

Ecological site R048AY007NM Mountain Shale

Last updated: 3/05/2024
Accessed: 04/20/2024

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.

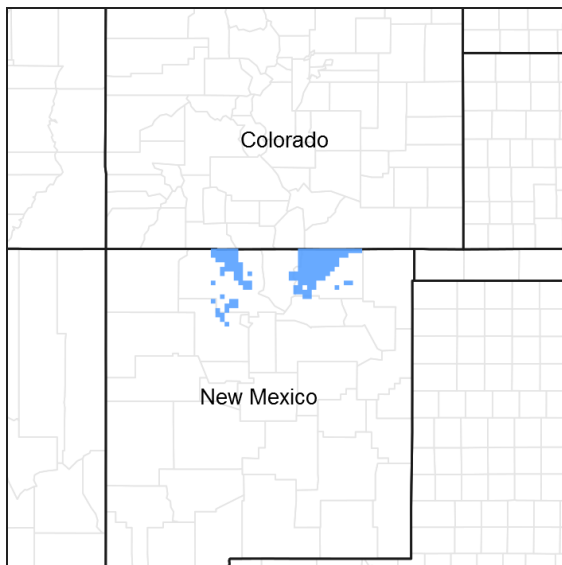


Figure 1. Mapped extent

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): 048A–Southern Rocky Mountains

This area is in Colorado (76 percent), New Mexico (11 percent), Utah (8 percent), and Wyoming (5 percent). It makes up about 45,920 square miles (119,000 square kilometers). The towns Jemez Springs, Los Alamos, Red River and Eagle Nest, New Mexico, are in this MLRA. This MLRA has numerous national forests, the Carson National Forest and part of the Santa Fe National Forest in New Mexico. The Jemez, Picuris, Santa Clara, and Taos Indian Reservations are in this MLRA. Most of this area is in the Southern Rocky Mountains Province of the Rocky Mountain System. Small parts of the southwest corner and some isolated areas farther west are in the Canyon Lands Section of the same province and division. The Southern Rocky Mountains consist primarily of two belts of strongly sloping to precipitous mountain ranges trending north to south. Several basins, or parks, are between the belts. The ranges include the Sangre de Cristo Mountains, Jemez Mountains, and Tusas Mountains. Elevation typically ranges from 6,500 to 13,167 feet (1,980 to 1,039 meters) in this area. The Rio Grande is a National Wild and Scenic River in northern New Mexico, which is in the southern part of this MLRA.

The mountains in this area were formed mainly by crustal uplifts during the late Cretaceous and early Tertiary periods. The rocks exposed in the mountains are mostly Precambrian igneous and metamorphic rocks, which in many places are flanked by steeply dipping Mesozoic sedimentary rocks. Younger igneous rocks, primarily basalt and andesitic lava flows, tuffs, breccias, and conglomerates, are throughout this area. Representative formations in this area are the Silver Plume and Pikes Peak granites, San Juan Volcanics, and Mancos Shale. Many of the

highest mountain ranges were reshaped by glaciation during the Pleistocene. Alluvial fans at the base of the mountains are recharge zones for local basin and valley fill aquifers. They also are important sources of sand and gravel.

The dominant soil orders in this MLRA are Mollisols, Alfisols, Inceptisols, and Entisols. The soils in the area dominantly have a frigid or cryic soil temperature regime and an ustic or udic soil moisture regime. Mineralogy is typically mixed, smectitic, or paramicaceous. In areas with granite, gneiss, and schist bedrock, Glossocryalfs (Seitz, Granile, and Leadville series) and Haplocryolls (Rogert series) formed in colluvium on mountain slopes. Dystrocryepts (Leighcan and Mummy series) formed on mountain slopes and summits at the higher elevations. In areas of andesite and rhyolite bedrock, Dystrocryepts (Endlich and Whitecross series) formed in colluvium on mountain slopes. In areas of sedimentary bedrock, Haplustolls (Towave series) formed on mountain slopes at low elevations and with low precipitation. Haplocryolls (Lamphier and Razorba series), Argicryolls (Cochetopa series), and Haplocryalfs (Needleton series) formed in colluvium on mountain slopes at high elevations.

LRU notes

This site is part of the RM-1 sub-resource area. This site is found on the east side of Sangre de Cristo mountains.

Classification relationships

This ecological site is correlated to soil components at the Major Land Resource Area (MLRA) level which is further described in USDA AgHandbook 296.

Ecological site concept

This site is located in mountainous terrain on mountain slopes and hillslopes. Slopes are dominantly moderately steep to steep with gradients varying from 15 to 75 percent. Topography varies from relatively uniform slopes of considerable length to short, steep, choppy terrain. Elevation ranges from 7,000 to 9,000 feet above sea level.

This site consists of soils that are shallow to moderately deep and are well drained. The surface texture is very stony clay, very stony clay loam, cobbly loam, and stony silty clay loam soils. The soils are derived from shale parent material. The effective rooting depth is 5 to 40 inches. Shale and sandstone outcrops are common. The subsoil is typically compacted clay, which restricts root penetration.

Associated sites

R048AY004NM	<p>Mountain Loam</p> <p>This site is on steep to moderately steep slopes on benches within the steeper slopes of the surrounding ponderosa pine tree zone. The slope is to the southwest; south and southeast, making the site directly exposed to the dry south and southwest winds and more intensive heat from the sun. Slopes vary from 5 to 70 percent. Elevation ranges from 6,900 to 9,000 feet above sea level. The soils on this site are moderately deep to deep and well drained. The surface texture is stony/cobbly silt loam or cobbly loam. The subsurface is stony loam or cobbly loam. They have a moderate permeability. The available water-holding capacity is low. Effective rooting depth is from 20 to 40 inches. There is cobble or stone throughout the profile and on the surface. Air-water-plant relationship is fair.</p>
R048AY003NM	<p>Mountain Valley</p> <p>This site is in mountain valleys in the ponderosa pine zone. It has gentle to moderate slopes and receives occasional light overflow from the stream course or adjacent side slopes. The alluvial slopes immediately adjacent to the stream are also included in this site. Slopes are 0-5%. Along valley bottoms where drainage is poor, it may blend with the Mountain Meadow ecological site. This site differs from the Mountain Meadow ecological site in the lack of high-water table. Elevation ranges from 7,000 to 9,000 feet above sea level. Soils on this site are well drained and deep to very deep. The surface layer is loam, sandy loam or fine sandy loam with subsoil of loam, clay loam, or sandy clay loam. These soils have moderate to moderately high permeability. Runoff is medium. Available water-holding capacity is high. Effective rooting depth is 20 inches to more than 60 inches. Severe gullying can carry off most of the water, and a loss of topsoil greatly reduces water intake. Gullies that carry off extra water will drastically alter the moisture-plant relationship in many areas.</p>

Similar sites

R048AY008NM	<p>Mountain Brush</p> <p>This site is located on the sides of basalt-capped mesas and escarpments of sandstone, basalt, shale and limestone. This site is formed on the upland leading away from vertical basalt escarpments and basalt-capped mesas. They are formed from a variety of materials derived from sandstone, basalt, shale and limestone. Rock outcrop is common and may occupy from 15 percent to 50 percent of the area. Slopes range from 5 to 25 percent. The exposure is mainly to the east, south and west. However, this site may occur on the drier north-facing slopes. North and east-facing slopes are generally more productive and tend to grow more woody vegetation. Elevation ranges from 7,500 to 9,000 feet above sea level. The soils on this site are shallow, well drained over sandstone, shale, basalt and limestone. Rock outcrops are common and occupy the nearly vertical basalt escarpments, ridges and benches of exposed sandstone, limestone and shale. Rubbleland occurs at the base of the basalt escarpments. The surface textures is usually clay loam and the subsoils are clay loam and clayey shale. The surface runoff is medium too rapid and the erosion hazard is severe. Effective rooting depth is from 12 to 20 inches.</p>
R048AY009NM	<p>Mountain Breaks</p> <p>This site occurs on mesa and canyon side-slopes and other mountain breaks. The site consists of productive areas interspersed with areas of low production, rock outcrop and badland. Slopes and exposure vary. Slopes range from 9 to 45 percent. Elevation ranges from 9,100 to 10,500 feet above sea level. Soil depths is deep. Surface texture is generally a gravelly loam. Subsoils range from gravelly clay loam, gravelly sandy clay loam to very gravelly sandy clay loam. The soil profile is generally high in rock fragments. Boulders are scattered about the site. There usually are pockets on the site where run-in of precipitation results in good soil-moisture relationships. Occurs in RM-2.</p>
R048AY015NM	<p>Mountain Shale Dry</p> <p>This site occurs on nearly level to sloping landscapes below steeper slopes of interbedded sandstone and shale. Slopes range from 1 to 35 percent. Elevation ranges from 6,800 to 7,700 feet above sea level. Soil depths range from shallow to moderately deep. Surface textures are generally clay loam and are very thin. Subsoils are generally clays. The amount of surface skeletal fragments varies from no fragments to very channery and erosion pavement forms as the surface is eroded. Permeability is slow to very slow. This ecological site used to have the ID number of R048BY008NM in RM-2 subresource area in 1982.</p>

Table 1. Dominant plant species

Tree	(1) <i>Juniperus scopulorum</i> (2) <i>Pinus edulis</i>
Shrub	(1) <i>Cercocarpus montanus</i> (2) <i>Symphoricarpos albus</i>
Herbaceous	(1) <i>Bouteloua gracilis</i> (2) <i>Pascopyrum smithii</i>

Physiographic features

This site is located in mountainous terrain. Slopes are dominantly moderately steep to steep with gradients varying from 15 to 75 percent where steeper slopes make grazing use by domestic livestock impossible. Topography varies from relatively uniform slopes of considerable length to short, steep, choppy terrain. Mountainous topography in the ponderosa pine zone and shale soils is considered to belong to this site even if separated from the main mountain chain. North and east-facing slopes are generally more productive and tend to grow more tall trees, but in many cases, are not significantly higher in potential or range forage. In some cases, this site is on the dryer, north-facing slopes being forested. Elevation ranges from 7,000 to 9,000 feet above sea level.

Table 2. Representative physiographic features

Landforms	(1) Mountain slope (2) Hillslope
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	7,000–9,000 ft
Slope	15–75%

Aspect	N, E
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Climatic features

Climate conditions for this site are typical of the lower elevation limits of the Rocky Mountains. Average annual precipitation ranges from 16 to 22 inches. Most of the precipitation received is in the form of rain from heavy thunderstorms during the hottest summer months. Winter and spring moisture is an important facet of this site and determines production of the cool-season species. Summer moisture received during the principal growing season of July, August and September determines the production of the principal warm-season grasses. Summer precipitation accounts for approximately 60 percent of the total annual precipitation, although at a moderately high elevation, the climatic features of this site are not too unlike sites at lower elevations in that precipitation amounts fluctuate greatly from year to year. Annual amounts commonly range from 8 to 35 inches. Spring precipitation in the latter part of March may be sufficient in some years to contribute greatly to the production of both warm and cool-season forage plants.

Air temperatures vary from a monthly mean of 29 degrees F in January to 69 degrees F in July. Daily high temperatures average in the 80's during the summer. Winter low temperatures fall below the freezing mark much of the time from mid-September through April. Date of the last killing frost is approximately May 15th. The first killing frost is approximately October 3rd. The dates of the last killing frost and the first killing frost vary from lower elevations to the higher elevation points.

The frost-free season ranges from 90 to 140 days, from mid-May through early October. The frost-free period is important only in the limiting of the production of the warm-season species that are present on the site.

Mountain winds are an important part of the climatic complex of this site, because of their indirect effect on soil and moisture and translocation of seed.

Table 3. Representative climatic features

Frost-free period (characteristic range)	34-40 days
Freeze-free period (characteristic range)	86 days
Precipitation total (characteristic range)	16-22 in
Frost-free period (actual range)	33-42 days
Freeze-free period (actual range)	86 days
Precipitation total (actual range)	16-22 in
Frost-free period (average)	37 days
Freeze-free period (average)	86 days
Precipitation total (average)	19 in

Climate stations used

- (1) EAGLE NEST [USC00292700], Eagle Nest, NM
- (2) ANGEL FIRE 1S [USC00290407], Cimarron, NM

Influencing water features

This site is not influenced by water from a wetland or stream.

Figure 7-1 The hydrologic cycle with factors that affect hydrologic processes

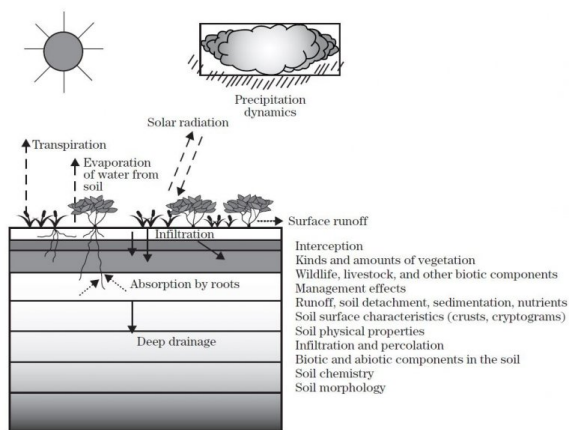


Figure 8.

Soil features

This site consists of soils that are shallow to moderately deep and are well drained. The surface texture is very stony clay, very stony clay loam, cobbly loam, and stony silty clay loam soils. The soils are derived from shale parent material. The effective rooting depth is 5 to 40 inches. Shale and sandstone outcrops are common. The subsoil is typically compacted clay, which restricts root penetration. Soils of this site on the steeper slopes are conducive to the development of geological slides when completely saturated. Runoff is rapid to very rapid, and water erosion hazard is severe. When in a dry condition, the soils require as much as 2 inches of moisture to wet a foot of soil. For this reason, light showers fail to penetrate deep enough to be used for plant growth.

Soils associated with this site are:
Midnight, Cueva and Rombo

Table 4. Representative soil features

Parent material	(1) Alluvium–sandstone and shale (2) Colluvium–sandstone and shale (3) Alluvium–shale (4) Slope alluvium–shale
Surface texture	(1) Very stony clay (2) Very stony clay loam (3) Cobbly silty clay loam (4) Cobbly loam (5) Clay
Family particle size	(1) Fine
Drainage class	Well drained
Permeability class	Moderate to slow
Soil depth	5–40 in
Surface fragment cover <=3"	5–20%
Surface fragment cover >3"	15–30%
Available water capacity (Depth not specified)	1.5–4 in
Calcium carbonate equivalent (Depth not specified)	0–5%
Electrical conductivity (Depth not specified)	0–2 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0–1

Soil reaction (1:1 water) (Depth not specified)	6.1–7.8
Subsurface fragment volume <=3" (Depth not specified)	10–25%
Subsurface fragment volume >3" (Depth not specified)	10–25%

Ecological dynamics

Continuous grazing during the growing season will cause the potential plant community to deteriorate. Most of the dominant grasses will decrease as the ecological condition declines. Species most likely to invade under these conditions are ring muhly, rabbitbrush, pingue and Kentucky bluegrass. Species most likely to increase as the ecological conditions decline are Gambel oak, sleepygrass, threeawn spp., broom snakeweed and sagebrush. Oak brush may completely dominate the plant community.

Below is a State and Transition Model diagram to illustrate the “phases” (common plant communities), and “states” (aggregations of those plant communities) that can occur on the site. Differences between phases and states depend primarily upon observations of a range of disturbance histories in areas where this ESD is represented. These situations include grazing gradients to water sources, fence-line contrasts, patches with differing dates and intensities of fire, herbicide treatment, etc. Reference State 1 illustrates the common plant communities that probably existed just prior to European settlement.

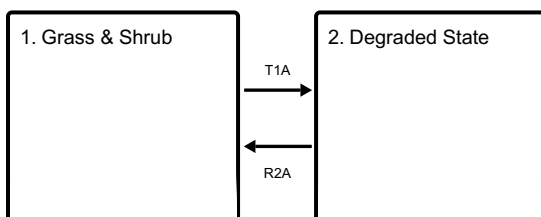
The major successional pathways within states, (“community pathways”) are indicated by arrows between phases. “Transitions” are indicated by arrows between states. The drivers of these changes are indicated in codes decipherable by referring to the legend at the bottom of the page and by reading the detailed narratives that follow the diagram.

The plant communities shown in this State and Transition Model may not represent every possibility but are probably the most prevalent and recurring plant communities. As more monitoring data are collected, some phases or states may be revised, removed, and/or new ones may be added.

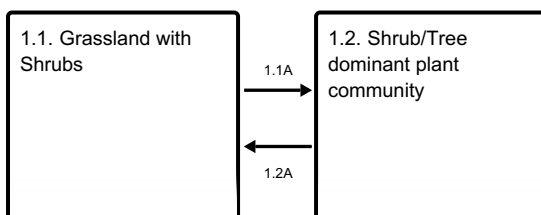
The state and transition model was added to comply with the provisional ecological site instruction. It is a very general model.

State and transition model

Ecosystem states



State 1 submodel, plant communities



State 1 Grass & Shrub

This state represents the natural range of variability on the site. The plant communities within the reference state were shaped and maintained by disturbances such as grazing, browsing, drought, wet years, and fire. The removal

or alteration of these processes can cause a shift to an alternative state. Continuous grazing during the growing season will cause the potential plant community to deteriorate. Most of the dominant grasses will decrease as the ecological condition declines.

Community 1.1 Grassland with Shrubs

The aspect of this site is a grass and shrubs dominated plant community; however, 65 to 75 percent of the annual production is made up of grasses and forbs. The vegetation of this site is composed of a mixture of both warm-season and cool-season grasses, forbs and shrubs whose relative composition percentage is dependent upon climatic and grazing factors. Grasses have a relative composition of approximately 65 percent. Shrub species are subdominant and display a percentage composition of about 25 percent; forbs make up approximately 10 to 15 percent of the vegetation complex. Oak brush is the dominant shrub on this site. Scattered, light, open stands of ponderosa pine may give this site a savannah aspect. Pinyon-juniper stands are encountered at the lower elevations of this site. Tree species associated with the site are ponderosa pine, pinyon pine and juniper species. Overstory canopy cover is less than 5 percent.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	325	553	780
Shrub/Vine	125	212	780
Forb	50	85	120
Total	500	850	1680

Table 6. Ground cover

Tree foliar cover	0-5%
Shrub/vine/liana foliar cover	20-30%
Grass/grasslike foliar cover	15-25%
Forb foliar cover	0-10%
Non-vascular plants	0%
Biological crusts	0%
Litter	5-15%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	10-20%

Figure 10. Plant community growth curve (percent production by month). NM3107, R048AY007NM Mountain Shale HCPC. R048AY007NM Mountain Shale HCPC Mixed warm and cool-season grassland with a major component of shrubs and a minor component of forbs. .

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	3	5	10	10	25	30	12	5	0	0

Community 1.2 Shrub/Tree dominant plant community

Shrubs and trees have increased in canopy cover to be the dominant plants on the site. This has altered the hydrology and energy flow of the plant community. If grazing and browsing of the site persist, palatable species may

decrease in be replaced by invasive or less desirable plants.

Pathway 1.1A Community 1.1 to 1.2

Lack of fire, improper grazing of herbaceous species, lack of insects and disease, and/or drought.

Pathway 1.2A Community 1.2 to 1.1

Proper grazing, browsing of shrubs, active insects and pathogens are present on the site; fire and/or wet climatic cycles.

State 2 Degraded State

This state represents a shift from the reference state. The site has crossed a threshold that will require significant inputs to return to reference conditions, if possible. This has altered the hydrology and energy flow of the plant community. Continuous grazing during the growing season will cause the potential plant community to deteriorate. Most of the dominant grasses will decrease as the ecological condition declines. Species most likely to invade under these conditions are ring muhly, rabbitbrush, pingue rubberweed, and Kentucky bluegrass. Species most likely to increase as the ecological conditions decline are Gambel oak, sleepygrass, threeawn., broom snakeweed and big sagebrush. Oak brush may completely dominate the plant community.

Transition T1A State 1 to 2

Removal of periodic fire may result in an increase in woody canopy across the site. Improper grazing will cause desirable species to decrease and less desirable species to increase Long term drought can also have an impact on the shifting structure and composition of the plant community.

Restoration pathway R2A State 2 to 1

Fire, wetter climatic cycles, and/or proper grazing management can help return the plant community back to grassland. Shrub/tree management may be needed to decrease shrubs and/or trees.

Additional community tables

Table 7. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1				102–128	
	blue grama	BOGR2	<i>Bouteloua gracilis</i>	102–128	–
2				102–128	
	western wheatgrass	PASM	<i>Pascopyrum smithii</i>	102–128	–
3				102–128	
	little bluestem	SCSC	<i>Schizachyrium scoparium</i>	102–128	–
4				68–85	
	sideoats grama	BOCU	<i>Bouteloua curtipendula</i>	68–85	–
5				68–85	
	alkali sacaton	SPAI	<i>Sporobolus airoides</i>	68–85	–
6				26–43	

	mountain muhly	MUMO	<i>Muhlenbergia montana</i>	26–43	–
7				26–43	
	Arizona fescue	FEAR2	<i>Festuca arizonica</i>	26–43	–
8				26–43	
	sedge	CAREX	<i>Carex</i>	26–43	–
9				26–43	
	James' galleta	PLJA	<i>Pleuraphis jamesii</i>	–	–
10				50–90	
	Grass, native	2GN	<i>Grass, native</i>	26–43	–
	Indian ricegrass	ACHY	<i>Achnatherum hymenoides</i>	26–43	–
	needle and thread	HECOC8	<i>Hesperostipa comata ssp. comata</i>	26–43	–
	prairie Junegrass	KOMA	<i>Koeleria macrantha</i>	26–43	–
	mountain brome	BRMA4	<i>Bromus marginatus</i>	0–15	–
	muttongrass	POFE	<i>Poa fendleriana</i>	0–15	–
	pine dropseed	BLTR	<i>Blepharoneuron tricholepis</i>	0–15	–
	spike muhly	MUWR	<i>Muhlenbergia wrightii</i>	0–15	–
	threeawn	ARIST	<i>Aristida</i>	0–15	–
Forb					
11				50–90	
	common yarrow	ACMI2	<i>Achillea millefolium</i>	26–43	–
	lupine	LUPIN	<i>Lupinus</i>	26–43	–
	vetch	VICIA	<i>Vicia</i>	26–43	–
	clover	TRIFO	<i>Trifolium</i>	26–43	–
	geranium	GERAN	<i>Geranium</i>	26–43	–
	buckwheat	ERIOG	<i>Eriogonum</i>	26–43	–
	pea	LATHY	<i>Lathyrus</i>	26–43	–
	Forb, native	2FN	<i>Forb, native</i>	26–43	–
	ragwort	PACKE	<i>Packera</i>	0–10	–
	cinquefoil	POTEN	<i>Potentilla</i>	0–10	–
Shrub/Vine					
12				100–130	
	oak	QUERC	<i>Quercus</i>	102–128	–
13				50–100	
	Shrub (>.5m)	2SHRUB	<i>Shrub (>.5m)</i>	26–51	–
	sagebrush	ARTEM	<i>Artemisia</i>	26–43	–
	alderleaf mountain mahogany	CEMO2	<i>Cercocarpus montanus</i>	26–43	–
	snowberry	SYMPH	<i>Symphoricarpos</i>	26–43	–
	broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	0–10	–
	winterfat	KRLA2	<i>Krascheninnikovia lanata</i>	0–10	–
Tree					
14				20–50	
	oneseed juniper	JUMO	<i>Juniperus monosperma</i>	9–27	–

twoneedle pinyon	PIED	<i>Pinus edulis</i>	9-27	-
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Animal community

Grazing:

Approximately 75 to 80 percent of the total annual yield are from species that furnish forage for grazing and browsing animals. This site is adapted for late spring, summer and early fall grazing. Distribution of domestic livestock is a problem on this site. All ages and classes of livestock prefer to graze the flatter slopes, leaving the steeper slopes ungrazed. Some of the steeper slopes are not suitable for grazing by domestic livestock because of the high erosion hazard on such soils. Goats would be best suited to graze this site. A younger age of domestic livestock would be better suited to this site due to the steep slopes and surface rock. The large variety of grasses, forbs and shrubs provide a good balanced feed and excellent nutrition for all grazing and browsing animals.

A system of deferred grazing, which varies the time and season of grazing and rest in the pastures in successive years, is needed to maintain or to improve a healthy well-balanced plant community.

Habitat for Wildlife:

This site provides habitats, which support a resident animal community that is characterized by mule deer, mountain cottontail, rock squirrel, Stephen's woodrat, western harvest mouse and rufus-sided towhee. Elk will use these sites during the winter months.

Hydrological functions

The runoff curve numbers are determined by field investigations using hydrologic cover conditions and hydrologic soil groups.

Hydrologic Interpretations

Soil Series-----Hydrologic Group

Cueva-----D

Midnight-----D

Rombo-----C

Recreational uses

This site provides limited recreation potential due to the steep slopes and stoniness of the soil surface. Hunting for mule deer is fair to good.

Wood products

Some pinyon-juniper and ponderosa pine can furnish limited firewood and fence posts.

Other information

Guide to Suggested Initial Stocking Rate Acres per Animal Unit Month

Similarity Index-----Ac/AUM

100 - 76-----4.5 - 6.7

75 - 51-----6.0 - 10.7

50 - 26-----8.8 - 16.0

25 - 0-----16.0+

Inventory data references

Data collection for this site was done in conjunction with the progressive soil surveys within the State of New Mexico. This site is found in the following soil surveys: Colfax, Taos, Mora, Santa Fe National Forest (Pecos-Las Vegas Ranger District), and San Miguel.

These site descriptions were developed as part of a Provisional ESD project using historic soil survey manuscripts, available range site descriptions.

Other references

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.

Contributors

Don Sylvester
Elizabeth Wright

Approval

Kirt Walstad, 3/05/2024

Acknowledgments

Site Development and Testing Plan:

Future work, as described in a Project Plan, to validate the information in this Provisional Ecological Site Description is needed. This will include field activities to collect low, medium and high intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document. Annual reviews of the Project Plan are to be conducted by the Ecological Site Technical Team.

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	04/20/2024
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

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

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

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

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

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

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

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

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

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

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

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

Dominant:

Sub-dominant:

Other:

Additional:

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

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

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

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

17. **Perennial plant reproductive capability:**
