

Ecological site EX044B01C136

Shallow Loamy (SwLo) 15-19" PZ

Frigid

North

Last updated: 3/03/2025

Accessed: 06/21/2026

General information

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

MLRA notes

Major Land Resource Area (MLRA): 044B–Central Rocky Mountain Valleys

Major Land Resource Area (MLRA) 44B, Central Rocky Mountain Valleys, is nearly 3.7 million acres of southwest Montana. This MLRA borders two other MLRAs: 43B, Central Rocky Mountains and Foothills, and 46, Northern and Central Rocky Mountain Foothills. The major watersheds of this MLRA are the Missouri and Yellowstone Rivers and their associated headwaters, such as the Beaverhead, Big Hole, Jefferson, Ruby, Madison, Gallatin, and Shields Rivers. Limited portions of the MLRA are west of the Continental Divide along the Clark Fork River. These waters allow for extensive irrigation for crop production in an area that is generally only compatible with rangeland and grazing. The Missouri River and its headwaters are behind several reservoirs used for irrigation water, hydroelectric power, and municipal water. The primary land use of this MLRA is production agriculture (grazing, small grain production, and hay) with limited mining. Urban development is high, with large expanses of rangeland being converted to subdivisions for a rapidly growing population. MLRA 44B consists of one Land Resource Unit (LRU) and seven climate-based LRU subsets. Annual precipitation ranges from a low of 9 inches to a high of near 24 inches. The driest areas tend to be in the valley bottoms of southwest Montana, in the rain shadow of the mountains. The wettest portions tend to be near the edges of the MLRA, where it borders MLRA 43B. Frost-free periods also vary greatly, with less than 30 days in the Big Hole Valley to approximately 110 days in the warm valleys along the Yellowstone and Missouri Rivers. MLRA 44B's plant communities are highly variable but are dominated by a cool-season grass and shrub-steppe community on the rangeland and a mixed coniferous forest in the mountains. Warm-season grasses occupy an extremely limited extent and number of species in this MLRA. Most subspecies of big sagebrush are present, to some extent, across the MLRA.

LRU notes

LRU 01 Subset C Central Concept: • Moisture Regime: Ustic • Temperature Regime: Frigid • Dominant Cover: rangeland (mixed grassland and sagebrush steppe) • Representative Value (RV) of range of Effective Precipitation: 15 to 19 inches • Representative Value (RV) of range of Frost Free Days: 75 to 105days This LRU subset exists in northern portion of MLRA 44B particularly in Meagher, Powell, Broadwater, Lewis and Clark, Granite, and Deer Lodge Counties.

Classification relationships

Mueggler and Stewart. 1980. Grassland and Shrubland habitat types of Western Montana 1. *Artemisia tridentata*/Agropyron spicatum h.t. 2. Agropyron spicatum/Agropyron smithii h.t. 3. *Artemisia tridentata*/Festuca scabrella h.t. 4. Agropyron spicatum/Bouteloua gracilis h.t. EPA Ecoregions of Montana, Second Edition: Level I: Northwestern Forested Mountains Level II: Western Cordillera Level III: Middle Rockies & Northern Great Plains Level IV: Paradise Valley Townsend Basin Dry Intermontane Sagebrush Valleys Shield-Smith Valleys National Hierarchical Framework of Ecological Units: Domain: Dry Division: M330 – Temperate Steppe Division – Mountain Provinces Province: M332 –Middle Rocky Mountain Steppe – Coniferous Forest – Alpine Meadow Section: M332D – Belt Mountains Section M332E – Beaverhead Mountains Section Subsection: M332Ej – Southwest Montana Intermontane Basins and Valleys M332Dk – Central Montana Broad Valleys

Ecological site concept

- Site does not receive any additional water
- Soils are o Generally not saline or saline-sodic o Shallow with root restrictive lithic or paralithic layer 10 to 20 inches below soil surface. o Typically less than 5 percent stone and boulder cover (15 percent maximum) o Not Skeletal (less than 35 percent rock fragments) at 10-20 inch control section o Not strongly or violently effervescent within surface mineral 4 inches o Soil surface texture ranges from loam to clay loam in surface mineral 4 inches (clay percentage less than 32 percent).
- Parent material is alluvium and residuum

Associated sites

EX044B01C138	<p>Shallow Droughty (SwDr) 15-19" PZ Frigid North</p> <p>EX044B01B138 The Shallow Droughty ecological site often occupies similar landscape position and has a similar plant community</p>
EX044B01C040	<p>Loamy Steep (LoStp) 15-19" PZ Frigid North</p> <p>The Loamy Steep ecological site is often a neighboring site. Sites share similar plant communities</p>

Similar sites

EX044B01C138	<p>Shallow Droughty (SwDr) 15-19" PZ Frigid North</p> <p>EX044B01B138 The Shallow Droughty ecological site differs by being skeletal within 10 to 20 inch soil control section. These two sites share plant communities.</p>
--------------	---

Table 1. Dominant plant species

Tree	Not specified
Shrub	<p>(1) <i>Artemisia tridentata ssp. wyomingensis</i></p> <p>(2) <i>Tetradymia canescens</i></p>
Herbaceous	<p>(1) <i>Festuca campestris</i></p> <p>(2) <i>Pseudoroegneria spicata</i></p>

Legacy ID

R044BC136MT

Physiographic features

This ecological site can occur on nearly level to very steep hillslopes. It often occurs in a complex with other ecological sites. This site occurs from 2 to 45 percent; however, the core concept exists between 8 and 25 percent. Variations in plant community composition and production can result due to aspect, with south and west exposures tending to produce less. The amount of exposed rock outcrop tends to increase as slopes increase. Runoff and the potential for water erosion can be important features of this site.

Table 2. Representative physiographic features

Hillslope profile	<p>(1) Summit</p> <p>(2) Shoulder</p>
Landforms	<p>(1) Intermontane basin > Scarp</p> <p>(2) Intermontane basin > Hillslope</p> <p>(3) Intermontane basin > Knoll</p>

Runoff class	Medium to high
Elevation	1,460 – 1,980 m
Slope	10 – 30 %

Climatic features

The Central Rocky Mountain Valleys MLRA has a continental climate. 50 to 60 percent of the annual long-term average total precipitation falls between May and August with the highest in May and June. Most of the precipitation in the winter is snow on frozen ground. Average precipitation for LRU 01 Subset C is 15 inches, and the frost-free period averages 75 to 105 days.

Table 3 Representative climatic features

Frost-free period (characteristic range)	80-110 days
Freeze-free period (characteristic range)	110-140 days
Precipitation total (characteristic range)	360-430 mm
Frost-free period (actual range)	80-110 days
Freeze-free period (actual range)	110-140 days
Precipitation total (actual range)	330-510 mm
Frost-free period (average)	90 days
Freeze-free period (average)	120 days
Precipitation total (average)	380 mm

- (1) WILLSALL 8 ENE [USC00249023], Wilsall, MT
- (2) ANACONDA [USC00240199], Anaconda, MT
- (3) AUSTIN 1 W [USC00240375], Helena, MT
- (4) PHILIPSBURG RS [USC00246472], Philipsburg, MT
- (5) LENNEP 5 SW [USC00244954], White Sulphur Springs, MT
- (6) BOZEMAN MONTANA ST U [USC00241044], Bozeman, MT

Influencing water features

This ecological site is not associated with water features. The Shallow Loamy ecological site is an upland site that is well drained.

Wetland description

Site is not associated with wetlands.

Soil features

These soils are shallow to root-restricting bedrock. They have moderate-to-moderately rapid permeability, and they are well to somewhat excessively drained. These soils formed from residuum of mixed origins from non-calcareous geology. Typically, soil surface textures consist of loam, clay loam, and silt loam textures. Soils sometimes have a gravelly surface, but this will vary depending on their association with neighboring rocky sites. Common soil series in this ecological site include Cabba and Copnhaver. These soils may exist across multiple ecological sites due to natural variations in slope, texture, rock fragments, and pH.

Table 4. Representative soil features

Parent material	(1) Residuum – igneous, metamorphic and sedimentary rock
Surface texture	(1) Loam (2) Clay loam (3) Silt loam
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderate to moderately rapid
Depth to restrictive layer	30 – 50 cm
Soil depth	30 – 50 cm
Surface fragment cover <=3"	0 – 10 %
Surface fragment cover >3"	Not specified
Available water capacity (0-50.8cm)	3.81 – 6.35 cm
Soil reaction (1:1 water) (0-50.8cm)	7.6 – 8.2
Subsurface fragment volume <=3" (25.4-50.8cm)	0 – 30 %
Subsurface fragment volume >3" (25.4-50.8cm)	0 – 10 %

Ecological dynamics

The reference plant community is dominated by rough fescue (*Festuca campestris*), bluebunch wheatgrass (*Pseudoroegneria spicata*), and green needlegrass (*Nassella viridula*). Subdominant species may include western wheatgrass (*Pascopyrum smithii*), Idaho fescue (*Festuca idahoensis*), needle and thread (*Hesperostipa comata*), Wyoming big sage (*Artemisia tridentata* ssp. *wyomingensis*), sumac (*Rhus* spp.), winterfat (*Krascheninnikovia lanata*), and Indian ricegrass (*Achnatherum hymenoides*).

Natural fire was a major ecological driver of this entire ecological site. Fire tended to restrict tree and sagebrush growth to small patches and promote an herbaceous plant community. The natural fire return interval was highly variable, ranging up to 100 years; however, it was likely shorter than 35 years (Arno and Gruell 1983). With the historically recent, since 1910, suppression of fire sagebrush and trees have increased significantly.

Wyoming big sagebrush steppe communities historically had low fuel loadings and were characterized by 10- to 70-year interval fires that produced a mosaic of burned and unburned lands (Bunting et al., 1987). A shift to the dominance of shrubs may occur in response to improper grazing management, drought, or where big sagebrush occurs due to a lack of fire. Shrub encroachment by a variety of species, including, broom snakeweed (*Gutierrezia sarothrae*), fringed sagewort (*Artemisia frigida*), Wyoming big sagebrush, rubber rabbitbrush (*Ericameria nauseosa*), yellow rabbitbrush (*Chrysothamnus viscidiflorus*) and plains prickly pear cactus (*Opuntia polyacantha*) occur within this site as the mid-statured bunchgrasses decrease. Shrub dominance and grass loss can be associated with soil erosion and, ultimately, thinning of the native soil surface. Subsequent loss of soil could lead to a Degraded State. All states could also lead to the Invaded State when there is a lack of weed prevention and control measures.

Historical records indicate that, prior to the introduction of livestock (cattle and sheep) during the late 1800s, elk and bison grazed this ecological site. Due to the nomadic nature and herd structure of bison, areas that were grazed received periodic, high-intensity, short-duration grazing pressure. Livestock grazing has occurred on most of this ecological site in southwestern Montana for more than 150 years. The gold boom in the 1860s brought the first herds of livestock overland from Texas, and homesteaders began settling the area. During this time, cattle were the primary domestic grazers in the area. In the 1890s, Montana sheep production began to increase and dominated the livestock industry until the 1930s. Since the 1930s, cattle production has dominated the livestock industry in the region (Wyckoff and Hansen 2001).

Some of the major invasive species that can occur on this site include (but are not limited to) spotted knapweed (*Centaurea stoebe*), leafy spurge (*Euphorbia esula*), cheatgrass (*Bromus tectorum*), field brome (*Bromus arevensis*), yellow toadflax (*Linaria vulgaris*), and dandelion (*Taraxicum* spp.). Invasive weeds are beginning to have a high impact on this ecological site, particularly cheatgrass invasion.

Plant Communities and Transitions

A state and transition model (STM) for this ecological site is depicted below. Thorough descriptions of each state, transition, plant community, and pathway follow the model. This model is based on available experimental research, field data, field observations, and interpretations by experts. It is likely to change as knowledge increases.

The plant communities within the same ecological site will differ across the MLRA due to the naturally occurring variability in weather, soils, and aspect. The biological processes on this site are complex; therefore, representative values are presented in a land management context. The species lists are representative and are not botanical descriptions of all species occurring, or potentially occurring, on this site. They are intended to cover the core species and the known range of conditions and responses.

Although there is considerable qualitative experience supporting the pathways and transitions within the STM, no quantitative information exists that specifically identifies threshold parameters between grassland types and invaded types in this ecological site. For information on STMs, see the following citations: Bestelmeyer et al. (2003), Bestelmeyer et al. (2004), Bestelmeyer and Brown (2005), and Stringham et al. (2003).

State and transition model

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production ()	Foliar Cover (%)
Grass/Grasslike					
1	Mid-Statured Bunchgrasses			908-981	
	rough fescue	FECA4	<i>Festuca campestris</i>	504-785	25-35
	bluebunch wheatgrass	PSSP6	<i>Pseudoroegneria spicata</i>	448-673	20-30
	green needlegrass	NAVI4	<i>Nassella viridula</i>	112-179	10-15
2	Rhizomatous Grasses			67-140	
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	45-112	2-5

	thickspike wheatgrass	ELLA3	<i>Elymus lanceolatus</i>	0-112	0-5
	plains reedgrass	CAMO	<i>Calamagrostis montanensis</i>	22-45	1-2
3	Shortgrasses/grasslikes			67-140	
	Idaho fescue	FEID	<i>Festuca idahoensis</i>	28-84	3-10
	needle and thread	HECO26	<i>Hesperostipa comata</i>	34-84	5-10
	threadleaf sedge	CAFI	<i>Carex fillifolia</i>	22-67	2-6
	Sandberg bluegrass	POSE	<i>Poa secunda</i>	22-67	2-6
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	22-67	1-6
	sedge	CAREX	<i>Carex</i>	0-45	0-2
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	0-11	0-1
Forb					
4	Forbs			67-112	
	lupine	LUPIN	<i>Lupinus</i>	22-34	1-3
	American vetch	VIAM	<i>Vicia americana</i>	22-34	1-3
	scarlet globemallow	SPCO	<i>Sphaeralcea coccinea</i>	11-22	1-3
	dotted blazing star	LIPU	<i>Liatris punctata</i>	0-22	0-1
	spiny phlox	PHHO	<i>Phlox hoodii</i>	0-11	0-1
	deathcamas	ZIGAD	<i>Zigadenus</i>	0-6	0
Shrub/Vine					
5	Shrubs			67-112	
	big sagebrush	ARTR2	<i>Artemisia tridentata</i>	67-112	10-15
	common snowberry	SYAL	<i>Symphoricarpos albus</i>	11-56	1-5
	Woods' rose	ROWO	<i>Rosa woodsii</i>	0-22	0-3
	currant	RIBES	<i>Ribes</i>	0-22	0-2
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0-22	0-2
6	Subshrubs			11-34	
	winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	11-34	1-3
	prairie sagewort	ARFR4	<i>Artemisia frigida</i>	0-11	0-1
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0-11	0-1
Tree					
7	Coniferous Trees and Tall Shrubs			0-11	
	ponderosa pine	PIPOS	<i>Pinus ponderosa var. scopulorum</i>	0-11	0-1
	Rocky Mountain juniper	JUSC2	<i>Juniperus scopulorum</i>	0-11	0-1
	Douglas-fir	PSME	<i>Pseudotsuga menziesii</i>	0-11	0-1

Table 6. Community 1.2 plant community composition

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

Table 7. Community 2.1 plant community composition

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

Table 8. Community 2.2 plant community composition

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

Table 9. Community 3.1 plant community composition

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

Table 10. Community 4.1 plant community composition

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

Table 11. Community 5.1 plant community composition

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

Animal community

The Shallow Loamy ecological site provides a variety of wildlife habitats for an array of species. Prior to the settlement of this area, large herds of antelope, elk, and bison roamed. Though the bison have been replaced, mostly with domesticated livestock, elk and antelope still frequently utilize this largely intact landscape. Greater sage grouse may be present on sites with suitable habitat, typically requiring a minimum of 15 percent sagebrush canopy cover (Wallestad 1975). The Rough Fescue Community (1.1) is likely to have this minimum sagebrush cover for sage grouse presence given its low to moderate sagebrush canopy cover. Also, the potentially diverse forb component of the Reference State may provide important early-season (spring) foraging habitat for the greater sage grouse. Managed livestock grazing is suitable on this site due to the potential to produce an abundance of high-quality forage. This is often a preferred site for grazing by livestock, and animals tend to congregate in these areas. In order to maintain the productivity of the Shallow Loamy site, grazing on adjoining sites with less production must be managed carefully to be sure utilization on this site is not excessive. Management objectives should include maintenance or improvement of the native plant community. Careful management of the timing and duration of grazing is important. Shorter grazing periods and adequate deferment during the growing season are recommended for plant maintenance, health, and recovery. According to McLean et al., early-season defoliation of bluebunch wheatgrass can result in high mortality and reduced vigor in plants. They also suggest, based on prior studies, that regrowth is necessary before dormancy to reduce injury of bluebunch. Since needle and thread normally matures earlier than bluebunch wheatgrass and rough fescue and produces a sharp awn, this species is usually avoided after seed set. Changing the grazing season of use will help utilize needle and thread more efficiently while preventing overuse of bluebunch wheatgrass and rough fescue. The grazing season has more influence on winterfat than grazing intensity. Late winter or early spring grazing is detrimental. However, early winter grazing may actually be beneficial (Blaisdell 1984). Continual non-prescribed grazing of this site will be detrimental, will alter the plant composition and production over time, and will result in the transition to the Altered State. The transition to other states will depend on the duration of poorly managed grazing as well as other circumstances such as weather conditions and fire frequency. The Altered State is subject to further degradation to the Degraded State or Invaded State. Management should focus on grazing management strategies that will prevent further degradation, such as seasonal grazing deferment or winter grazing where feasible. Communities within this state are still stable and healthy under proper management. Forage quantity and/or quality may be substantially decreased from the Reference State. Grazing is possible in the Invaded State. Invasive species are generally less palatable than native grasses. Forage production is typically greatly reduced in this state. Due to the aggressive nature of invasive species, sites in the Invaded State face an increased risk of further degradation. Grazing has to be carefully managed to avoid further soil loss and degradation and possible livestock health issues. Prescriptive grazing can be used to manage invasive species. In some instances, carefully targeted grazing (sometimes in combination with other treatments) can reduce or maintain the species composition of invasive species. In the Degraded State, grazing may be possible but is generally not economically and/or environmentally sustainable.

Hydrological functions

The hydrologic cycle functions best in the Reference State (1) with good infiltration and deep percolation of rainfall; however, the cycle degrades as the vegetation community declines. Rapid rainfall infiltration, high soil organic matter, good soil structure, and good porosity accompany high bunchgrass canopy cover. High ground cover reduces raindrop impact on the soil surface, which keeps erosion and sedimentation transport low. Water leaving the site will have a minimal sediment load, which allows for high water quality in associated streams. High rates of infiltration will allow water to move below the rooting zone during periods of heavy rainfall. The Rough Fescue Community (1.1) should have no rills or gullies present, and drainage ways should be vegetated and stable. Water flow patterns, if present, will be barely observable. Plant pedestals are essentially nonexistent. Plant litter remains in place and is not moved by wind or water. Improper grazing management results in a community shift to the Mixed Bunchgrass Community (1.2). This plant community has a similar canopy cover, but the bare ground will be less than 15 percent. Therefore, the hydrologic cycle is functioning at a level similar to the water cycle in the Rough Fescue Community (1.1). In the Shortgrass Community (2.2), Degraded State (3) and the Invaded State (4) canopy and ground cover are greatly reduced compared to the Reference State (1), which impedes the hydrologic cycle. Infiltration will decrease and runoff will increase due to reduced ground cover, the presence of shallow-rooted species, rainfall splash, soil capping, reduced organic matter, and poor structure. Sparse ground cover and decreased infiltration can combine to increase the frequency and severity of flooding within a watershed. Soil erosion is accelerated, the quality of surface runoff is poor, and sedimentation increases. The hydrology of the Conifer Encroached State (5) is highly variable, but studies suggest that an increased tree canopy affects the interception of rainfall and reduces available soil moisture for herbaceous vegetation. This can negatively affect infiltration and increase runoff.

Recreational uses

This site provides recreational opportunities for wildlife viewing, hiking, horseback riding, big game hunting, and upland bird hunting. Some plants have flowers that appeal to photographers. This site provides valuable open space.

Wood products

none

Other products

none

Inventory data references

Information presented was derived from the site's Range Site Description, NRCS clipping data, literature, field observations, and personal contacts with range-trained personnel (i.e., used professional opinion of agency specialists, observations of land managers, and outside scientists).

References

Masters, R. and R. Sheley. 2001. Principles and practices for managing rangeland invasive plants. *Journal of Range Management* 38:21–26.

McCalla, G.R., W.H. Blackburn, and L.B. Merrill. 1984. Effects of Livestock Grazing on Infiltration Rates of the Edwards Plateau of Texas. *Journal of Range Management* 37:265–269.

McLean, A. and S. Wikeem. 1985. Influence of season and intensity of defoliation on bluebunch wheatgrass survival and vigor in southern British Columbia. *Journal of Range Management* 38:21–26.

Miller, R.F., T.J. Svejcar, and J.A. Rose. 2000. Impacts of western juniper on plant community composition and structure. *Journal of Range Management* 53:574–585.

Moulton, G.E. and T.W. Dunlay. 1988. The Journals of the Lewis and Clark Expedition. Pages in University of Nebraska Press.

Mueggler, W.F. and W.L. Stewart. 1980. Grassland and Shrubland Habitat Types of Western Montana.

Pelant, M., P. Shaver, D.A. Pyke, and J.E. Herrick. 2005. Interpreting Indicators of Rangeland Health.

Pellant, M. and L. Reichert. 1984. Management and Rehabilitation of a burned winterfat community in Southwestern Idaho. Proceedings--Symposium on the biology of *Atriplex* and related *Chenopods*. 1983 May 2-6; Provo UT General Technical Report INT-172.. USDA Forest Service Intermountain Forest and Range Experiment Station. 281–285.

Pitt, M.D. and B.M. Wikeem. 1990. Phenological patterns and adaptations in an *Artemisia/Agropyron* plant community. *Journal of Range Management* 43:350–357.

Pokorny, M.L., R. Sheley, C.A. Zabinski, R. Engel, T.J. Svejcar, and J.J. Borkowski. 2005. Plant Functional Group Diversity as a Mechanism for Invasion Resistance.

Wambolt, C. and G. Payne. 1986. An 18-Year Comparison of Control Methods for Wyoming Big Sagebrush in Southwestern Montana. *Journal of Range Management* 39:314–319.

West, N.E. 1994. Effects of Fire on Salt-Desert shrub rangelands. Proceedings--Ecology and Management of Annual Rangelands: 1992 May 18-22. Boise ID General Technical Report INT-GTR-313.. USDA Forest Service Intermountain Research Station. 71–74.

- Whitford, W.G., E.F. Aldon, D.W. Freckman, Y. Steinberger, and L.W. Parker. 1989. Effects of Organic Amendments on Soil Biota on a Degraded Rangeland. *Journal of Range Management* 41:56–60.
- Wilson, A.M., G.A. Harris, and D.H. Gates. 1966. Cumulative Effects of Clipping on Yield of Bluebunch wheatgrass. *Journal of Range Management* 19:90–91.
- . 1966. **Fire Effects Information System**. <http://www.fs.fed.us/database/feis/>.
- . 2021 (Date accessed). **USDA PLANTS Database**. <http://plants.usda.gov>.
- Arno, S.F. and G.E. Gruell. 1982. Fire History at the Forest-Grassland Ecotone in Southwestern Montana. *Journal of Range Management* 36:332–336.
- Barrett, H. 2007. *Western Juniper Management: A Field Guide*.
- Bestelmeyer, B., J.R. Brown, J.E. Herrick, D.A. Trujillo, and K.M. Havstad. 2004. Land Management in the American Southwest: a state-and-transition approach to ecosystem complexity. *Environmental Management* 34:38–51.
- Bestelmeyer, B. and J. Brown. 2005. State-and-Transition Models 101: A Fresh look at vegetation change.
- Blaisdell, J.P. 1958. Seasonal development and yield of native plants on the Upper Snake River Plains and their relation to certain climate factors.
- Blaisdell, J.P. and R.C. Holmgren. 1984. *Managing Intermountain Rangelands--Salt-Desert Shrub Ranges*. General Tech Report INT-163. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. 52.
- Bunting, S.C., B.M. Kilgore, and C.L. Bushey. 1987. *Guidelines for Prescribe burning sagebrush-grass rangelands in the Northern Great Basin*. General Technical Report INT-231. USDA Forest Service Intermountain Research Station, Ogden, UT. 33.
- Colberg, T.J. and J.T. Romo. 2003. Clubmoss effects on plant water status and standing crop. *Journal of Range Management* 56:489–495.
- Daubenmire, R. 1970. *Steppe vegetation of Washington*.
- DiTomaso, J.M. 2000. Invasive weeds in Rangelands: Species, Impacts, and Management. *Weed Science* 48:255–265.
- Dormaar, J.F., B.W. Adams, and W.D. Willms. 1997. Impacts of rotational grazing on mixed prairie soils and vegetation. *Journal of Range Management* 50:647–651.
- Hobbs, J.R. and S.E. Humphries. 1995. An integrated approach to the ecology and management of plant invasions. *Conservation Biology* 9:761–770.
- Kuchler, A.W. 1964. *Potential natural vegetation of the conterminous United States*.

Lacey, J.R., C.B. Marlow, and J.R. Lane. 1989. Influence of Spotted knapweed (*Centaurea maculosa*) on surface runoff and sediment yield.. *Weed Technology* 3:627–630.

Lesica, P. and S.V. Cooper. 1997. Presettlement vegetation of Southern Beaverhead County, MT.

Manske, L.L. 1980. Habitat, phenology, and growth of selected sandhills range plants.

Contributors

Petersen

Approval

Grant Petersen, 3/03/2025

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)	Grant Petersen
Contact for lead author	grant.petersen@usda.gov
Date	03/01/2020
Approved by	
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. Number and extent of rills: Rills will primarily be absent on gentle slopes however on the steepest of slopes of this site (greater than 30 percent) small, short rills (less than 2-3 feet) may be evident after high precipitation events.

2. Presence of water flow patterns: Water flow patterns are rare in the reference condition. If present, they are most likely to occur on steeper slopes (greater than 20 percent) and are inconspicuous, disconnected, and very short in length.

3. **Number and height of erosional pedestals or terracettes:** Pedestals are not evident in the reference condition

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is between 5 and 15 percent

5. **Number of gullies and erosion associated with gullies:** Gullies are not present in the reference condition.

6. **Extent of wind scoured, blowouts and/or depositional areas:** Wind scoured, or depositional areas are not evident in the reference condition.

7. **Amount of litter movement (describe size and distance expected to travel):** Movement of fine herbaceous litter may occur within less than a foot from where it originated.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil Surface Stable with Stability Ratings of 4-6 (both under canopy and bare). Biotic crusts and/or root mats may be present.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Structure trends to weak, fine granular. The A horizon is approximately 3 inches thick with wet Munsell colors Value 5 or less, Chroma 3 or less. Dry colors tend to be quite light prior to wetting. Official Series Description (OSD) for characteristic range.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Evenly distributed across the site, bunchgrasses improve infiltration while rhizomatous grass protects the surface from runoff forces. The Shallow Loamy ecological site is well drained and has a moderately rapid infiltration rate. An even distribution of mid stature grasses (approximately 65 to 70 percent of site production) with cool season rhizomatous grasses accounting for 10 percent of site production along with a mix of shortgrasses (5-15 percent), forbs and shrubs (5-10 percent each). Trees and tall coniferous shrubs may be present as a trace on this site (less than 1 stem per acre)

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** Not Present

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: Mid-statured, cool season, perennial bunchgrasses

Sub-dominant: perennial shortgrasses/grasslikes ? rhizomatous grasses ? shrubs = forbs >> trees

Other:

Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**
Mortality in herbaceous species is not evident. Species with bunch growth forms may have some natural mortality in centers.
-
14. **Average percent litter cover (%) and depth (in):** Total litter cover ranges from 30-35 percent. Most litter is irregularly distributed on the soil surface and is typically less than 1/2 inch deep.
-
15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**
Average annual production is 1265 pounds per acre (lbs/ac) or 1418 kilograms per hectare (kg/ha) Low: 940 lbs/acre or 1054 kg/ha High 1510 lb/ac or 1692 kg/ha Production varies based on effective precipitation and natural variability of soil properties for this ecological site.
-
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:** Potential invasive (including noxious) species (native and non-native). Invasive species on this ecological site include (but not limited to) annual brome spp., spotted knapweed, yellow toadflax, leafy spurge, ventenata, crested wheatgrass, etc. Native species such as Rocky Mountain juniper, ponderosa pine, Douglas fir, broom snakeweed, rabbitbrush spp., blue grama, Sandberg bluegrass, etc. when their populations are significant enough to affect ecological function, indicate site condition departure.
-
17. **Perennial plant reproductive capability:** In the reference condition, all plants are vigorous enough for reproduction either by seed or rhizomes in order to balance natural mortality with species recruitment. Density of plants indicates that plants reproduce at level sufficient to fill available resource.
-