USDA Natural Resources
Conservation Service

Ecological site R022BI207CA
Alpine Slopes

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General information

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

Figure 1. Mapped extent

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

MLRA notes

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

Site Concept –
Slopes: 15 to 150, generally are 20 to 75.
Landform: Mountain slopes and volcanic domes.
Soils: Very deep to moderately deep, well drained soils with greater than 35 percent rock fragments. Bedrock occurs between 20 to 60 inches in the moderately deep and deep soils.
Temp regime: Cryic.
MAAT: 38 to 41 degrees F (3.3 to 5 degrees C).
MAP: 73 to 125 inches (1,854 to 3,175 mm)
Soil texture: Gravelly ashy sandy loam, extremely gravelly ashy fine sandy loam, and very gravelly ashy loamy coarse sand.
Surface fragments: 25 to 60 percent gravels and 20 to 55 percent large rock fragments.
Vegetation: low cover of mountain hemlock with mixed forbs such as bluntlobe lupine (*Lupinus obtusilobus*) and mountain pride (*Penstemon newberryi*).

Classification relationships

This site is approx. 0.5 miles east southeast of the Terracelake Trailhead, on the north facing slope between Reading Peak and Shadow Lake.

Associated sites

F022BI104CA	**Cryic Coarse Loamy Colluvial Slopes** This is a mountain hemlock forest site, generally found downslope or in more protected conditions.
F022BI124CA	**Upper Cryic Slopes** This is a mountain hemlock and whitebark pine forest with a lupine dominated understory on surrounding slopes.

Table 1. Dominant plant species

Tree	(1) *Tsuga mertensiana*
Shrub	Not specified
Herbaceous	(1) *Elymus elymoides* (2) *Lupinus obtusilobus*

Physiographic features

This ecological site is confined to the upper elevations of exposed colluvial aprons, mountain slopes, volcanic domes and cirque walls at tree line and above. This site is correlated to map units that extend up to 10,450 feet, but the site itself does not extend above treeline. Treeline varies due to climatic conditions and exposure, but generally stays consistent at approximately 9,000 feet. Slopes range from 15 to 150 percent, but are generally between 20 to 75 percent.

Table 2. Representative physiographic features

Landforms	(1) Volcanic dome (2) Mountain slope
Flooding frequency	None
Ponding frequency	None
Elevation	1,972–3,185 m
Slope	15–150%
Aspect	N, E, W

Climatic features

This ecological site receives most of its annual precipitation in the winter months in the form of snow. The mean annual precipitation ranges from 53 to 125 inches (1,346 to 3,175 mm) and 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 65 to 190 days.

There are no representative climate stations for this site. The nearest one is Manzanita Lake, which receives substantially less precipitation than this area.

Table 3. Representative climatic features

Frost-free period (average)	85 days
Freeze-free period (average)	190 days
Precipitation total (average)	3,175 mm

Influencing water features

This site is not influenced by water features.

Soil features

This site is associated with the Terracelake, Readingpeak, Emeraldlake and Vitrandic Cryorthents, debris flows, high elevation soil components. These soils formed from ash or tephra over colluvium and residuum or in debris flows. They are very deep to moderately deep, well drained soils with greater than 35 percent rock fragments. The surface textures are gravelly ashy sandy loam, extremely gravelly ashy fine sandy loam, and very gravelly ashy loamy coarse sand, with coarse to medium subsurface textures. The percentage and size of rock fragments generally increases with depth. Bedrock occurs between 20 to 60 inches in the moderately deep and deep soils. These soils have very low to moderate AWC (available water capacity). These soils generally have moderately rapid permeability in the upper horizons, with impermeable bedrock below.

This ecological site has been correlated with the following map units and components within the CA789 Soil Survey Area:

Map Unit Component / Percent
114 Acroph / 3
114 Emeraldlake / 25
114 Terracelake / 23
116 Acroph / 5
136 Acroph / 10
137 Terracelake / 2
144 Terracelake / 5
149 Emeraldlake / 15
149 Terracelake / 3
167 Emeraldlake / 35
167 Terracelake / 15
170 Emeraldlake / 20
170 Readingpeak / 15
170 Terracelake / 12
174 Terracelake / 7
177 Vitrandic Cryorthents, debris flows high elevation / 85

Table 4. Representative soil features

Family particle size	(1) Sandy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderately rapid
Soil depth	51 cm
Surface fragment cover <=3"	25–60%
Surface fragment cover >3"	20–55%
Available water capacity (0-101.6cm)	0.1–13.64 cm
Soil reaction (1:1 water) (0-101.6cm)	5.6–6.7
Subsurface fragment volume <=3" (Depth not specified)	50–75%
Subsurface fragment volume >3" (Depth not specified)	10–40%

Ecological dynamics

This ecological site is found at upper elevations on exposed northern slopes throughout Lassen Volcanic National Park. Vegetation varies in different areas but the most common species associated with this site are bluntlobe lupine (*Lupinus obtusilobus*), mountain pride (*Penstemon newberryi*), woodrush (Luzula spp.), and Howell's pioneer rockcress (*Arabis platysperma* var. howellii).

Cover is relatively low for all species across the site with the exception of bluntlobe lupine, which can range from 25 to 45%. Accompanying forbs equal about 1 to 8% in cover, depending on the species. Plants growing here are generally prostrate or low growing with the majority of the biomass underground, a common trait of alpine species (Billings and Mooney, 1968). Slope and aspect are largely responsible for the range in plant cover, as well changes in species from site to site. Slope orientation accounts for variability in local hydrologic dynamics, affecting the vegetation and soil development (Woo, Marsh, and Pomeroy, 2000).

All species growing on this ecological site must be able to tolerate a short growing season, heavy snow pack, freezing temperatures, and high winds. All limit the productivity of the site, making it only a moderately important wildlife resource.

Tree cover is generally low, between 1 to 20 percent, and dominated by mountain hemlock (*Tsuga mertensiana*). The trees at this elevation are very slow growing. Older trees may be 500 years old while younger trees appear to be 75 to 200 years old. The high elevations are buried with deep snow from November to June and remain cool for most of the year. Several physiological adaptations allow mountain hemlock to survive in this cold environment. They have maximum photosynthetic rates at colder temperatures than lower elevation trees, and close stomata to reduce water loss during dormant periods. The tips of mountain hemlock are very flexible, an attribute that reduces snow build-up and stem breakage. Snow burial can be helpful in protecting trees from strong winter winds, desiccation from warm winter winds and sunny winter days, extreme cold, and repeated freezing and thawing (Arno and Hammerly, 1984). Snow burial can, however, be detrimental as well. In some areas, those portions of the trees exposed above the snow can die back, leaving short multi-stemmed trees. Snow creep can create pistol-butted trees, and avalanches can destroy swaths of forest.
Timberline trees are able to withstand extremely cold winter conditions when they are dormant but need at least a 2 to 3-month frost free growing period in the summer. During this short growing season, usually in July and August, new mountain hemlock growth is susceptible to frost. The new shoots are soft and succulent and need time to "ripen" (Arno and Hammerly, 1984). The duration of the growing season is crucial for seedling establishment. As elevations increase, temperatures drop and the growing season is shortened. Growing season length is one of the limiting factors to determine treeline. Another is wind. Wind induced treelines can be caused by drought conditions, due to increased evapotranspiration (Tomback, et al. 2001).
The fire interval is poorly documented for this site, but are estimated to be between 400 to 800 years (Tesky, 1992). The natural fire cycle for the native forb community is described as infrequent, indicating a range from 75 to 150 years (Morgan et al. 1996). Fire is of slight concern in this ecosystem because there is a lack of available fuel, both in the canopy and on the ground. The high winds and steep slopes prevent a heavy litter accumulation.

Historically the plant community on this site is much like the one that exists today. There has been little to no direct human impact at this elevation.

State and transition model

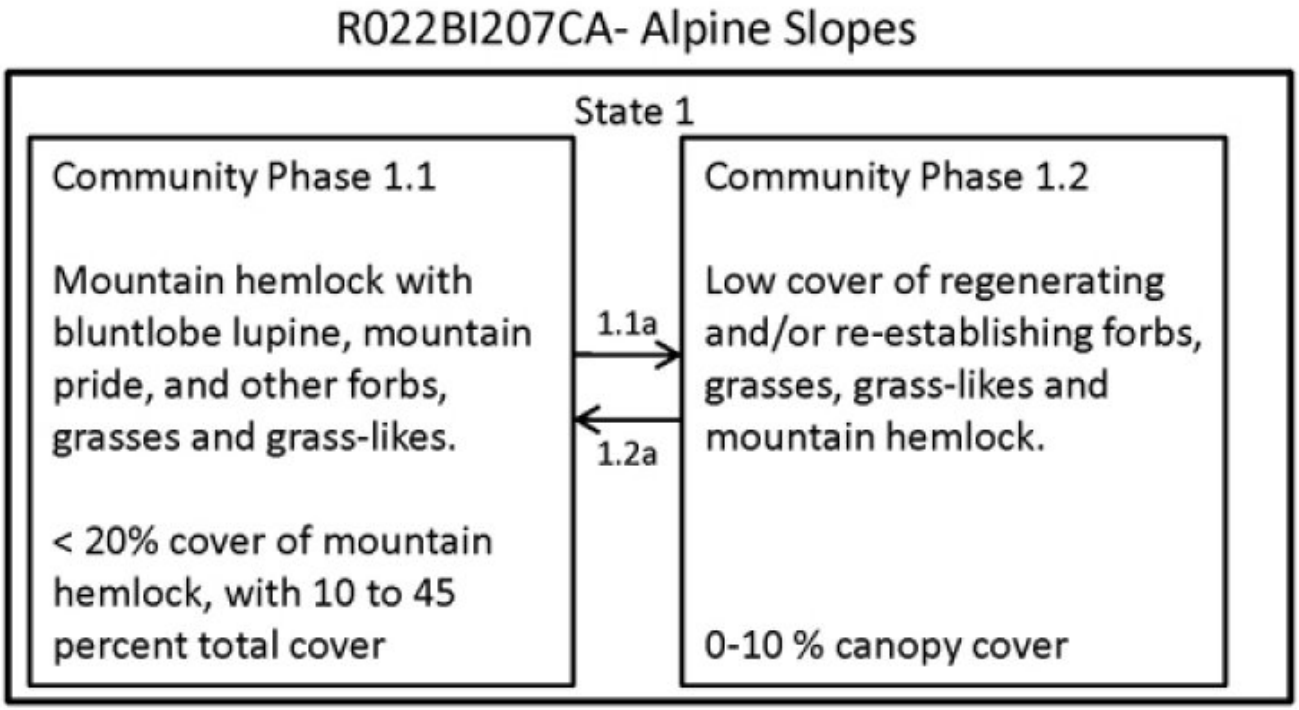

Figure 3. Alpine Slopes

State 1
Natural State

Community 1.1
Mountain hemlock with forbs and grasses

Figure 4. Alpine slopes

This plant community is associated with a late successional community on this ecological site. Mountain hemlock trees are present but are mostly widely scattered and small or shrubby. Total canopy cover is less than 20%. Vegetation can vary from site to site but the most common species associated with this plant community are bluntlobe lupine (*Lupinus obtusilobus*), mountain pride (*Penstemon newberryi*), woodrush (Luzula spp.), and Howell's pioneer rockcress (*Arabis platysperma* var. howellii). Other species found in smaller quantities on this ecological site may include Ross' sedge (*Carex rossii*), squirreltail (*Elymus elymoides*), western needlegrass (*Achnatherum occidentale*), mountain monardella (*Monardella odoratissima*), purple mountainheath (*Phyllodoce breweri*i), prickly hawkweed (*Hieracium horridum*), Sierra cliffbrake (*Pellaea brachyptera*), Shasta knotweed (*Polygonum shastense*), Mt. Hood pussypaws (*Cistanthe umbellata* var. umbellata), dwarf mountain ragwort (*Senecio fremontii*), Davidson's penstemon (*Penstemon davidsonii*), King's sandwort (*Arenaria kingii*) and various buckwheat species (Eriogonum spp.). There are minor amounts of tree and shrub species present in various

quantities. Mountain hemlock (*Tsuga mertensiana*) is the most common, ranging from 1 to 15%. Additional tree species include whitebark pine (*Pinus albicaulis*) and California red fir (*Abies magnifica*). Trees growing on this site are commonly reduced to a shrubby form or remain small due to the harshness of the exposed slope. It is typical to find trees growing on or near rock outcrops; these rocks serve as anchors and protection. Shrubs present in minor amounts can include pinemat manzanita (*Arctostaphylos nevadensis*) and oceanspray (*Holodiscus discolor*). Ross's sedge is well suited to this site. It is very drought tolerant and is also has a high level of winter hardiness. Ross's sedge is tolerant of a variety of soil conditions and is able to grow on steep slopes and unstable hillsides (Anderson, 2008).

Forest overstory. Percent cover can vary from a trace to approximately 20%, depending on the site. On the harshest sites trees are reduced to a shrubby growth form. Mountain hemlock is the most commonly occurring species, while California red fir and whitebark pine occur less frequently.

Forest understory. Species composition and production varies from site to site. Some sites are almost bare while others have up to 45% vegetative ground cover. Limited available resources do not allow all species to occur on every site.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Forb	112	286	531
Shrub/Vine	112	124	336
Grass/Grasslike	7	24	52
Tree	–	22	45
Total	**231**	**456**	**964**

Table 6. Soil surface cover

Tree basal cover	0-1%
Shrub/vine/liana basal cover	0-8%
Grass/grasslike basal cover	0-1%
Forb basal cover	0-3%
Non-vascular plants	0%
Biological crusts	0%
Litter	0-30%
Surface fragments >0.25" and <=3"	25-60%
Surface fragments >3"	20-55%
Bedrock	5-30%
Water	0%
Bare ground	0-22%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	1-7%	–
>0.15 <= 0.3	–	–	1-3%	5-20%
>0.3 <= 0.6	–	1-35%	0-3%	10-25%
>0.6 <= 1.4	0-2%	0-10%	–	–
>1.4 <= 4	0-5%	–	–	–
>4 <= 12	1-3%	–	–	–
>12 <= 24	5-12%	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 1.2
Barren with few forbs and grasses

Following disturbance, forbs and grasses would begin to return immediately. This plant community is characterized by large open patches void of vegetation, with intermittent grass or forb plants and occasional shrubs. Much of the propagation that could re-colonize this site would come from wind or animal dispersed seed. Species composition would reflect the native plants of nearby sites as well as the remaining seed bank. There is little threat of nonnative plant invasion on this site due to the “inability of the weedy species to produce enough seeds to compensate for the high mortality rate caused by the harsh environment”, and the stress adapted characteristics of plants that occur on the site (Denslow, 1980). Although mountain hemlock is very hardy, regeneration and establishment may be slower than other high elevation tree species. Since seed production and germination depend on the amount of precipitation received during the growing season, mountain hemlock performs better during years of higher precipitation (Tesky, 1992). Mountain hemlock also reproduce vegetatively through layering (Tesky 1992), a form of reproduction that helps to fill gaps created by disturbances. Following a disturbance on this site the trees will be mostly young but, with the proper conditions they will survive and increase in overall canopy cover.

Pathway 1.1a
Community 1.1 to 1.2

1.1a- A disturbance such as a rock slide, avalanche or perhaps a lightning strike could remove existing vegetation and leave a mostly barren landscape.

Pathway 1.2a
Community 1.2 to 1.1

1.2a- Regeneration of mountain hemlock and colonization of shrubs, forbs, and grasses will increase the total canopy cover. With time, proper conditions, and the absence of large scale disturbances, mountain hemlock seedlings establish on the site. Understory species will increase percent cover from plant Community 1.2. Species will reflect the harshness of the environment, and the rate of propagation will be much the same for recently disturbed openings as for long undisturbed patches within the same site, according to Denslow, 1980.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**naitve grasses/grass likes**			7–40	
	squirreltail	ELEL5	*Elymus elymoides*	0–17	0–3
	western needlegrass	ACOC3	*Achnatherum occidentale*	3–17	1–3
	woodrush	LUZUL	*Luzula*	3–11	1–5
	sedge	CAREX	*Carex*	0–7	0–2
Forb					
2	**native forbs**			112–531	
	bluntlobe lupine	LUOB	*Lupinus obtusilobus*	28–448	2–45
	mountain pride	PENE3	*Penstemon newberryi*	0–17	0–8
	mountain monardella	MOOD	*Monardella odoratissima*	0–17	0–4
	marumleaf buckwheat	ERMA4	*Eriogonum marifolium*	0–13	0–8
	prickly hawkweed	HIHO	*Hieracium horridum*	0–8	0–3
	naked buckwheat	ERNU3	*Eriogonum nudum*	0–7	0–3
	Davis' knotweed	PODA	*Polygonum davisiae*	0–7	0–3
	Sierra cliffbrake	PEBR3	*Pellaea brachyptera*	0–7	0–2
	Shasta knotweed	POSH	*Polygonum shastense*	0–6	0–2
	Sacramento waxydogbane	CYHU	*Cycladenia humilis*	0–2	0–1
Shrub/Vine					
3	**native shrubs**			112–336	
	pinemat manzanita	ARNE	*Arctostaphylos nevadensis*	28–224	1–25
	oceanspray	HODI	*Holodiscus discolor*	0–84	0–10
	mountain pride	PENE3	*Penstemon newberryi*	0–17	0–8
	purple mountainheath	PHBR4	*Phyllodoce breweri*	0–11	0–2
Tree					
4	**native trees**			0–45	
	mountain hemlock	TSME	*Tsuga mertensiana*	0–17	0–3
	California red fir	ABMA	*Abies magnifica*	0–11	0–2
	whitebark pine	PIAL	*Pinus albicaulis*	0–11	0–2

Animal community

High elevation sites with limited stands of mountain hemlock (*Tsuga mertensiana*) are home to Clark’s nutcracker, deer mice and various species of chipmunks. The upper limits of this ecological site are home to gray-crowned rosy finch, pika, and the golden mantled ground squirrel.

Pikas are a smaller cousin of the rabbit, are diurnal and choose to live on rocky sites at high elevations. They eat the leaves and stems of grasses, forbs, and shrubs. They do not hibernate and are known for making haystacks during the summer months to ensure their survival through the winter. Winter survival is directly related to the success of their haying the previous summer (Smith 1994).

A variety of invertebrates also use this site, the most common of which is the California tortoise shell butterfly. This orange-brown butterfly can be seen by the thousands, commonly around the peaks of mountains.

Recreational uses

This site is generally found on very steep rocky slopes not well suited for trails, but providing excellent views.

Inventory data references

The following NRCS vegetation plots were used to describe this ecological site:

789208 Emeraldlake modal
789260
789319
789320
789323 Site location for Ecological Site
789390

Type locality

Location 1: Shasta County, CA	
UTM zone	N
UTM northing	4481571
UTM easting	629422
General legal description	This site is approx. 0.5 miles east-southeast of the Terrace Lake Trailhead, on the north facing slope between Reading Peak and Shadow Lake.

Other references

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Morgan, P., S.C. Bunting, A.E. Black, T. Merrill, and S. Barrett. 1996. Fire regimes in the interior Columbia River Basin: past and present. Final report for RJVA-INT-94913. Intermountain Fire Sciences Laboratory, Intermountain Research Station, Missoula, MT.

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Available: http://www.fs.fed.us/database/feis/ [2008, June 16].

Contributors

Marchel M. Munnecke

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:**

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2. **Presence of water flow patterns:**

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3. **Number and height of erosional pedestals or terracettes:**

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

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5. **Number of gullies and erosion associated with gullies:**

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6. **Extent of wind scoured, blowouts and/or depositional areas:**

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7. **Amount of litter movement (describe size and distance expected to travel):**

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

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

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

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

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

    Dominant:

    Sub-dominant:

    Other:

    Additional:

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

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

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

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

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17. **Perennial plant reproductive capability:**
