

Ecological site R022BI203CA Moderately Deep Fragmental 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.

MLRA notes

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

Site Concept – Slopes: 10 to 80, but generally 10 to 50 Landform: Mountain slope Soils: moderately deep, well drained soils that formed in tephra and colluvium over residuum from hydrothermally altered rock. A Cr horizon begins at 15 inches and indurated bedrock is encountered at 20-40 inches. Temp regime: Frigid MAT: 38 to 42 degrees F (3.3 to 5.5 degrees C). MAP: 63 to 119 inches (2,515 to 2,870 mm). Soil texture: Gravelly ashy loam Surface fragments: 40 to 65 percent gravel and cobbles. Vegetation: High cover of woolly mule-ears (*Wyethia mollis*) and/or arrowleaf balsamroot (*Balsamorhiza sagittata*) with other forbs and grasses. Note: The soils formed from the hydrothermally altered parent material are higher in clay content and have lower pH than other soils in Lassen Volcanic National Park.

Associated sites

F022BI113CA	Frigid Very Deep Loamy Slopes This is an open red fir forest found on very deep hydrothermally altered soils.
R022BI209CA	Loamy Seeps This site is associated with wet seeps and springs in drainages and valley bottoms.

Table 1. Dominant plant species

Tree	(1) <i>Abies magnifica</i>
Shrub	Not specified
Herbaceous	(1) <i>Wyethia mollis</i> (2) <i>Balsamorhiza sagittata</i>

Physiographic features

This ecological site is found on convex mountain side slopes in hydro-thermally altered areas within Brokeoff Volcano at elevations between 5,680 and 8,570 feet. Slopes range from 10 to 80 percent, but are usually between 10 to 50 percent.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope
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Flooding frequency	None
Ponding frequency	None
Elevation	1,730 – 2,610 m
Slope	10 – 80 %
Aspect	E, S, W

Climatic features

This ecological site receives most of its annual precipitation in the form of snow from November to April. The mean annual precipitation ranges from 63 to 119 inches (2,515 to 2,870 mm). The mean annual temperature ranges from 38 to 42 degrees F (3.3 to 5.5 degrees C). The frost free (>32 degrees F) season is 60 to 85 days. The freeze free (>28 degrees F) season is 80 to 195 days.

There are no representative climate stations for this ecological site.

Table 3 Representative climatic features

Frost-free period (average)	90 days
Freeze-free period (average)	200 days
Precipitation total (average)	3,020 mm

Influencing water features

This ecological site is not associated with wetland or riparian water features.

Soil features

The Brokeoff series associated with this site consists of moderately deep, well drained soils that formed in tephra and colluvium over residuum from hydrothermally altered volcanic rock. Acidic steam and water of various temperatures and pH have altered the mineralogy of the rock to produce minerals that have weathered into soils with significantly higher amounts of clay and a lower pH than those soils in the rest of the Park. The pH was sampled in the field at 4.8 at depths from 0 to 2 inches, and 5.0 to 5.2 in the lower horizons. A lab pit from deeper soils with similar chemistry had pH ranges from 4.7 to 5.1. These soils are very strongly acidic to neutral, and may have high levels of aluminum and manganese. Aluminum +++ becomes soluble in acidic soils, and impairs root growth, reducing the plants ability to access water. Plants may show symptoms of Phosphorus (P), calcium (Ca), and magnesium (Mg), deficiencies due to the high pH. Manganese toxicity is also associated with acidic soils. The symptoms of manganese toxicity are reduced shoot growth, discoloring and chlorosis of leaves.

The surface texture is a gravelly ashy loam with 18 percent clay and 30 percent gravel. Subsurface textures are gravelly ashy loam, very gravelly clay loam, and extremely gravelly loam. Percent gravel ranges from 30 to 40 and percent cobbles ranges from 2 to 20 increasing with depth. At 15 to 37 inches in depth is a Cr horizon of cobbles with 98 percent rock fragments that include gravels, cobbles and stones. Indurated bedrock is encountered at 37 inches in the modal pit and ranges from 20 to 40 inches. This soil is fragmental with a high percentage of gravels and cobbles.

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

Table 4. Representative soil features

Family particle size	(1) Loamy
Drainage class	Well drained
Permeability class	Not specified
Soil depth	50 – 100 cm
Surface fragment cover <=3"	30 – 50 %
Surface fragment cover >3"	10 – 20 %
Available water capacity (0-101.6cm)	1.98 – 5.92 cm
Soil reaction (1:1 water) (0-101.6cm)	4.8 – 6.7
Subsurface fragment volume <=3" (Depth not specified)	30 – 50 %
Subsurface fragment volume >3" (Depth not specified)	0 – 10 %

Ecological dynamics

This ecological site is heavily dominated by woolly mule-ears (*Wyethia mollis*), although it may be replaced by arrowleaf balsamroot (*Balsamorhiza sagittata*) in some areas. Other common plants include bluntlobe lupine (*Lupinus obtusilobus*), mountain monardella (*Monardella odoratissima*), squirreltail (*Elymus elymoides*) and blue wildrye (*Elymus glaucus*). There are very few trees on this site.

The soils are unique to this area because of a high clay content, low pH, and potentially toxic levels of aluminum and manganese. In addition to the inherent properties of the soil, there may be ongoing chemical deposition from the active hydrothermal vents. Deposition can sometimes be seen as a yellow coating on the snow, which can affect surface pH and mineralogy. Hydrogen sulfide (H₂S), Carbon dioxide (CO₂), hydrogen gas (H₂), nitrogen (N), and helium (He) are some of the chemicals found in the thermal springs, which react with oxygen and other elements to form a variety of chemicals which may be found in the steam deposits.

The soil chemistry alone does not inhibit tree growth however, as trees are growing in similar conditions nearby. The trees nearby are not growing in a normal forest-like structure. They tend to stay open with multiple age classes, possibly indicating some response to low pHs, aluminum or manganese toxicity. Another factor may be the droughtiness of the Brokeoff soils. The Cr layer begins at 15 inches, with 98 percent rock fragments and indurated bedrock occurring between 20 to 40 inches. Even with its finer textures this soil has a limited

available water holding capacity. It is this low available water capacity, due to high rock fragments and moderately deep soils over indurated bedrock, which inhibits tree growth. Additionally, woolly mule-ears can interfere with conifer establishment through competition for water and/or allelopathy.

Woolly mule-ears (*Wyethia mollis*) can grow in a variety of soils but tend to be most aggressive in heavy clay soils, making it well adapted to this site. It does well on the moderate to steep slopes characterizing this site (Matthews 1993). Woolly mule-ears (*Wyethia mollis*) and arrowleaf balsamroot (*Balsamorhiza sagittata*) are tolerant of drought conditions and both can be found throughout the successional process.

There is a strong possibility that fire will create a disturbance in this landscape. In late summer and fall, when woolly mule-ears (*Wyethia mollis*) and arrowleaf balsamroot (*Balsamorhiza sagittata*) dry out, there is an abundance of available fuel, which increases the chance of fire. When woolly mule-ears (*Wyethia mollis*) cures it is covered with a resin that makes it rather flammable (Matthews 1993), further increasing the likelihood of fire. Arrowleaf balsamroot has a “high fire resistance rating” and following a fire it will sprout from the caudex, but growth increases slowly until seed production (McWilliams 2002). There is some indication that woolly mule-ears (*Wyethia mollis*) will resprout after a fire (Matthews 1993).

In the short term, a fire on this site will create a patchy pattern on the landscape by decreasing the amount of large forbs like woolly mule-ears and arrowleaf balsamroot, and increasing the amount of grasses.

State and transition model

Figure 3. Moderately Deep Fragmental Slopes Model

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
Grass/Grasslike					
1	native grasses			1-62	
	squirreltail	ELEL5	<i>Elymus elymoides</i>	1-20	1-6
	blue wildrye	ELGL	<i>Elymus glaucus</i>	0-17	0-5
	California brome	BRCA5	<i>Bromus carinatus</i>	0-13	0-3
	western needlegrass	ACOC3	<i>Achnatherum occidentale</i>	0-11	0-4
Forb					
2	native forbs			392-1098	
	woolly mule-ears	WYMO	<i>Wyethia mollis</i>	168-673	15-60
	arrowleaf balsamroot	BASA3	<i>Balsamorhiza sagittata</i>	11-168	2-15
	bluntlobe lupine	LUOB	<i>Lupinus obtusilobus</i>	0-135	0-12
	mountain monardella	MOOD	<i>Monardella odoratissima</i>	6-36	2-8
	California stickseed	HACA	<i>Hackelia californica</i>	0-18	0-5
	hairy brackenfern	PTAQP2	<i>Pteridium aquilinum var. pubescens</i>	0-13	0-5
	sweetcicely	OSBE	<i>Osmorhiza berteroi</i>	0-10	0-3
	silverleaf phacelia	PHHA	<i>Phacelia hastata</i>	0-9	0-2
	Brewer's aster	EUBR12	<i>Eucephalus breweri</i>	0-9	0-2
	naked buckwheat	ERNU3	<i>Eriogonum nudum</i>	0-8	0-3
	mountain tarweed	MAGL2	<i>Madia glomerata</i>	0-7	0-2
Tree					
3	native trees			3-53	
	California red fir	ABMA	<i>Abies magnifica</i>	3-50	5-15
	western white pine	PIMO3	<i>Pinus monticola</i>	0-2	0-1

Table 6. Community 1.2 plant community composition

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

This site can provide good foraging resource early in the growing season, for species like deer. When ground cover is high small mammals and rodents will use the site for shelter, therefore it can also be a good hunting ground for predatory birds. Grazing animals will eat the leaves of woolly mule-ears (*Wyethia mollis*) and arrowleaf balsamroot (*Balsamorhiza sagittata*) in the early spring, but they quickly dry and become undesirable later in growing season. Grazers will also eat sunflower-like flower heads before the seeds ripen (McWilliams, 2002). Blue wildrye (*Elymus glaucus*) also provides fair forage value along with being a deep rooted drought tolerant perennial (Johnson, 1999).

Hydrological functions

This site is in hydrologic soil group b.

Recreational uses

This area provides scenic vistas.

Other information

Native Americans fermented the roots of woolly mule-ears (*Wyethia mollis*) in a pit with hot stones to make a sweet flavored food. Arrowleaf balsamroot (*Balsamorhiza sagittata*) was used by many Native American tribes for food and medicine. The young shoots were eaten in spring. The large tap root, bud stalks and seeds were eaten as well. It was used to treat a variety of ailments including stomachache, headache, wounds, insect bites, swellings, tuberculosis and whooping cough (McWilliams, 2002). Arrowleaf balsamroot is still valued for food and medicinal uses.

Inventory data references

There are two NRCS soil pits for this site with vegetation data. 789317 789175- Site location

Type locality

Location 1: Shasta County, CA	
Township/Range/Section	T30 N R4 E S15
UTM zone	N
UTM northing	4479536
UTM easting	624772
General legal description	The site is about 3,800 feet north-northeast from the Sulfur Works parking lot on Highway 89.

Other references

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Contributors

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	
Contact for lead author	
Date	
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. Number and extent of rills:

2. Presence of water flow patterns:

3. Number and height of erosional pedestals or terracettes:

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

5. Number of gullies and erosion associated with gullies:

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

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

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

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

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

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

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

Dominant:

Sub-dominant:

Other:

Additional:

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

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

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

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

17. Perennial plant reproductive capability:
