

Ecological site EX043B23C176 Very Shallow (VS) Absaroka Subalpine Zone

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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): 043B–Central Rocky Mountains

Major Land Resource Unit (MLRA) 43B: Central Rocky Mountains

43B – Central Rocky Mountains – The Central Rocky Mountains extends from northern Montana to southern extent of Wyoming and from Idaho to central Wyoming. The southern extent of 43B is comprised of a combination of metamorphic, igneous, and sedimentary mountains and foothills. Climatic changes across this extent are broad and create several unique breaks in the landscape.

Further information regarding MLRAs, refer to: United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296.
Available electronically at: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053624#handbook.

LRU notes

Land Resource Unit (LRU) 43B23C: Absaroka Subalpine Zone

Based on the shifts in geology, precipitation patterns and other climatic factors, as well as elevation and vegetation, the Absaroka Range was divided into LRU 23. Further division of this LRU is necessary due to the gradient moving from the foothills to the summit, as well as aspect shifts (north/east face versus south/west face). Subset C is the high elevation zone noted for dense timber interspersed with open parks and longer persisting snowpack (within timberline). Precipitation can range from 18 to 20 plus inches and is more noted for the duration of snow cover and shorter growing season. To verify or identify Subset C (the referenced subset for this ecological site), refer to the Wyoming LRU matrix key contained within the Ecological Site Key.

This LRU/Subset occurs on the eastern divide of the Absaroka Range. This LRU starts north of Clark, WY and runs to the Thermopolis, WY area. Once the Absaroka Range merges with the Owl Creek and Wind River Ranges, the climatic patterns and elevational changes shifts the plant community and creates a break in the LRU/Subset.

The extent of soils currently correlated to this ecological site does not fit within the digitized boundary. Many of the noted soils are provisional and will be reviewed and corrected in mapping update projects. Other map units are correlated as small inclusions within other MLRA's/LRU's based on elevation, landform, and biological references.

Moisture Regime: Typic Ustic

Temperature Regime: Cryic

Dominant Cover: Rangeland – Sagebrush Steppe (major species is Mountain Big Sagebrush)

Representative Value (RV) Effective Precipitation: 20+ inches (508 mm)

RV Frost-Free Days: 31-65 days

Classification relationships

Relationship to Other Established Classification Systems:

National Vegetation Classification System (NVC):

2 Shrub & Herb Vegetation Class

2.B Temperate & Boreal Grassland & Shrubland Subclass

2.B.2 Temperate Grassland & Shrubland Formation

2.B.2.Na Western North American Grassland & Shrubland Division

M048 Central Rocky Mountain Montane-Foothill Grassland & Shrubland Macro-group

G273 Central Rocky Mountain Lower Montane, Foothill & Valley Grassland Group

Ecoregions (EPA):

Level I: 6 North Western Forested Mountains

Level II: 6.2 Western Cordillera

Level III: 6.2.10 Middle Rockies

Level IV: 6.2.17ao – Absaroka Volcanic Subalpine Zone

6.2.17i – Absaroka – Gallatin Volcanic Mountains

Ecological site concept

- Site receives no additional water.
- Slope is < 70%
- Soils are:
 - o Textures range from loamy sand to clay loam in top 4" (10 cm) of mineral soil surface
 - o Clay content is \leq 35% in top 4" (10 cm) of mineral soil surface
 - o All subsurface horizons have a weighted average of < 35% clay.
 - o very shallow (< 10 in. (25 cm))
 - o <3% stone and boulder cover and < 15% cobble and gravel cover
 - o Generally not skeletal (< 35% rock fragments) but occasionally will have up to 75% gravels and cobbles.

Associated sites

R043BY162WY	Shallow Loamy High Mountains Shallow Loamy
R043BY172WY	Stony High Mountains Stony

Similar sites

R043BY276WY	Very Shallow Foothills and Mountains West Very Shallow (VS) 15-19W has lower production.
R043BY172WY	Stony High Mountains Stony (St) 20+M has a high volume of coarse fragments.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) <i>Artemisia tridentata ssp. vaseyana</i>
Herbaceous	(1) <i>Pseudoroegneria spicata</i> (2) <i>Festuca idahoensis</i>

Legacy ID

R043BX776WY

Physiographic features

This site occurs in an upland position with steep slopes. It is prevalent on wind-swept ridges.

Table 2. Representative physiographic features

Landforms	(1) Mountain range > Mountain slope (2) Mountain range > Ridge (3) Mountain range > Escarpment
Runoff class	Negligible to high
Elevation	1,981–3,658 m
Slope	1–70%
Aspect	Aspect is not a significant factor

Climatic features

Annual precipitation and modeled relative effective annual precipitation range from 18 to 35 inches (457 – 889 mm). The normal precipitation pattern is evenly distributed through the year and averages over 20 inches. Annual snowfall averages 150 to 200 inches annually. Wide fluctuations may occur in yearly precipitation and result in more dry years than those with more than normal precipitation.

Because of the varied topography, the wind will vary considerably for different parts of the area. Prevailing winds are from the southwest, and strong winds are less frequent than over other areas of Wyoming. Occasional storms, however, can bring brief periods of high winds with gusts exceeding 50 mph.

Temperatures show a wide range between summer and winter and between daily maximums and minimums, due to the high elevation and dry air, which permits rapid incoming and outgoing radiation. Cold air outbreaks from Canada in winter move rapidly from northwest to southeast and account for extreme minimum temperatures. Chinook winds may occur in winter and bring rapid rises in temperature. High winds are generally blocked by high mountains but occur in conjunction with thunderstorms, which are common in late summer. Growth of native cool-season plants begins about June 1, but can be as late as July 15, and continues until the beginning of September.

For detailed information visit the Natural Resources Conservation Service National Water and Climate Center at <http://www.wcc.nrcs.usda.gov/>. Climate station representative of this precipitation zone include: “Cooke City 2W” and “Tower Falls”. The following graphs and charts are a collective sample representing the averaged normals and 30-year annual rainfall data for the selected weather stations from 1981 to 2010.

Table 3. Representative climatic features

Frost-free period (characteristic range)	1-2 days
Freeze-free period (characteristic range)	23-47 days
Precipitation total (characteristic range)	457-584 mm
Frost-free period (actual range)	1-2 days
Freeze-free period (actual range)	17-53 days
Precipitation total (actual range)	432-610 mm
Frost-free period (average)	2 days
Freeze-free period (average)	35 days
Precipitation total (average)	533 mm

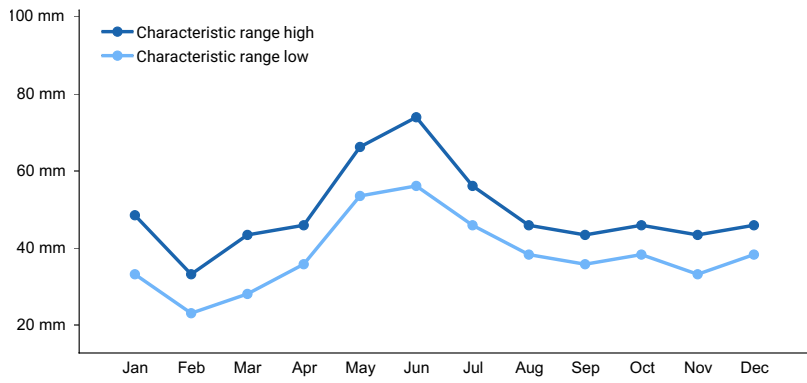


Figure 1. Monthly precipitation range

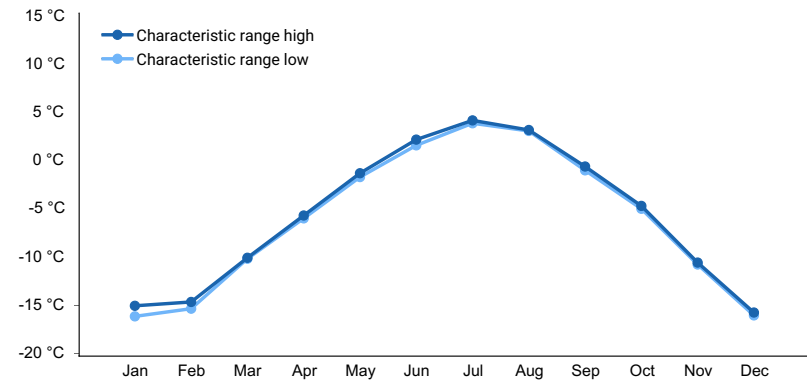


Figure 2. Monthly minimum temperature range

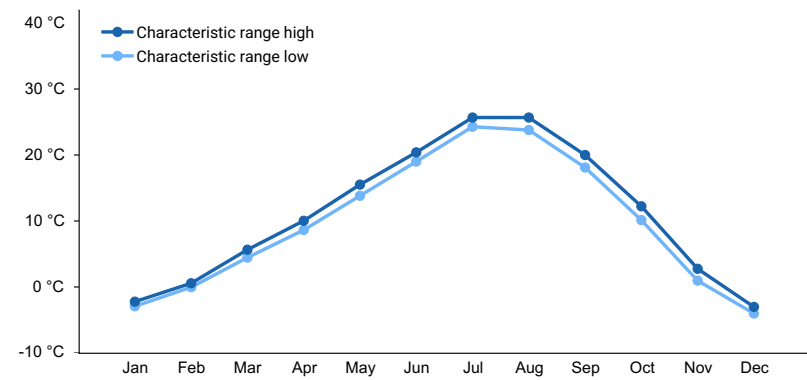


Figure 3. Monthly maximum temperature range

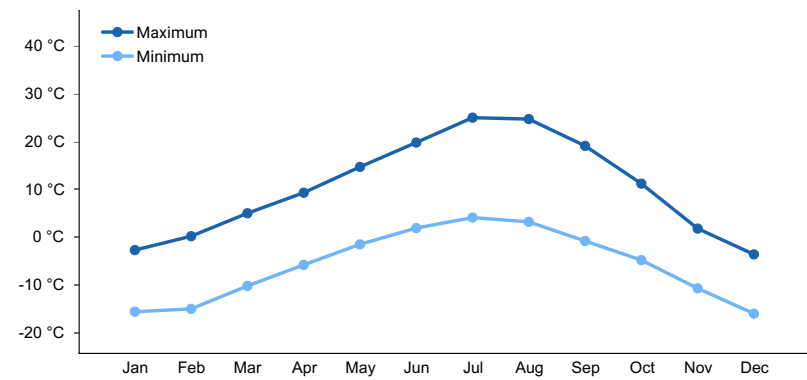


Figure 4. Monthly average minimum and maximum temperature

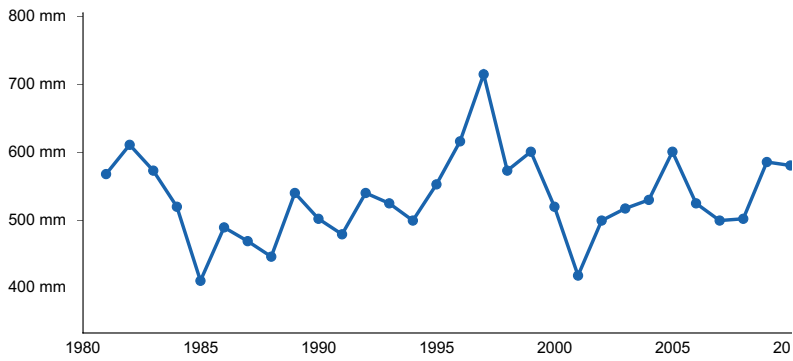


Figure 5. Annual precipitation pattern

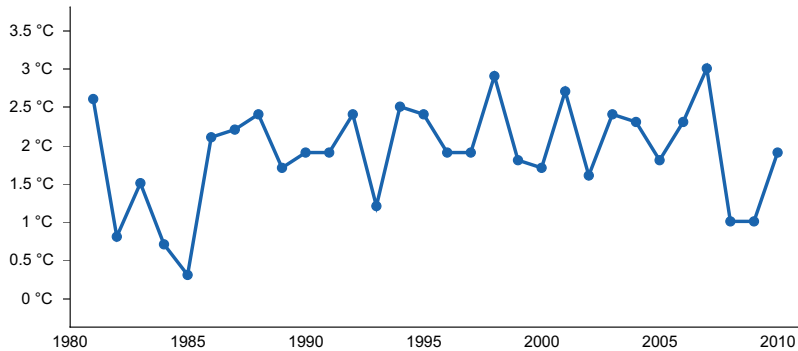


Figure 6. Annual average temperature pattern

Climate stations used

- (1) COOKE CITY 2 W [USC00241995], Gardiner, MT
- (2) TOWER FALLS [USC00489025], Yellowstone National Park, WY

Influencing water features

The characteristics of these upland soils have no influence from ground water (water table below 60 inches (150 cm)) and have minimal influence from surface water/overland flow. There may be isolated features that are affected by snow pack that persists longer than surrounding areas due to position on the landform (shaded/protected pockets).

Soil features

Soils of this site are generally less than 10 inches deep, but will include areas of exposed bedrock and pockets of deep soil. Bedrock, of all types except igneous and soft clay shale, may be fractured which allows shrub species to grow. Soils are well-drained, and infiltration is good above bedrock. Runoff commonly occurs from these sites due to shallow soils and limited water storage capacity.

Table 4. Representative soil features

Parent material	(1) Colluvium–sedimentary rock (2) Residuum
Surface texture	(1) Gravelly sandy loam (2) Channery fine sandy loam (3) Flaggy loam (4) Sandy clay loam
Family particle size	(1) Loamy
Drainage class	Well drained to somewhat excessively drained
Permeability class	Moderately slow to rapid

Depth to restrictive layer	3–25 cm
Soil depth	3–25 cm
Surface fragment cover ≤3"	10–40%
Surface fragment cover >3"	0–30%
Available water capacity (0-101.6cm)	1.78–3.81 cm
Calcium carbonate equivalent (0-101.6cm)	0–15%
Electrical conductivity (0-101.6cm)	0–4 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–5
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume ≤3" (Depth not specified)	10–40%
Subsurface fragment volume >3" (Depth not specified)	10–30%

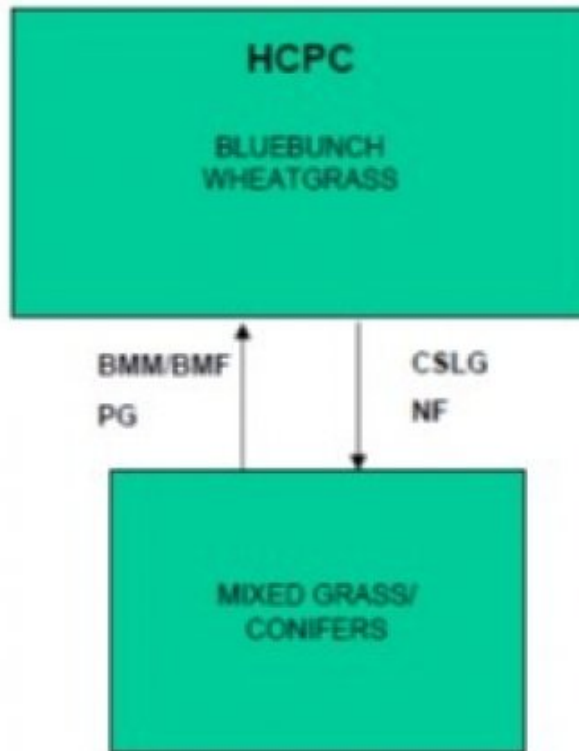
Ecological dynamics

As this site deteriorates, species such as rhizomatous wheatgrass, snowberry, green rabbitbrush, and mountain muhly will increase. Cool season bunchgrasses such as bluebunch wheatgrass, Idaho fescue, and spike fescue will decrease in frequency and production. This site has relatively low productivity potential, and is not well suited to grazing improvement practices unless treated as part of a larger unit containing more productive areas.

The Historic Climax Plant Community (description follows the plant community diagram) has been determined by study of rangeland relic areas, or areas protected from excessive disturbance. Trends in plant communities going from heavily grazed areas to lightly grazed areas, seasonal use pastures, and historical accounts have also been used.

The following is a State and Transition Model Diagram that illustrates the common plant communities (states) that can occur on the site and the transitions between these communities. The ecological processes will be discussed in more detail in the plant community narratives following the diagram.

State and transition model



BMA – Brush Management (all methods)
BMC – Brush Management (chemical)
BMF – Brush Management (fire)
BMM – Brush Management (mechanical)
CSP – Chemical Seedbed Preparation
CSLG – Continuous Season-long Grazing
DR – Drainage
CSG – Continuous Spring Grazing
HB – Heavy Browse
HCSLG – Heavy Continuous Season-long Grazing
HI – Heavy Inundation
LPG – Long-term Prescribed Grazing
MT – Mechanical Treatment (chiseling, ripping, pitting)

NF – No Fire
NS – Natural Succession
NWC – Noxious Weed Control
NWI – Noxious Weed Invasion
NU – Nonuse
P&C – Plow & Crop (including hay)
PG – Prescribed Grazing
RPT – Re-plant Trees
RS – Re-seed
SGD – Severe Ground Disturbance
SHC – Severe Hoof Compaction
WD – Wildlife Damage (Beaver)
WF – Wildfire

Bluebunch Wheatgrass Plant Community (HCPC)

Community 1.1

Bluebunch Wheatgrass Plant Community (HCPC)

The interpretive plant community for this site is the Historic Climax Plant Community. Potential vegetation is estimated at 65% grasses or grass-like plants, 10% forbs, and 25% woody plants. The major grasses include bluebunch wheatgrass, Idaho fescue, spike fescue, and thickspike wheatgrass. Other grasses include Canby, big, and mutton bluegrass, prairie junegrass, Letterman and Columbia needlegrass, California and timber oatgrass, mountain brome, mountain muhly, oniongrass, bentgrass, slender wheatgrass, and spike trisetum. Bitterbrush is the dominant woody plant. Other woody plants may include mountain big sagebrush, chokecherry, serviceberry, snowberry, limber pine, and Rocky Mountain juniper. A typical plant composition for this state consists of bluebunch wheatgrass 35-45%, Idaho fescue 5-10%, spike fescue 5-10%, thickspike wheatgrass 5-10%, other grasses and grass-like plants 10-20%, perennial forbs 5-10%, bitterbrush 5-10% and 5-15% other woody plants. Ground cover, by ocular estimate, varies from 15-25%. The total annual production (air-dry weight) of this state is about 800 pounds per acre, but it can range from about 600 lbs./acre in unfavorable years to about 1000 lbs./acre in above average years. The following is the growth curve of this plant community expected during a normal year: Growth curve number: WY0101 Growth curve name: 20+M, UPLAND SITES Growth curve description: ALL UPLAND SITES JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC 0 0 0 0 5 30 40 20 5 0 0 0 (Monthly percentages of total annual growth) The state is stable and well adapted to the Central Rocky Mountains climatic conditions. The diversity in plant species allows for high drought resistance. This is a sustainable plant community (site/soil stability, watershed function, and biologic integrity Transitions or pathways leading to other plant communities are as follows: • Continuous Season-long Grazing and No Fire will convert the plant community to the Mixed Grass/Conifer State.

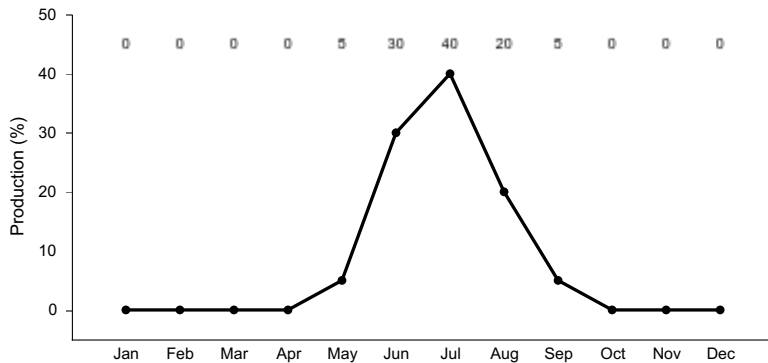


Figure 8. Plant community growth curve (percent production by month). WY0101, 20+ upland sites.

State 2

Mixed Grass/Conifer Plant Community

Community 2.1

Mixed Grass/Conifer Plant Community

This plant community is a result of long-term continuous grazing and lack of fire. Conifers have encroached along ridges and near fractures in bedrock and pockets of deep soil. This state is commonly found on exposed, windswept ridges that are subject to harsh climatic conditions as well as severe winter use due to their exposed nature. The total annual production (air-dry weight) of this state is about 400 pounds per acre, but it can range from about 200 lbs./acre in unfavorable years to about 600 lbs./acre in above average years. The following is the growth curve of this plant community expected during a normal year: Growth curve number: WY0101 Growth curve name: 20+M, UPLAND SITES Growth curve description: ALL UPLAND SITES JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC 0 0 0 0 5 30 40 20 5 0 0 0 (Monthly percentages of total annual growth) The state is stable and protected from excessive erosion. The biotic integrity of this plant community is usually intact, however forage value will decrease and wildlife values will shift toward different species. The watershed is functioning. Transitional pathways leading to other plant communities are as follows: • Brush Management and Prescribed Grazing will eventually return this state to near Historic Climax Plant Community (Bluebunch Wheatgrass State).

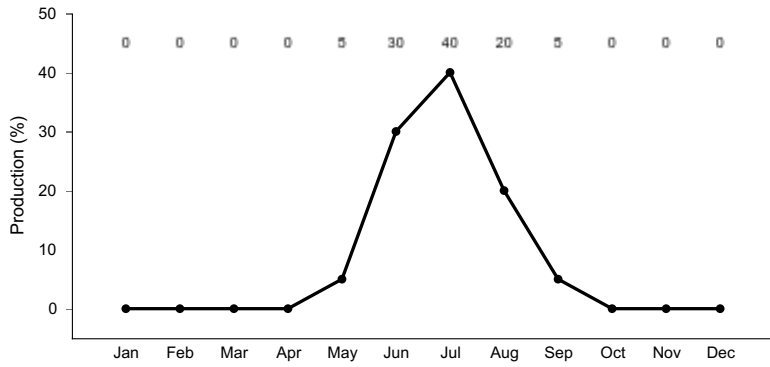


Figure 9. Plant community growth curve (percent production by month). WY0101, 20+ upland sites.

Additional community tables

Table 5. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1				314–404	
	bluebunch wheatgrass	PSSP6	<i>Pseudoroegneria spicata</i>	314–404	–
2				45–90	
	Idaho fescue	FEID	<i>Festuca idahoensis</i>	45–90	–
3				45–90	
	spike fescue	LEKI2	<i>Leucopoa kingii</i>	45–90	–
4				45–90	
	thickspike wheatgrass	ELLAL	<i>Elymus lanceolatus ssp. lanceolatus</i>	45–90	–
5				90–179	
	Grass, perennial	2GP	<i>Grass, perennial</i>	0–45	–
	Letterman's needlegrass	ACLE9	<i>Achnatherum lettermanii</i>	0–45	–
	Columbia needlegrass	ACNE9	<i>Achnatherum nelsonii</i>	0–45	–
	bentgrass	AGROS2	<i>Agrostis</i>	0–45	–
	mountain brome	BRMA4	<i>Bromus marginatus</i>	0–45	–
	California oatgrass	DACA3	<i>Danthonia californica</i>	0–45	–
	timber oatgrass	DAIN	<i>Danthonia intermedia</i>	0–45	–
	slender wheatgrass	ELTR7	<i>Elymus trachycaulus</i>	0–45	–
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	0–45	–
	oniongrass	MEBU	<i>Melica bulbosa</i>	0–45	–
	mountain muhly	MUMO	<i>Muhlenbergia montana</i>	0–45	–
	muttongrass	POFE	<i>Poa fendleriana</i>	0–45	–
	spike trisetum	TRSP2	<i>Trisetum spicatum</i>	0–45	–
Forb					
6				45–90	
	Forb, perennial	2FP	<i>Forb, perennial</i>	0–45	–
	common yarrow	ACMI2	<i>Achillea millefolium</i>	0–45	–
	pussytoes	ANTEN	<i>Antennaria</i>	0–45	–

	sandwort	ARENA	<i>Arenaria</i>	0–45	–
	milkvetch	ASTRA	<i>Astragalus</i>	0–45	–
	balsamroot	BALSA	<i>Balsamorhiza</i>	0–45	–
	hawksbeard	CREPI	<i>Crepis</i>	0–45	–
	draba	DRABA	<i>Draba</i>	0–45	–
	fleabane	ERIGE2	<i>Erigeron</i>	0–45	–
	buckwheat	ERIOG	<i>Eriogonum</i>	0–45	–
	elkweed	FRSP	<i>Frasera speciosa</i>	0–45	–
	sunflower	HELIA3	<i>Helianthus</i>	0–45	–
	flax	LINUM	<i>Linum</i>	0–45	–
	stoneseed	LITHO3	<i>Lithospermum</i>	0–45	–
	desertparsley	LOMAT	<i>Lomatium</i>	0–45	–
	creeping barberry	MARE11	<i>Mahonia repens</i>	0–45	–
	bluebells	MERTE	<i>Mertensia</i>	0–45	–
	ragwort	PACKE	<i>Packera</i>	0–45	–
	phlox	PHLOX	<i>Phlox</i>	0–45	–
	stonecrop	SEDUM	<i>Sedum</i>	0–45	–
	ragwort	SENEC	<i>Senecio</i>	0–45	–
	aster	SYMPH4	<i>Symphyotrichum</i>	0–45	–
	clover	TRIFO	<i>Trifolium</i>	0–45	–
	American vetch	VIAM	<i>Vicia americana</i>	0–45	–
Shrub/Vine					
7				45–90	
	antelope bitterbrush	PUTR2	<i>Purshia tridentata</i>	45–90	–
8				45–135	
	Shrub, deciduous	2SD	<i>Shrub, deciduous</i>	0–45	–
	Shrub, evergreen	2SE	<i>Shrub, evergreen</i>	0–45	–
	Tree, deciduous	2TD	<i>Tree, deciduous</i>	0–45	–
	Tree, evergreen	2TE	<i>Tree, evergreen</i>	0–45	–
	Saskatoon serviceberry	AMAL2	<i>Amelanchier alnifolia</i>	0–45	–
	mountain big sagebrush	ARTRV	<i>Artemisia tridentata ssp. vaseyana</i>	0–45	–
	yellow rabbitbrush	CHVI8	<i>Chrysothamnus viscidiflorus</i>	0–45	–
	Rocky Mountain juniper	JUSC2	<i>Juniperus scopulorum</i>	0–45	–
	limber pine	PIFL2	<i>Pinus flexilis</i>	0–45	–
	chokecherry	PRVI	<i>Prunus virginiana</i>	0–45	–
	snowberry	SYMPH	<i>Symphoricarpos</i>	0–45	–

Animal community

Animal Community – Wildlife Interpretations

Bluebunch Wheatgrass Plant Community (HCPC): When blown clear, this plant community provides winter and spring forage for large grazers when snow depth prevents foraging on other sites. Otherwise, it is mostly used by wildlife in transit to other habitats.

Mixed Grass/Conifer Plant Community: This plant community may be useful for the same wildlife that would use the Historic Climax Plant Community. However, the plant community composition is less diverse, and thus, less apt to meet the seasonal needs of these animals.

Animal Community – Grazing Interpretations

The following table lists suggested stocking rates for cattle under continuous season-long grazing under normal growing conditions. These are conservative estimates that should be used only as guidelines in the initial stages of the conservation planning process. Often, the current plant composition does not entirely match any particular plant community (as described in this ecological site description). Because of this, a field visit is recommended, in all cases, to document plant composition and production. More precise carrying capacity estimates should eventually be calculated using this information along with animal preference data, particularly when grazers other than cattle are involved. Under more intensive grazing management, improved harvest efficiencies can result in an increased carrying capacity. If distribution problems occur, stocking rates must be reduced to maintain plant health and vigor.

Plant Community Production Carrying Capacity*
(lb./ac) (AUM/ac)
Bluebunch Wheatgrass (HCPC) 600-1000 0.25
Mixed Grass/Conifer 200-600 0.1

* - Continuous, season-long grazing by cattle under average growing conditions.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide yearlong forage for cattle, sheep, or horses. During the dormant period, the forage for livestock use needs to be supplemented with protein because the quality does not meet minimum livestock requirements.

Hydrological functions

Water and soil depth are the principal factors limiting forage production on this site. This site is dominated by soils in hydrologic group C and D. Infiltration ranges from very slow to slow. Runoff potential for this site varies from moderate to high depending on soil hydrologic group, depth and fracturing of bedrock, slope, and ground cover (refer to Part 630, NRCS National Engineering Handbook for detailed hydrology information).

Rills and gullies may be present, but should be small. Water flow patterns should be barely distinguishable. Pedestals are only slightly present in association with bunchgrasses such as bluebunch wheatgrass. Litter typically falls in place, and signs of movement are not common. Chemical and physical crusts are rare to non-existent. Cryptogammic crusts are present, but only cover 1-2% of the soil surface.

Recreational uses

This site provides hunting opportunities for upland game species. Wildflowers that bloom throughout the growing season have esthetic values that appeal to visitors.

Wood products

No appreciable wood products are present on the site.

Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range trained personnel were also used. Those involved in developing this site include: Bill Christensen, Range Management Specialist, NRCS; Karen Clause, Range Management Specialist, NRCS; and Everet Bainter, Range Management Specialist, NRCS. Other sources used as references include USDA NRCS Water and Climate Center, USDA NRCS National Range and Pasture Handbook, USDI and USDA Interpreting Indicators of Rangeland Health Version 3, and USDA NRCS Soil Surveys from various counties.

Information presented here has been derived from NRCS inventory data, Field observations from range trained personnel, and the existing range site descriptions. Those involved in developing the Loamy range site include: Karen Clause, Range Management Specialist, NRCS and Everet Bainter, Range Management Specialist.

Those involved in the development of the new concept for Loamy and Loamy Calcareous Ecological site include: Ray Gullion, Area Range Management Specialist, NRCS; Jim Wolf, Resource Manager, USDI-BLM; Jack Mononi, Range Management Specialist, USDI-BLM; Daniel Wood, MLRA Soil Survey Leader, NRCS; Jane Karinen, Soil Data Quality Specialist, NRCS; and Marji Patz, Ecological Site Specialist, NRCS.

Inventory Data References:

Ocular field estimations observed by trained personnel were completed at each site. Then sites were selected where a 100-foot tape was stretched, and the following sample procedures were completed by inventory staff. For full sampling protocol and guidelines with forms please refer to the Wyoming ESI Operating Procedures, compiled in 2012 for the Powell and Rock Springs Soil Survey Office, USDA-NRCS.

- Double Sampling Production Data (4.8 square foot hoop used to estimate 10 points, clipped a minimum of 2 of these estimated points, with two 21-foot X 21-foot square extended shrub plots).
- Line Point Intercept (over story and understory captured with soil cover). Height of herbaceous and woody cover is collected every three feet along established transect.)
- Continuous Line Intercept (Woody Canopy Cover, with minimum gap of 0.2 of a foot for all woody species and succulents. Intercept height collected at each measurement.),
- Gap Intercept (Basal Gap measured with a minimum gap requirement of 0.7 foot.),
- Sample Point (10 – 1-meter square point photographs taken at set distances on transect. Red using the sample point computer program established by the High Plains Agricultural Research Center, WY).
- Soil Stability (Slake Test – surface and subsurface samples collected and processed according to the soil stability guidelines provided by the Jornada Research Center, NM.)

Other references

Baker, William L. 2006. Fire and Restoration of Sagebrush Ecosystems. *Wildlife Society Bulletin* 34(1): 177-185.

Bestelmeyer, B., and J. R. Brown. 2005. State-and-transition models 101: a fresh look at vegetation change. *The Quivira Coalition Newsletter*, Vol. 7, No. 3.

Bestelmeyer, B., J. R. Brown, K. M. Havstad, B. Alexander, G. Chavez, J. E. Herrick. 2003. Development and use of state and transition models for rangelands. *Journal of Range Management* 56(2):114-126.

Bestelmeyer, B., J. E. Herrick, J. R. Brown, 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(1):38-51.

Herrick, J. E., J. W. Van Zee, K. M. Havstad, L. M. Burkett, and W. G. Whitford. 2005. Monitoring manual for grassland, shrubland and savanna Ecosystems. Volume I Quick Start. USDA - ARS Jornada Experimental Range, Las Cruces, New Mexico.

Herrick, J. E., J. W. Van Zee, K. M. Havstad, L. M. Burkett, and W. G. Whitford. 2005. Monitoring manual for grassland, shrubland and savanna Ecosystems. Volume II: Design, supplementary methods and interpretation. USDA - ARS Jornada Experimental Range, Las Cruces, New Mexico.

NRCS. 2014. (electronic) National Water and Climate Center. Available online at <http://www.wcc.nrcs.usda.gov/>

NRCS. 2014. (electronic) Field Office Technical Guide. Available online at http://efotg.nrcs.usda.gov/efotg_locator.aspx?map=WY NRCS. 2009. Plant Guide: Cheatgrass. Prepared by Skinner et al., National Plant Data Center.

Pellant, M., P. Shaver, D. A. Pyke, and J. E. Herrick. 2005. Interpreting indicators of rangeland health. Version 4. Technical Reference 1734-6.

USDI-BLM. Ricketts, M. J., R. S. Noggles, and B. Landgraf-Gibbons. 2004. Pryor Mountain Wild Horse Range

Survey and Assessment. USDA-Natural Resources Conservation Service.

Schoeneberger, P. J., D. A. Wysocki, E. C. Benham, and Soil Survey Staff. 2012. Field book for describing and sampling soils, Version 3.0. Natural Resources Conservation Service, National Soil Survey Center, Lincoln, NE. (<http://soils.usda.gov/technical/fieldbook/>)

Stringham, T. K. and W. C. Krueger. 2001. States, transitions, and thresholds: Further refinement for rangeland applications. Agricultural Experiment Station, Oregon State University. Special Report 1024.

Stringham, T. K., W. C. Kreuger, and P. L Shaver. 2003. State and transition modeling: an ecological process approach. *Journal of Range Management* 56(2):106-113.

United States Department of Agriculture. Soil Survey Division Staff. 1993. Soil Survey Manual, United States Department of Agriculture Handbook No. 18, Chapter 3: Examination and Description of Soils. Pg.192-196.

USDA, NRCS. 1997. National Range and Pasture Handbook. (<http://www.glti.nrcs.usda.gov/technical/publications/nrph.html>)

Trlica, M. J. 1999. Grass growth and response to grazing. Colorado State University. Cooperative Extension. Range. Natural Resource Series. No. 6.108.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA/NRCS). 2007. The PLANTS Database (<http://plants.usda.gov>). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA/NRCS), Soil Survey Staff. 2010. Keys to Soil Taxonomy, Eleventh Edition, 2010.

USDA/NRCS Soil survey manuals for appropriate counties within MLRA 43B.

Western Regional Climate Center. (2014) (electronic) Station Metadata. Available online at: <http://www.wrcc.dri.edu/summary/climsmwy.html>.

Contributors

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Approval

Scott Woodall, 10/05/2019

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.

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Date	03/16/2007
Approved by	E. Bainter
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Some rills to be expected on this site.

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

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

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground can range from 15-45%.

5. **Number of gullies and erosion associated with gullies:** Active gullies, where present, should be rare.

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

7. **Amount of litter movement (describe size and distance expected to travel):** Herbaceous litter expected to move in moderate amounts. Large woody debris will show only slight movement down slope.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil Stability Index ratings range from 1 (interspaces) to 6 (under plant canopy), but average values should be 3.0 or greater.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil data is limited for this site. Soil Organic Matter of 4-6% is expected.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Plant community consists of 65-80% grasses, 10% forbs, and 10-25% shrubs/trees. Sparse plant canopy (40-60%) and litter plus slow to moderate infiltration rates result in slight to moderate runoff. Basal cover is typically less than 10% and marginally affects runoff on this site. Surface rock outcrop of 10-30% provide stability to the site, but reduce infiltration. Runoff can be rapid on this site with a moderate to high erosion hazard associated with steep slopes on this site.

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

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-size, cool season bunchgrasses

Sub-dominant: perennial shrubs/trees=perennial forbs=cool season rhizomatous grasses

Other: short, cool season bunchgrasses

Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Minimal decadence, typically associated with shrub component.
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14. **Average percent litter cover (%) and depth (in):** Litter ranges from 10-30% of total canopy measurement with total litter (including beneath the plant canopy) from 30-50% expected. Herbaceous litter depth typically ranges from 3-10 mm. Woody litter can be up to several inches (>6 cm).
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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** English: 600-1000 lb/ac (800 lb/ac average); Metric 672-1120 kg/ha (896 kg/ha average).
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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:** Bare ground greater than 60% is the most common indicator of a threshold being crossed. Rabbitbrush, Sandberg bluegrass, buckwheat, yarrow, and phlox are common increasers. Annual weeds such as cheatgrass and mustards are common invasive species on disturbed sites.
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17. **Perennial plant reproductive capability:** All species are capable of reproducing, except in extreme drought years.
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