subalpine forests relative to lower elevations due to lower productivity with lower fuel availability, and a shorter fire season due to cooler temperatures and higher relative humidity, and longer and deeper snowpack (Skinner and Chang 1996, Bekker and Taylor 2010, Mallek et al. 2013). These forests experienced a mixed-severity fire regime, with most fires small and of low severity and more rare large, high severity stand-clearing fires (Bekker and Taylor 2010, Mallek et al. 2013). Successional dynamics following stand-clearing fire in these forests are not well studied. In Oregon, lodgepole pine was found to become dominant after stand-clearing fire in mountain hemlock forests, maintaining dominance for up to 200 years (Dickman and Cook 1989). However a southern Cascades study found that composition in red fir-mountain hemlock forests remained fairly constant after fire (Bekker and Taylor 2010). Slightly lower elevation red fir-western white pine forests in the Lake Tahoe Basin that were logged during the Comstock era are currently dominated by lodgepole pine (Taylor 2007), and it is assumed that lodgepole pine, which is an important component of these forests pre-fire, would initially dominate post-fire phases here.

Fire suppression over the last century has impacted contemporary forests, although since fire return intervals are naturally longer in these forests, the impacts are much slower to develop relative to lower elevation forests (Skinner and Chang 1996, Bekker and Taylor 2010, Mallek et al. 2013). The dominant effect of fire suppression is an increase in forest density, without major changes in forest composition as are seen in other forest types (Bekker and Taylor 2010, Mallek et al. 2013, Safford and Water 2014).

Whether observed changes in forest density in the subalpine is due to fire suppression or due to climate warming are difficult to disentangle. Several studies attribute observed patterns of increased forest density in the subalpine more to climate warming over fire suppression (Dolanc et al. 2012, Mallek et al. 2013, Safford and Water 2014). Between 1929 and 2009, stem density of subalpine forests in the Sierra Nevada increased over 30 percent, 63 percent of which comes from small understory trees (Dolanc et al. 2012). Over the same time period, daily minimum temperatures increased by 1.2 degrees Celsius, and precipitation increased (Dolanc et al. 2012). Areas mapped by the U.S. Forest Service as subalpine forest in the 1930s are currently mapped as red fir (Safford and Water 2014), indicating a potential compositional shift in these forests. Mountain hemlock establishment is positively affected by warm wet climatic periods, with historic mountain hemlock forest expansion occurring during these climatic phases (Taylor 1995). Lodgepole pine recruitment is also positively impacted by warm wet periods with low snowpack (Pierce and Taylor 2011). Increases in subalpine forest density, likely due to a warmer climate, are already occurring. Recent California based climate models predict a 9 degree F increase in temperature by 2100, and more conservative models predict a 2 to 4 degree F increase in winter and 4 to 8 degree increase in summer (Safford et al. 2012). Models are more variable for precipitation, but recent models for the Sierra Nevada, predict similar to slightly less precipitation. Most models agree that summers will become drier, since more of the precipitation is predicted to come as rain, and snow melt-off will occur earlier in spring (Hayhoe et al. 2004, Safford et al. 2012). These scenarios will bring more extreme changes to subalpine forests. Species requiring cool, moist conditions to dominate, such as mountain hemlock, will likely be pushed upslope, while species with wider ecological amplitude, like red fir and lodgepole pine, may remain dominant in this site. With extreme warming, lower montane species like Jeffrey pine (*Pinus jeffreyi*) and white fir (*Abies concolor*) will likely move into the elevation zone occupied by this site. How pathogens, both existing and novel, increased fire frequencies with increased tree densities, introduced species, mycorrhizal relationships, and new species interactions will impact dynamics under these warming scenarios is unknown.

Several pathogens may impact the dominant tree species of this ecological site, but none have been observed to initiate community phase shifts or state transitions. The loamy volcanic soils of this ecological site may be more susceptible than similar sites on granitic soils with lower moisture holding capacity to infestation by white pine blister rust (Maloney et al. 2012), which could reduce the importance of western white pine on this site. A description of these pathogens may be found in the Other information narrative of the Site Interpretations section of this ESD.

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

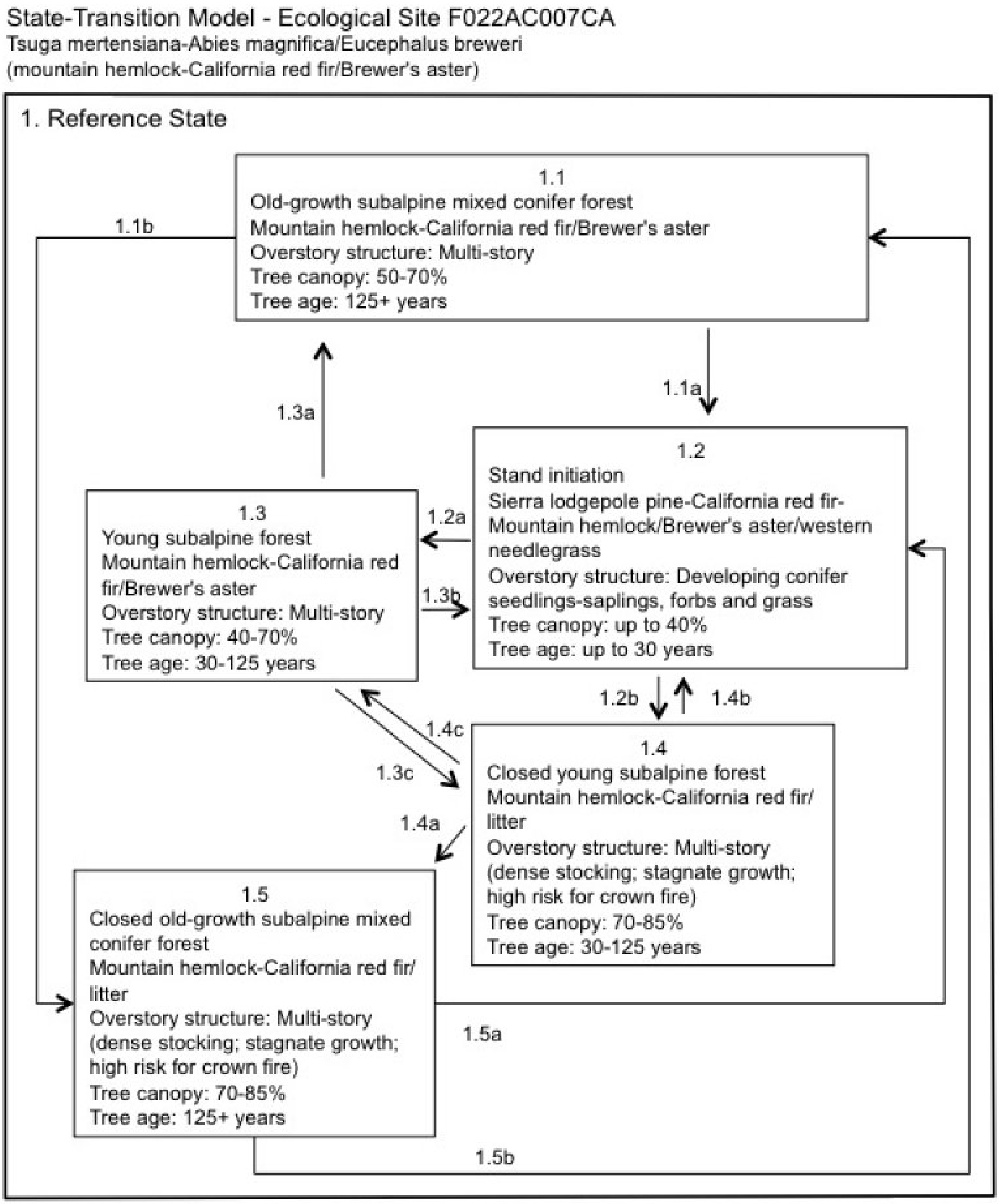

Figure 6. F022AC007CA

State 1
Reference

Community 1.1
Old-growth subalpine mixed conifer forest

Figure 7. Community phase 1.1

This plant community phase is fairly undisturbed by human influences because of its inaccessibility, so this old growth subalpine mixed conifer community phase is representative of the most successionally advanced phase. Mountain hemlock, Sierra lodgepole pine, California red fir,and western white pine create a relatively dense multi-layered forest. The trees in this forest are commonly over 200 years old, and are slow growing due to the short growing season on cool high elevation slopes. An estimate on age for this community phase ranges 125 to more than 500 years.

Forest overstory. Mountain hemlock, Sierra lodgepole pine, and California red fir provide almost equal portions of cover, with a total average between 45 and 65 percent. Western white pine averages approximately 5 percent cover. The forest has several canopy layers, with the height of the upper canopy ranging from 80 to 110 feet, with an average of 90 feet. There are two understory layers; one will often be found between 40 and 60 feet, and the other at 25 feet. Tree diameters vary by species but average 30 inches, with Sierra lodgepole pine and mountain hemlock generally being smaller than California red fir.

Forest understory. The understory is occupied by sparse grasses and forbs, with western needlegrass (Achnatherum occidentale), Ross' sedge (Carex rossii), and Brewer's aster (Eucephalus breweri) most common. Shrubs are rare.

Community 1.2
Stand initiation

This community phase develops after severe canopy fire or clear-cut. Detailed data on post-fire succession is not available for the geographic area of this ecological site. Herbaceous species will be abundant in the immediate post-fire phase, as they are released from the dense canopy cover of these forests. Forbs such as Brewer's lupine (*Lupinus breweri*), lambstongue ragwort (*Senecio integerrimus*), Brewer's aster and mountain pride (*Penstemon newberryi*) will likely increase, while more shade-loving species like whiteveined wintergreen will decline. Western needlegrass is likely to be top-killed by fire, and will readily resprout to become abundant post-fire. Ross' sedge is a colonizer after fire, and can regenerate from surviving rhizomes or from heat-activated seed stored in the soil (Anderson 2008). Although not present in the pre-fire stage, shrubs such as pinemat manzanita (*Arctostaphylos nevadensis*) are likely to increase in the high light conditions post-fire. Remnant overstory trees may be present in limited numbers in this phase, and succession will occur more rapidly if more mature trees remain (Agee and Smith 1984, Pierce and Taylor 2011). Sierra lodgepole pine establishes best in full sun in bare mineral soil (Cope 1993b, Pierce and Taylor 2011), and will establish in the spring following fire, possibly dominating the post-fire community phase for up to 200 years (Dickman and Cook 1989). In the Tahoe Basin, Sierra lodgepole pine became and remains dominant in red fir forests after clear-cutting (Taylor 2007). Western white pine is a fire-dependent species that also requires open conditions for regeneration (Griffith 1992), and will establish early post-burn. Since western white pine is not as abundant in this ecological site, or as fast growing as Sierra lodgepole pine, it does not become dominant. Red fir seeds germinate best in bare mineral soil, but seedlings develop best under shade (Cope 1993a), so the growth of red fir in this community phase occurs more slowly, after other vegetative cover is established.

Mountain hemlock seeds may germinate on bare mineral soil, litter, or even snow if sufficient moisture is available, and seedlings grow best in partial shade (Tesky 1992). Like red fir, the growth of mountain hemlock is slow in this community phase, and it may be centuries before mountain hemlock regains dominance (Agee and Smith 1984, Dickman and Cook 1989).

Community 1.3
Young subalpine forest

Young California red fir, mountain hemlock, Sierra lodgepole pine and western white pine provide a relatively open canopy over mixed shrubs, forbs and grasses. This forest community phase develops with the natural fire regime, with low to moderately intense fires that clear the understory and remove fuels before they reach hazardous levels. Pest outbreaks and avalanches may also create canopy openings in this forest community.

Community 1.4
Closed young subalpine forest

This community phase is defined by a dense canopy and high basal area of mixed subalpine conifers. Canopy cover ranges from 70 to 85 percent. The trees are overcrowded and often diseased and stressed due to the competition for water and nutrients. This stress makes the trees more susceptible to death from disease and drought.

Community 1.5
Closed old-growth subalpine mixed conifer forest

The old-growth closed subalpine mixed conifer forest develops with the continued exclusion of fire and other natural disturbances, allowing the tree density to increase. An estimated age for this community could range up to more than 500 years.

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 transition to the stand initiation phase (community phase 1.2).

Pathway 1.1b
Community 1.1 to 1.5

If fire continues to be excluded from this system for several centuries tree density will increase, and tree health and vigor will decline. This would shift this community phase towards the closed old-growth subalpine mixed conifer forest (community phase 1.5).

Pathway 1.2a
Community 1.2 to 1.3

The natural pathway is to community phase 1.3, a young, open subalpine mixed conifer forest. This pathway is facilitated by a natural fire regime, small pest outbreaks, avalanches, or other natural disturbances that create forest openings.

Pathway 1.2b
Community 1.2 to 1.4

An alternate pathway is created when fire or other natural disturbances do not create opening in the forest structure or canopy. In this case a young, closed subalpine mixed conifer forest develops (community phase 1.4).

Pathway 1.3a
Community 1.3 to 1.1

This is the natural pathway for this community phase, which evolved with a historic fire regime of sporadic lighting-ignited surface fires, partial tree mortality from a pest outbreaks, or from avalanches and other disturbances. This pathway leads to community phase 1.1.

Pathway 1.3b
Community 1.3 to 1.2

In the event of a canopy fire, this community phase would return to community phase 1.2, stand initiation.

Pathway 1.3c
Community 1.3 to 1.4

If natural disturbances do not occur, then the density of the forest increases, shifting this community phase towards the young closed, subalpine mixed conifer forest, community phase 1.4.

Pathway 1.4b
Community 1.4 to 1.2

A severe canopy fire would initiate stand initiation (community phase 1.2).

Pathway 1.4c
Community 1.4 to 1.3

Manual treatment to thin out the understory trees and fuels or prescribed burns could be implemented to shift this forest to the open subalpine-mixed conifer forest (community phase 1.3). A partial mortality disease or pest infestation could also create a shift towards community phase 1.3.

Pathway 1.4a
Community 1.4 to 1.5

If fire continues to be excluded from this system the mature, closed subalpine-mixed conifer forest community phase 1.5 develops.

Pathway 1.5b
Community 1.5 to 1.1

Manual treatment to thin out the understory trees and fuels or prescribed burns could be implemented to shift this forest back to the open subalpine mixed conifer forest (community phase 1.1). A partial mortality disease or pest infestation could also create a shift towards community phase 1.1.

Pathway 1.5a
Community 1.5 to 1.2

A severe canopy fire would initiate stand initiation (community phase 1.2).

Additional community tables

Table 5. 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	–	15–20	–	–
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	15–20	–	–
mountain hemlock	TSME	*Tsuga mertensiana*	Native	–	15–20	–	–
western white pine	PIMO3	*Pinus monticola*	Native	–	3–7	–	–

Table 6. 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	–	1–3
sedge	CAREX	*Carex*	Native	–	0–2
Ross' sedge	CARO5	*Carex rossii*	Native	–	0–2
bluegrass	POA	*Poa*	Native	–	0–2
Forb/Herb					
lupine	LUPIN	*Lupinus*	Native	–	1–3
Brewer's aster	EUBR12	*Eucephalus breweri*	Native	–	1–3
Brewer's lupine	LUBR3	*Lupinus breweri*	Native	–	0–2
aster	ASTER	*Aster*	Native	–	0–2
lambstongue ragwort	SEIN2	*Senecio integerrimus*	Native	–	0–2
pinewoods lousewort	PESE2	*Pedicularis semibarbata*	Native	–	0–0.5
pioneer rockcress	ARPL	*Arabis platysperma*	Native	–	0–0.5
mountain pride	PENE3	*Penstemon newberryi*	Native	–	0–0.5
whiteveined wintergreen	PYPI2	*Pyrola picta*	Native	–	0–0.5
Tree					
mountain hemlock	TSME	*Tsuga mertensiana*	Native	–	0–0.5
California red fir	ABMA	*Abies magnifica*	Native	–	0–0.5
Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	Native	–	0–0.2
western white pine	PIMO3	*Pinus monticola*	Native	–	0–0.2

Animal community

Almost 50 bird species and many mammals use this forest for food, cover, or habitat. Common animals include bears, deer, chipmunks, and squirrels. Dead or dying trees provide nesting sites for cavity-nesting birds, and the fallen branches from these trees provide sites for ground-nesting birds and mammals. The seeds are a food source for squirrels, chipmunks, birds, and mice (Tesky 1992, Cope 1993a).

Recreational uses

This area provides beautiful scenery and is used for backpacking, hiking, bike riding, photography, and other activities.

Wood products

The remoteness of this area and the slow growth of trees at this elevation make commercial forestry production impractical. However, the wood of Sierra lodgepole pine, mountain hemlock, California red fir and Western white pine is of good quality. Sierra lodgepole pine is suited for common lumber grades, and used for light framing materials, interior paneling, exterior trim, posts, railroad ties, pulp and paper, and has potential for structural particle board. The uniform size of Sierra lodgepole pine makes harvesting efficient (Cope 1993).

The wood of California red fir is of high quality and is stronger than other firs. It is used for fuel, coarse lumber, quality veneers, solid framing, plywood, printing paper, and high-quality wrapping paper, and is preferred for pulping (Cope 1993).

Western white pine can produce valuable timber and is often used for finish work. It is used to build doors, paneling, dimension stock, matches, and toothpicks. The wood is also excellent for carving (Griffith 1992).

The wood of western hemlock is moderately strong and light colored. It is most often used for small-dimension lumber and pulp. The wood is also used for railway ties, mine timbers, interior finish, crates, kitchen cabinets, and flooring and ceilings (Tesky 1992).

Other information

Site index documentation:
Schumacher (1928), Alexander (1966), Barnes (1962) and Dunning (1942) were used to determine forest site productivity for red fir, lodgepole pine, mountain hemlock and western white pine, respectively. Low to High values of Site index and CMAI (culmination of mean annual increment) give an indication of the range of inherent productivity of this ecological site. (CMAI values are not available for western white pine, so zeros were used to indicate the lack of data.) Site index relates to height of dominant trees over a set period of time and CMAI relates to the average annual growth of wood fiber in the boles/trunks of trees. Site index and CMAI listed in the Forest Site Productivity section are in units of feet and cubic feet/acre/year, respectively. Both site index and CMAI are estimates; on-site investigation is recommended for specific forest management units for each soil classified to this ecological site. The historical and actual basal area of trees within a growing stand will greatly influence CMAI.

Trees appropriate for site index measurement typically occur in stands of community phases 1.3 and 1.4. Site trees are selected according to guidance in their respective publications. Please refer to the Tahoe Basin Soil Survey for detailed site index information by soil component.

Forest pathogen information:
The major pathogens that affect California red fir in this area include: 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) (Murphy et al., 2000). Other diseases also affecting red fir are known as heart rots, which cause the centers of limbs and trunks to decay. Commonly seen heart rots include: yellow cap fungus (Pholiota limonella) and Indian paint fungus (Echinodontium tinctorium). Common pests affecting red fir are: cone maggots (Earomyia spp.), several chalcids (Megastigmus spp.) and cone moths (Barbara spp. and Eucosma spp.) (Burns and Honkala 1990).

Red fir dwarf mistletoe (Arceuthobium abietinum f. sp. magnificae) is a parasitic plant common in the survey area. Visible symptoms include witches brooms, top kill, stem cankers, and swellings. The vegetative shoots of the dwarf mistletoe are also often present from spring to fall. Infestation of the red fir dwarf mistletoe can cause reduced growth and vigor which weakens the tree and allows other pathogens to infest the tree. The mistletoe cankers create an entry point for other diseases such as heart rots and the cytospora canker (Cytospora abietis) (Burns and Honkala 1990).

Fir broom rust (Melampsorella caryophyllacearum) causes dense witches brooms with stunted yellow needles, and can damage tree growth by reducing crown development. Mortality is less common in mature trees than in the younger regeneration trees. 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).

Annosus root rot (Heterobasidion annosum) can affect large acres of fir forest. It slowly decays the roots, the root collar and the stem butt for many years causing structural weaknesses and making the tree vulnerable to wind throw. Annosus root rot can spread from infected roots to healthy roots as well as aerially by 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 because the rot itself does not often kill red fir directly, but it weakens the tree and makes it easier for bark beetles (Scolytus spp), annosus root rot, or dwarf mistletoe to infect the tree (Burns and Honkala 1990).

The fir engraver (Scolytus ventralis) can cause extensive damage to a California red fir forest and outbreaks can cause several acres of trees to die. It can reach epidemic levels when the trees are stressed due to annosus root rot, dwarf mistletoe, drought, or fire damage (Burns and Honkala 1990).

The major pathogen affecting western white pine is white pine blister rust (Cronartium ribicola). It is a non-native disease that was introduced from Europe and Asia in the 1920s. The fungus causes cankers on five needle pines that eventually kill 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 the portions above. The leaves on the upper portion eventually turn red and fall (Hagle et al. 2003). Pruning cankers off of infected stems has been shown to be beneficial. Some strains of western white pine have shown resistance to the disease.

Other pathogens that can affect western white pine are: white pine needle cast (Lophodermella arcuata), pine needle cast (Lophodermium nitens), Bifusella lineari, butt-rot fungi, red ring rot (Phellinus pini), root disease (Phaeolus schweinitzii), annosus root rot (Heterobasidion annosum), and Armillaria root disease (Armillaria spp). Insects affecting western white pine include: Mountain pine beetle (Dendroctonus ponderosae), emarginate ips (Ips emarginatus), and ips beetle (Ips montanus) (Taylor and Halpern 1991).

Table 7. 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*	30	30	104	104	140	050	–	
mountain hemlock	*TSME*	66	66	70	70	70	990	–	
Sierra lodgepole pine	*PICOM*	50	50	37	37	90	520	–	
western white pine	*PIMO3*	85	85	0	0	0	605	–	

Inventory data references

The following NRCS plots represent this ecological site:

mxf02h13
mxf02h30
mxf03h171
ra02h9
rtg02h39
rx03h174
sle02001- site location
tee03052

Type locality

Location 1: Placer County, CA	
Township/Range/Section	T14N R16E S8
UTM zone	N
UTM northing	4328268
UTM easting	740070

General legal description	Take Hw 89 to Barker Pass road. Take Barker Pass road to about 1 mile before Barker Pass. Plot is on the up hill side of road about 50 feet.

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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:**