USDA Natural Resources Conservation Service

Ecological site F022BI104CA
Cryic Coarse Loamy Colluvial Slopes

Accessed: 05/01/2024

General information

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

Figure 1. Mapped extent

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

MLRA notes

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

Site concept:
Landform: (1) Moraine, (2) Mountain slope, (3) Cinder cone
Elevation (feet): 6,960-9,160
Slope (percent): 1-80, but generally 15 to 60
Water Table Depth (inches): n/a
Flooding-Frequency: None
Ponding-Frequency: None
Aspect: North, East, West
Mean annual precipitation (inches): 37.0-125.0
Primary Precipitation: Snow from November to May
Mean annual temperature ranges from 38 to 43 degrees F (3 to 6 degrees C)
Restrictive Layer: Densic layer or bedrock between 20 to 60 inches or more
Temperature Regime: Cryic
Moisture Regime: Xeric
Parent Materials: Tephra over till, tephra over colluvium, or in colluvium derived from volcanic rock
Surface Texture: (1) Stony medial loamy sand, (2) Gravelly ashy sandy loam, (3) Very gravelly ashy fine sandy loam
Surface Fragments <=3" (% Cover): 20-65
Surface Fragments > 3" (% Cover): 0-10

Soil Depth (inches): 20-60+
Vegetation: Mountain hemlock (*Tsuga mertensiana*) forests dominate this ecological site, located just below or intermixed with whitebark pine forests.
Notes: This site is found near timberline on the flanks of Lassen Peak and on some of the nearby peaks.

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

F022BI111CA	**Cryic Gravelly Or Ashy Sandy Loam Gentle Slopes** This ecological site is a sub-alpine mixed conifer forest generally found just below the pure hemlock forests, but it intermingles in some areas.
R022BI205CA	**Cirque Floor** This rangeland site has high cover of lupine and is found on cirque bottoms.

Similar sites

F022BI124CA	**Upper Cryic Slopes** This open mountain hemlock-whitebark pine forest is often stunted and windblown and is found at timberline.

Table 1. Dominant plant species

Tree	(1) *Tsuga mertensiana*
Shrub	Not specified
Herbaceous	(1) *Lupinus obtusilobus* (2) *Cistanthe umbellata var. umbellata*

Physiographic features

This ecological site is found on glacial headlands, moraines, and cinder cones between 6,960 and 9,160 feet in elevation. Slopes range from 1 to 80 percent, but the majority of this site is on 15 to 60 percent slopes. This site is associated with northern aspects but is found in cooler positions on all aspects.

Table 2. Representative physiographic features

Landforms	(1) Moraine (2) Mountain slope (3) Cinder cone
Flooding frequency	None
Ponding frequency	None
Elevation	2,121–2,792 m
Slope	1–80%
Aspect	N, E, W

Climatic features

This ecological site receives most of its annual precipitation in the form of snow from November to May. The mean annual precipitation ranges from 37 to 125 inches (940 to 3,175 mm) and the mean annual temperature ranges from 38 to 43 degrees F (3 to 6 degrees C). The frost free (> 32 degrees F) season is 50 to 85 days. The freeze free (>28 degrees F) season is 60 to 110 days. Although this data is from several GIS prism layers it may reflect

inaccurate levels for the temperature and precipitation of the upper cinder cones on the east side of the park. It seems that the precipitation is low and the temperatures are high for this area, but the prism data may not be detailed enough to capture small cinder cones.

There are no representative climate stations available for this site.

Table 3. Representative climatic features

Frost-free period (average)	85 days
Freeze-free period (average)	110 days
Precipitation total (average)	3,175 mm

Influencing water features

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

Soil features

The Terracelake, Humic Xeric Vitricryands, Xeric Vitricryands, tephra over till, and the Xeric Vitricryands, colluvium soil components are associated with this site. These soils are moderately deep to very deep, with very low to low AWC. The moderately deep soils have a densic layer or bedrock between 20 to 40 inches. Permeability is rapid in the upper horizons, but very slow to impermeable through the densic layer or bedrock. The surface textures are stony medial loamy sand, gravelly ashy sandy loam, very gravelly ashy fine sandy loam, or gravelly medial sandy loam, with sandy subsurface textures. These soils formed in tephra over till, tephra over colluvium, or in colluvium derived from volcanic rock.

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

Map Unit/ Component /Comp %
116 Xeric Vitricryands, tephra over till 30
116 Terracelake (highest elevation of this component) 25
116 Humic Xeric Vitricryands, 10
122 Xeric Vitricryands, colluvium 35
136 Xeric Vitricryands, tephra over till, 10
144 Humic Xeric Vitricryands 30

Table 4. Representative soil features

Family particle size	(1) Sandy
Drainage class	Well drained
Permeability class	Rapid
Soil depth	51 cm
Surface fragment cover <=3"	20–65%
Surface fragment cover >3"	0–10%
Available water capacity (0-101.6cm)	5.33–8.89 cm
Soil reaction (1:1 water) (0-101.6cm)	3.5–7.3
Subsurface fragment volume <=3" (Depth not specified)	15–65%

Subsurface fragment volume >3" (Depth not specified)	10–40%

Ecological dynamics

Mountain hemlock (*Tsuga mertensiana*) forests dominate this ecological site, located just below or intermixed with whitebark pine forests. This site is found near timberline on the flanks of Lassen Peak and on some of the nearby peaks.

This area is buried with deep snow from November to June and remains cool for most of the year. Several physiological adaptations allow mountain hemlock to survive in this cold environment. It has maximum photosynthesis rates at colder temperatures than lower elevation trees; it closes its stomata to reduce water loss during its dormant period; and the tips of Mountain hemlock are very flexible, which reduce snow build up and stem breakage (Arno and Hammerly, 1984).

Timberline trees are able to withstand extremely cold winter conditions when they are dormant but need at least a 2 month frost free growing season in the summer. During this short growing season, usually in July and August, the new growth of mountain hemlock 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.

Snow burial can help protect the trees from strong winter winds, desiccation from warm winter winds and sunny winter days, from extreme cold, and from repeated freezing and thawing (Arno and Hammerly, 1984). Snow burial, however, can be detrimental as well. In some areas, the portion of the tree 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.

The fire return intervals for mountain hemlock forests in this area are poorly documented but they may be between 400 to 800 years (Tesky, 1992). Nine fires are documented for the mountain hemlock zone in Lassen Volcanic National Park between 1933 and 1977, resulting in a single tree being burned. Lightning strikes are very common in this area but the fuel loads and their capacity to carry fire is low. Even if fire started to spread, these forests are often dissected by wind exposed ridges and rock outcrops.

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).

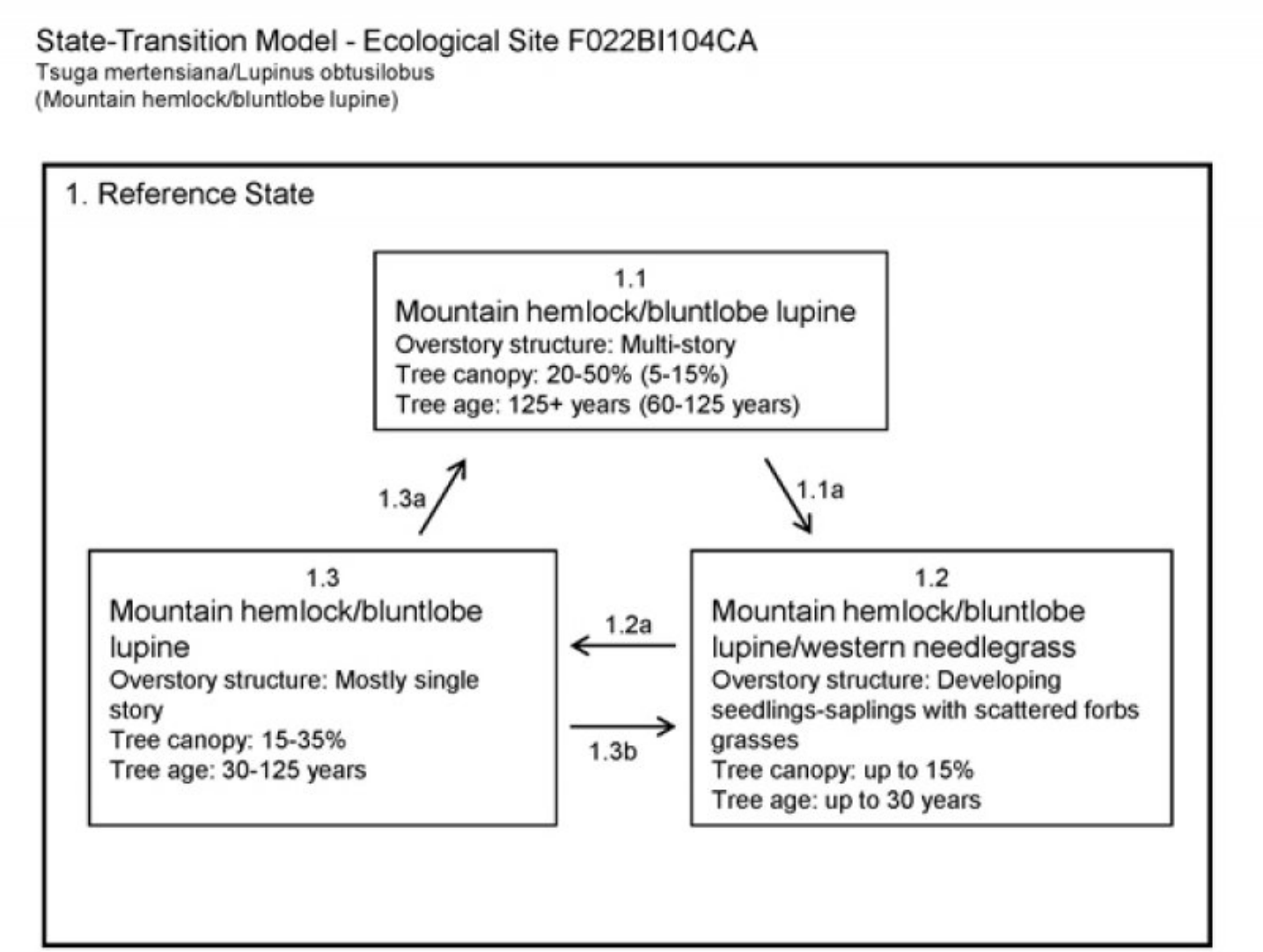
Mountain hemlock is not generally as susceptible to forest pathogens as the lower elevation conifers, but trees over 80 years old are very susceptible to laminated root rot (Phellinus weiri). Laminated root rot can rapidly spread by root contact and kill acres of forests (Tesky, 1992).

Other common fungal and parasitic pests of mountain hemlock include several heart rots, of which Indian paint fungus (Echinodontium tinctorum) is the most common and damaging, various needle diseases, snow mold (Herpotrichia nigra), and dwarf-mistletoe (*Arceuthobium tsugense*) (Tesky, 1992).

The reference state consists of the most successionally advanced community phase (numbered 1.1) as well as other community phases which result from natural and human disturbances. Community phase 1.1 is deemed the phase representative of the most successionally advanced pre-European plant/animal community including periodic natural surface fires that influenced its composition and production. Because this phase is determined from the oldest modern day remnant forests and/or historic literature, some speculation is necessarily involved in describing it.

All tabular data listed for a specific community phase within this ecological site description represent a summary of one or more field data collection plots taken in communities within the community phase. Although such data are valuable in understanding the phase (kinds and amounts of ground and surface materials, canopy characteristics, community phase overstory and understory species, production and composition, and growth), it typically does not represent the absolute range of characteristics nor an exhaustive listing of species for all the dynamic communities within each specific community phase.

State and transition model



State 1
Reference

Community 1.1
Mountain hemlock/bluntlobe lupine

This is a long lived stable mountain hemlock (*Tsuga mertensiana*) forest. Trees can live for 800 years but a mature forest may be 100 to 400 years old. In protected areas trees may be over 90 feet tall with 50 percent canopy cover. In areas exposed to wind, the forest remains more open with shorter trees.

Forest overstory. Canopy cover ranges from 20 to 50 percent with an average of 25 percent. Basal area ranges from 110 to 200 ft2/acre.

Forest understory. The understory is generally sparse but bluntlobe lupine (Lupinus obtusilobus) flourishes in some areas. Other common plants are western needlegrass (Achnatherum occidentale), Holboell's rockcress (Arabis holboellii), pioneer rockcress Arabis platysperma carex (Carex SP.), Mt. Hood pussypaws (Cistanthe umbellata var. umbellata), and spike trisetum (Trisetum spicatum).

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Forb	18	338	485
Grass/Grasslike	–	27	136
Tree	2	11	28
Shrub/Vine	–	1	2
Total	**20**	**377**	**651**

Table 6. Ground cover

Tree foliar cover	25-60%
Shrub/vine/liana foliar cover	0-1%
Grass/grasslike foliar cover	1-9%
Forb foliar cover	2-65%
Non-vascular plants	0%
Biological crusts	0%
Litter	40-60%
Surface fragments >0.25" and <=3"	5-30%
Surface fragments >3"	5-45%
Bedrock	0-10%
Water	0%
Bare ground	2-10%

Table 7. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	–	1-8%	0-1%
>0.15 <= 0.3	–	–	0-5%	0-2%
>0.3 <= 0.6	0-1%	–	–	2-65%
>0.6 <= 1.4	0-1%	–	–	–
>1.4 <= 4	0-5%	–	–	–
>4 <= 12	5-15%	–	–	–
>12 <= 24	20-60%	–	–	–
>24 <= 37	0-5%	–	–	–
>37	–	–	–	–

Community 1.2
Mountain hemlock/bluntlobe lupine/western needlegrass

Small scale disturbances from wind-throw, disease, single tree mortalities from lightning strikes, snow creep, and small avalanches are possible in this ecological site. Mountain hemlock has a shallow root system and is susceptible to wind-throw. These disturbances create small gaps for mountain hemlock regeneration. Canopy fires are uncommon in this mountain hemlock community phase but may occur if there are sufficient fuels and the right climatic conditions for fire to spread. Mountain hemlock is able to reproduce by layering and by seed. Trees that reproduce by layering create a circle of young trees around the original tree. Mountain hemlock seedlings prefer partial shade. Seeds are winged and are wind dispersed. Mountain hemlock produces cones in 3 year intervals with almost no cone production between intervals. For the seeds to establish, a good seed crop is needed with favorable temperature and moisture conditions. Mountain hemlock establishes well during years of lower than normal April

snowpack depths, which provides a longer snow-free growing season (Taylor, 1995). Adequate summer moisture is also important. Growth of the seedlings is very slow at first. In a study of mountain hemlock recruitment in Lassen Volcanic Park, 30 cm tall seedlings were 29 years old (Taylor, 1995). Lupines, grasses, and other forbs are present.

Community 1.3
Mountain hemlock/bluntlobe lupine

Even under favorable conditions this community phase may require over 100 years for the slow growing hemlocks to slowly regain a forest structure. In one study of the regrowth of mountain hemlock after a laminated root rot die-off, regrowth of the forest was very slow. Due to the slow and continual recruitment of mountain hemlock, an unevenly aged forest will develop (Boone et. al. 1988). If disturbances such as fire, clear-cutting or disease create large canopy openings, the trees may have difficulty reestablishing as a forest site. The lack of a nearby seed source, exposure to severe winds, or lack of protective shade may reduce a formerly forested site to a more open Krummholz statured forest.

Pathway 1.1a
Community 1.1 to 1.2

Fire, disease, wind-throw, avalanches, and/or winter desiccation create small canopy gaps for regeneration.

Pathway 1.2a
Community 1.2 to 1.3

With time and growth mountain hemlock increases in basal area, height and cover.

Pathway 1.3a
Community 1.3 to 1.1

With time and growth, mountain hemlock increases in basal area, height and cover.

Pathway 1.3b
Community 1.3 to 1.2

Fire, disease, wind-throw, avalanches, and/or winter desiccation create small canopy gaps for regeneration.

Additional community tables

Table 8. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Tree					
0	**Tree (understory only)**			2–28	
	mountain hemlock	TSME	*Tsuga mertensiana*	2–28	1–10
Shrub/Vine					
0	**Shrub**			0–2	
	pioneer rockcress	ARPL	*Arabis platysperma*	0–2	0–2
Grass/Grasslike					
0	**Grass/Grasslike**			0–136	
	western needlegrass	ACOC3	*Achnatherum occidentale*	0–62	0–7
	spike trisetum	TRSP2	*Trisetum spicatum*	0–56	0–10
	sedge	CAREX	*Carex*	2–18	1–8
Forb					
0	**Forb**			18–485	
	bluntlobe lupine	LUOB	*Lupinus obtusilobus*	18–482	2–50
	Mt. Hood pussypaws	CIUMU	*Cistanthe umbellata var. umbellata*	0–2	0–1
	Holboell's rockcress	ARHO2	*Arabis holboellii*	0–1	0–1

Table 9. Community 1.1 forest overstory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)	Diameter (Cm)	Basal Area (Square M/Hectare)
Tree							
mountain hemlock	TSME	*Tsuga mertensiana*	Native	–	20–50	–	–

Table 10. Community 1.1 forest understory composition

Common Name	Symbol	Scientific Name	Nativity	Height (M)	Canopy Cover (%)
Grass/grass-like (Graminoids)					
spike trisetum	TRSP2	*Trisetum spicatum*	Native	–	0–10
sedge	CAREX	*Carex*	Native	–	1–8
western needlegrass	ACOC3	*Achnatherum occidentale*	Native	–	0–7
Forb/Herb					
bluntlobe lupine	LUOB	*Lupinus obtusilobus*	Native	–	2–50
Holboell's rockcress	ARHO2	*Arabis holboellii*	Native	–	0–1
Mt. Hood pussypaws	CIUMU	*Cistanthe umbellata var. umbellata*	Native	–	0–1
Shrub/Subshrub					
pioneer rockcress	ARPL	*Arabis platysperma*	Native	–	0–2
Tree					
mountain hemlock	TSME	*Tsuga mertensiana*	Native	–	1–10

Animal community

Mountain hemlock forests provide cover and forage for wildlife species. Some birds eat the mountain hemlock seeds. In some areas the understory provides decent forage (Tesky, 1992).

Hydrological functions

This site is in the soil hydrologic groups A and B.

Recreational uses

This site is located on or near alpine peaks and ridges. This area is often steep but provides scenic views. Trails may need special planning to avoid erosion.

Wood products

Mountain hemlock is rarely harvested for commercial uses because of its inaccessibility. If harvested, it 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

Mountain hemlock is sometimes planted as an ornamental tree.

Other information

Site index documentation:

Barnes (1962) developed site curves and yield estimates for western hemlock which 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.

Trees appropriate for site index measurement typically occur in older stands of community phase 1.3. They are selected according to guidance in Barnes (1962).

Table 11. 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
mountain hemlock	*TSME*	61	65	69	75	–	–	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*	61	65	58	67	70	990	–	

Inventory data references

There following vegetation plots were used to describe this ecological site:

789149
789171- Site location
789207
789265
789326
789345
789387
789398

Type locality

Location 1: Shasta County, CA	
Township/Range/Section	T30 N R4 E S12
UTM zone	N
UTM northing	4482249
UTM easting	629292
General legal description	This site is about 650 feet north of the trailhead that starts at Highway 89 and goes down to Paradise Meadows and Terrace Lake.

Other references

Arno, Stephen F. and Hammerly, Ramona p. 1984. Timberline, Mountain and Artic Forest Frontiers. The Mountaneers, Seattle, WA.

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.

Boone, Richard D.; Sollins, Phillip; and Cromack, Kermit Jr, 1988. Stand and Soil Changes Along A Mountain Hemlock Death and Regrowth Sequence. Ecology, Vol. 69, No. 3 (Jun., 1988), pp. 714-722.

Means, Joseph E. *Tsuga mertensiana* (Bong.) Carr. Mountain Hemlock. In. Burns, Russell M; Honkala, Barbara H.; [Technical coordinators] 1990. Silvics of North America: Volume 1. Conifers. United States Department of Agriculture (USDA), Forest Service, Agriculture Handbook 54.

Parker, Albert J. 1991. Forest/Environment Relationships in Lassen Volcanic National Park, California, U.S.A. Journal of Biogeography, Vol. 18, No. 5, Sept., 1991. pp. 543-552.

Taylor, Alan H. 1995. Forest Expansion and Climate Change in the Mountain Hemlock (*Tsuga mertensiana*) Zone, Lassen Volcanic National Park, California, U.S.A. Artic and Alpine Research, Vol. 27, No. 3, 1995, pp. 207-216.

Tesky, Julie L. 1992. *Tsuga mertensiana*. In: Fire Effects Information System, [Online].
U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer).
Available: http://www.fs.fed.us/database/feis/ [2008, June 16].

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:

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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:**
