USDA Natural Resources
Conservation Service

# Ecological site R069XY058CO
# Limestone Breaks

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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.

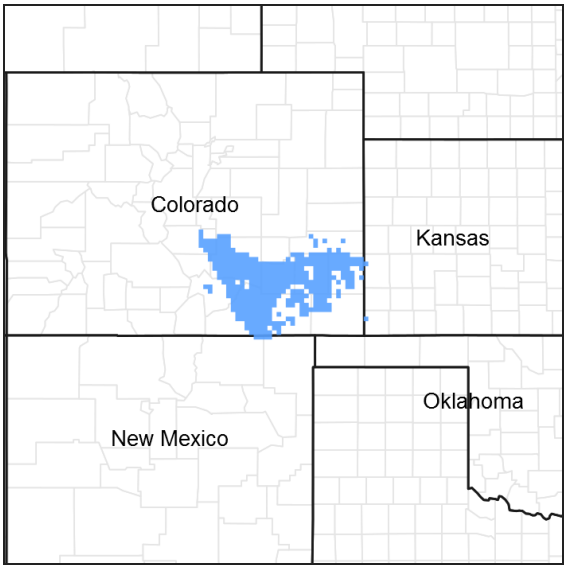



**Figure 1. Mapped extent**

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): 069X–Upper Arkansas Valley Rolling Plains

MLRA 69 is in the Arkansas Watershed of southeastern (SE) Colorado. It consists of rolling plains, river valleys, and canyonlands. The Arkansas River flows from the Rocky Mountains to Kansas. Tributaries include the Huerfano and Purgatoire Rivers. The MLRA is traversed by Interstate 25 and U.S. Highway 50, and includes the cities of Pueblo, La Junta, and Lamar. Other cities include Cañon City, and Walsenburg. Bent's Fort was once a major trading post along the Santa Fe Trail. The majority of land use is rangeland (greater than 75 percent), and 6 percent cropland. The remainder is urban, recreation, etc. Land ownership is mostly private. Federal lands include U.S. Forest Service Comanche National Grassland, Department of Defense Piñon Canyon Maneuver Site and Fort Carson. There is a minor amount of Bureau of Land Management and other federal land. State areas include Pueblo and John Martin reservoirs. Elevations MLRA-wide are 3,700 to 6,400 feet.

The "Dust Bowl" region (1930s) included SE Colorado, which is periodically affected by severe drought. Dust storms may form during drought years, in windy periods. Annual precipitation is 10 to 16 inches. Precipitation occurs mostly during the growing season, often during rapidly developing thunderstorms. Mean annual air temperature (MAAT) is 48 to 52 degrees Fahrenheit. Summer temperatures may exceed 100 degrees Fahrenheit. Evapotranspiration rates are high. Winter temperatures may be subzero. Snowfall varies from 20 to 40 inches per year. Blizzards can form quickly.

## Classification relationships

MLRA 69 is in the Piedmont and Raton Sections of the Great Plains Province. The MLRA is further defined by Land Resource Units (LRUs) A, B, and C. The modal concepts of each LRU can be defined by soil properties and annual precipitation zones (PZ). Other features, such as climate, geology, landforms, and key vegetation, further refine these concepts and are described in the Ecological Site Description (ESD).

LRU A (10 to 12 inches PZ) is 2.4 million acres in the central portion of MLRA 69. There is irrigated cropland in the Arkansas Valley. Precipitation is too limited for dryland crops. Most of LRU A is rangeland, and includes the Comanche National Grassland (USFS). This LRU is in portions of Bent, Crowley, Otero, and Pueblo counties. Soil Moisture Regime is Ustic Aridic. The Mean Annual Air Temperature (MAAT) is 51 to 54 degrees Fahrenheit.

LRU B (12 to 14 inches PZ) is 4.7 million acres and includes portions of Baca, Bent, Crowley, El Paso, Fremont, Kiowa, Las Animas, Lincoln, Prowers, and Pueblo counties. Most of the LRU is in rangeland. Land uses include irrigated and dry cropland, small acreage and urban ownership. Land east of Interstate 25 remains largely agricultural. Canyonlands are in the southern half and include Piñon Canyon Maneuver Site and the Picket Wire Canyon of the Comanche National Grasslands. Soil moisture regime is Ustic Aridic. The mean annual air temperature is 50 to 54 degrees Fahrenheit.

The Limestone Breaks Ecological Site, LRUs A and B, was developed from an earlier version of the Limestone Breaks Ecological Site (2005, revised in 2007). This earlier version of the Limestone Breaks Ecological Site (2005) was based on input from Natural Resources Conservation Service (formerly Soil Conservation Service) and historical information obtained from the Limestone Breaks Range Site descriptions (1975, revised 1983). This ESD meets the Provisional requirements of the National Ecological Site Handbook (NESH). This ESD will continue refinement towards an Approved status according to the NESH.

## Ecological site concept

This ecological site occurs in an upland position on slopes of greater than 10 percent. The soil depth is less than 20 inches to limestone bedrock.

## Associated sites

| | |
|---|---|
| R069XY042CO | **Clayey Plains**<br>This ecological site is commonly adjacent. |
| R069XY048CO | **Shale Breaks**<br>This ecological site is commonly adjacent. |
| R069XY006CO | **Loamy Plains**<br>This ecological site is commonly adjacent. |
| R069XY047CO | **Alkaline Plains**<br>This ecological site is commonly adjacent. |
| R069XY064CO | **Gravel Breaks**<br>This ecological site is commonly adjacent. |
| R069XY046CO | **Shaly Plains**<br>This ecological site is commonly adjacent. |

## Similar sites

| | |
|---|---|
| R069XY048CO | **Shale Breaks**<br>This ecological site is over shale bedrock. |
| R069XY053CO | **Sandstone Breaks**<br>This ecological site is over sandstone bedrock. |
| R069XY064CO | **Gravel Breaks**<br>This ecological site has a soil depth of greater than 20 inches, and is influenced by rock fragments. |

**Table 1. Dominant plant species**

| | |
|---|---|
| Tree | (1) *Juniperus monosperma*<br>(2) *Pinus edulis* |
| Shrub | (1) *Artemisia bigelovii*<br>(2) *Krascheninnikovia lanata* |
| Herbaceous | (1) *Bouteloua curtipendula*<br>(2) *Hesperostipa neomexicana* |

## Physiographic features

This site occurs on plains.

**Table 2. Representative physiographic features**

| | |
|---|---|
| Landforms | (1) Hill<br>(2) Ridge<br>(3) Scarp<br>(4) Hogback<br>(5) Mesa<br>(6) Cuesta |
| Runoff class | Low to very high |
| Flooding frequency | None |
| Ponding frequency | None |
| Elevation | 1,128–1,951 m |
| Slope | 1–65% |
| Ponding depth | 0 cm |
| Water table depth | 152 cm |
| Aspect | Aspect is not a significant factor |

## Climatic features

Approximately 75 percent of the annual precipitation occurs during the growing season from mid-April to late September. Snowfall can vary greatly from year to year and can range from 20 to 40 inches per year. Winds are estimated to average 6 to 7 miles per hour annually. Daytime winds are generally stronger than nighttime winds. Occasional strong storms may bring brief periods of high winds with gusts to more than 60 miles per hour. The average length of the freeze-free period (28 °F) is 168 days. The average last freeze in the spring is April 22nd, and the average date of first freeze in fall is October 7th. The average length of the frost-free period (32 °F) is 149 days. The last frost in the spring is May 5th, and the average date for first frost in the fall (32 °F), is October 1. July is the hottest month, and January is the coldest. It is not uncommon for temperature to exceed 100 degrees Fahrenheit during the summer. Summer humidity is low and evaporation is high. The winters are characterized with frequent northerly winds, producing severe cold and temperatures dropping to -30 degrees Fahrenheit.

LRU A, in the Arkansas River Valley, is the hottest and driest portion of the MLRA. Mean Annual Precipitation (MAP) is 10 to 12 inches, and Mean Annual Air Temperature (MAAT) is 51 to 54 degrees Fahrenheit. LRU B is the largest extent. MAP is 12 to 14 inches, and MAAT is 50 to 54 degrees Fahrenheit.

**Table 3. Representative climatic features**

| | |
|---|---|
| Frost-free period (characteristic range) | 127-134 days |
| Freeze-free period (characteristic range) | 149-161 days |
| Precipitation total (characteristic range) | 305-356 mm |
| Frost-free period (actual range) | 121-135 days |
| Freeze-free period (actual range) | 141-164 days |
| Precipitation total (actual range) | 279-406 mm |

| | |
|---|---|
| Frost-free period (average) | 129 days |
| Freeze-free period (average) | 153 days |
| Precipitation total (average) | 330 mm |

## Climate stations used

- (1) EADS [USC00052446], Eads, CO
- (2) ORDWAY 21 N [USC00056136], Ordway, CO
- (3) PUEBLO RSVR [USC00056765], Pueblo, CO
- (4) PUEBLO MEM AP [USW00093058], Pueblo, CO
- (5) LA JUNTA 20 S [USC00054726], La Junta, CO
- (6) CHERAW 1 N [USC00051539], La Junta, CO
- (7) ROCKY FORD 2 SE [USC00057167], Rocky Ford, CO
- (8) ORDWAY 2 ENE [USC00056131], Ordway, CO
- (9) TACONY 13 SE [USC00058157], Boone, CO

## Influencing water features

There is no influential water table or wetland associated with this site.

## Wetland description

N/A

## Soil features

The soils of this site are very shallow or shallow. They are well drained with moderate slow through moderately rapid permeability. The surface layer thickness ranges from 2 to 6 inches. The soil moisture regime is ustic aridic. The soil temperature regime is mesic. Parent material kind is slope alluvium over residuum weathered from limestone. Parent material originated from limestone.

Major soil series correlated to this ecological site include Penrose.

Revisions to soil surveys are on-going. For the most recent updates, visit the Web Soil Survey, the official site for latest soils information: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.

**Table 4. Representative soil features**

| | |
|---|---|
| Parent material | (1) Alluvium–limestone |
| Surface texture | (1) Channery loam |
| Family particle size | (1) Loamy |
| Drainage class | Well drained |
| Permeability class | Moderately slow to moderately rapid |
| Soil depth | 23–51 cm |
| Surface fragment cover <=3" | 0–35% |
| Surface fragment cover >3" | 0–5% |
| Available water capacity (0-101.6cm) | 9.14–20.32 cm |
| Calcium carbonate equivalent (0-101.6cm) | 5–75% |

| | |
|---|---|
| Electrical conductivity (0-101.6cm) | 0–4 mmhos/cm |
| Sodium adsorption ratio (0-101.6cm) | 0–10 |
| Soil reaction (1:1 water) (0-101.6cm) | 7.4–9 |
| Subsurface fragment volume <=3" (Depth not specified) | 0–35% |
| Subsurface fragment volume >3" (Depth not specified) | 0–5% |

## Ecological dynamics

The information in this ESD, including the state-and-transition model (STM), was developed using archeological and historical data, professional experience, and scientific studies. The information is representative of a complex set of plant communities. The plant composition has been determined by study of rangeland relic areas, areas protected from excessive disturbance, seasonal-use pastures, short-duration or time-controlled grazing strategies, and historical accounts.

Not all scenarios or plants are included. Key indicator plants, animals, and ecological processes are described to inform land management decisions.

This region was historically occupied by large grazing animals, such as bison, along with pronghorn and mule deer. Deer and pronghorn are widely distributed throughout the MLRA. This is an important site for livestock grazing, especially cattle.

Drought has historically impacted the vegetation of this region. Changes in species composition vary depending upon the duration and severity of the drought cycle and prior grazing management. Recent drought events have increased mortality of blue grama significantly in some locales, along with other bunchgrasses, such as sand bluestem, little bluestem, needle and thread, Fendler threeawn, and squirreltail. Historic fire frequency (pre-industrial) is estimated at 15 to 20 years (Guyette, 2012), randomly distributed, and started by lightning at various times throughout the growing season. Early human inhabitants were also likely to start fires (deliberate or accidental).

The site is dominated by mid warm-season bunchgrasses (sideoats grama and little bluestem), mid cool-season bunchgrass (New Mexico Feathergrass), and short warm-season bunchgrass (blue grama). Secondary grasses are mid warm-season rhizomatous grass (galleta), and mid cool-season rhizomatous grass (western wheatgrass). Minor grasses include short warm-season bunchgrass (hairy grama, hairy tridens), mid cool-season bunchgrasses (needle and thread, Indian ricegrass and green needlegrass), and tall warm-season bunchgrass (big bluestem). Various shrubs (Bigelow sagebrush, fourwing saltbush, winterfat) and forbs (American vetch, dotted gayfeather, and purple prairieclover), occur on the site and are subdominant in composition. Other minor grasses and grass-likes are littleseed ricegrass, ring muhly, and sun sedge). Trees such as oneseed juniper and pinyon pine are present in minor amounts.

Continuous grazing without allowing for adequate recovery opportunities between grazing events causes this site to deteriorate. Grasses such as little bluestem, sideoats grama, big bluestem, switchgrass, yellow Indiangrass, New Mexico feathergrass, western wheatgrass, and needle and thread decrease in both frequency and production. Blue grama, hairy grama, and galleta increase. Forbs and shrubs such as purple prairie clover, American vetch, winterfat, and fourwing saltbush decrease. Mid- and tallgrasses can eventually be removed from the plant community. Over the long-term, heavy, continuous use results in large amounts of bare ground. Species such as Fendler's threeawn, sand dropseed, mat loco, sessile nailwort, small soapweed, broom snakeweed, and annuals increase or invade the site.

Drier and warmer climatic conditions exist in the central portion of MLRA 69. This area includes the eastern half of Pueblo county, northern Otero, extreme northwestern Bent, western edge of Kiowa, southern edge of Lincoln and all of Crowley County. These conditions are primarily caused by a rain shadow effect from the southern Rocky

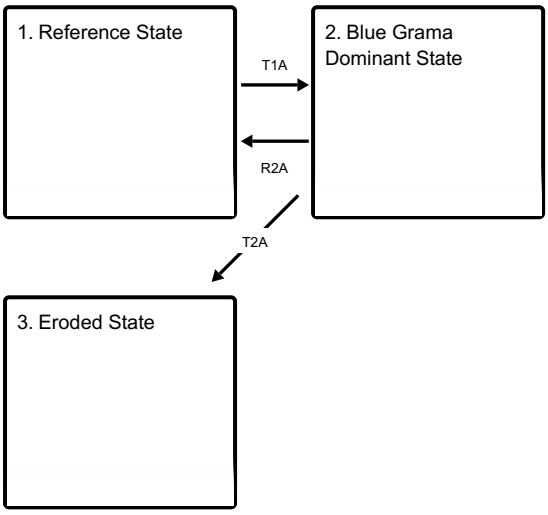
Mountains. Evapotranspiration rates (atmospheric demand) are higher in this area of MLRA 69. Total annual production is typically lower.

Southeastern Colorado was strongly affected by extended drought conditions in the “Dust Bowl” period of the 1930s, with recurrent drought cycles in the 1950s and 1970s. Extreme to exceptional drought conditions have re-visited the area from 2002 to 2012, with brief interludes of near normal to normal precipitation years. “During periods of drought, high winds give rise to the dust storms which are especially characteristic of the southeastern plains (WRCC, 2022).” Recent drought events have increased mortality of blue grama upwards of 80 percent in some locales. The long-term effects of these latest drought years have yet to be determined.

Growth of native cool-season plants begins about April 15 and continues to mid-June. Native warm-season plants begin growth about May 1 and continue to about August 15. Regrowth of cool-season plants occurs in September and October in most years, depending on moisture. For detailed information, visit the Western Regional Climate Center website at https://wrcc.dri.edu/.

## State and transition model

**Ecosystem states**

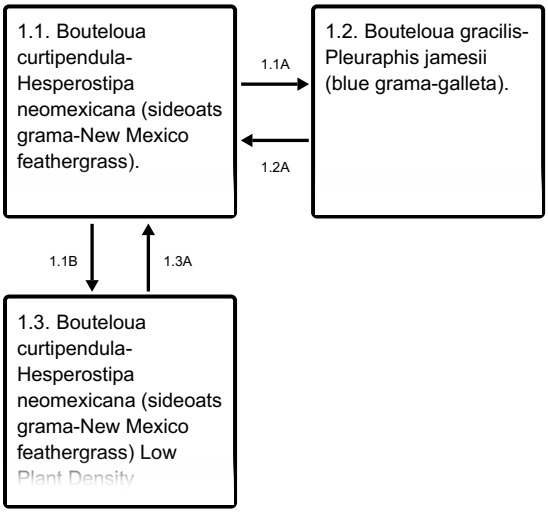



**T1A** - Heavy, continuous grazing. Lack of fire.

**R2A** - Prescribed grazing. Prescribed fire.

**T2A** - Heavy, continuous grazing. Lack of fire.

**State 1 submodel, plant communities**




**1.1A** - Heavy, season-long grazing. Lack of fire.

**1.1B** - Non-use. Lack of fire.

**1.2A** - Prescribed grazing. Prescribed fire.

**1.3A** - Prescribed grazing. Prescribed fire.

**State 2 submodel, plant communities**

2.1. Bouteloua gracilis (blue grama) Community.

**State 3 submodel, plant communities**

3.1. Bromus tectorum-Salsola (cheatgrass-russian thistle) Eroded Community.

## State 1
## Reference State

The Reference State is characterized by three plant community phases that represent the natural range of variability and disturbance regimes within the site. These plant community phases are maintained by a historic fire frequency (estimated to be on 15 to 20 year intervals), grazing by large ungulates, and adequate recovery periods.

**Dominant plant species**

- oneseed juniper (*Juniperus monosperma*), tree
- twoneedle pinyon (*Pinus edulis*), tree
- Bigelow sage (*Artemisia bigelovii*), shrub
- James' seaheath (*Frankenia jamesii*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- fourwing saltbush (*Atriplex canescens*), shrub
- sideoats grama (*Bouteloua curtipendula*), grass
- New Mexico feathergrass (*Hesperostipa neomexicana*), grass
- little bluestem (*Schizachyrium scoparium*), grass

## Community 1.1
## Bouteloua curtipendula-Hesperostipa neomexicana (sideoats grama-New Mexico feathergrass).

This plant community is the interpretive plant community for this site and is considered to be the reference plant community. This community evolved with grazing by large herbivores and is suited to grazing by domestic livestock. Historically, fires likely occurred infrequently. This plant community can be found on areas that are grazed and where the grazed plants receive adequate periods of recovery during the growing season. The potential vegetation is about 70 to 80 percent grasses and grass-likes, 10 to 15 percent forbs and 10 to 15 percent woody plants. The principal grasses that dominate this community are sideoats grama, little bluestem, New Mexico Feathergrass, and blue grama. Secondary grasses are galleta, western wheatgrass, Indian ricegrass, hairy grama, and needle and thread. Dominant forbs include purple prairie clover, American vetch, dotted gayfeather, mat loco, sessile nailwort, and Hood’s phlox. Bigelow sagebrush, winterfat, fourwing saltbush, skunkbush sumac, and golden currant are key shrubs. Oneseed juniper and pinyon pine may be present in very small amounts. This is a sustainable plant community in terms of soil stability, watershed function, and biological integrity. Litter is properly distributed where vegetative cover is continuous. Some litter movement may occur on steeper slopes. Decadence and natural plant mortality is very low. Community dynamics, nutrient cycle, water cycle, and energy flow are functioning properly. This community is resistant to many disturbances with the exception of heavy, continuous grazing, tillage, and development into urban or other uses. Areas having lost all vegetation, such as livestock and vehicle trails are subject to high erosion rates and extreme runoff. Total annual production, during an average year, ranges from 350 to 900 pounds of air-dry weight and averages 600 pounds.

### Dominant plant species

- oneseed juniper (*Juniperus monosperma*), shrub
- twoneedle pinyon (*Pinus edulis*), shrub
- sideoats grama (*Bouteloua curtipendula*), grass
- New Mexico feathergrass (*Hesperostipa neomexicana*), grass
- little bluestem (*Schizachyrium scoparium*), grass

**Table 5. Annual production by plant type**

| Plant Type | Low (Kg/Hectare) | Representative Value (Kg/Hectare) | High (Kg/Hectare) |
|---|---|---|---|
| Grass/Grasslike | 269 | 501 | 785 |
| Forb | 62 | 84 | 106 |
| Shrub/Vine | 62 | 84 | 106 |
| Tree | – | 3 | 11 |
| **Total** | **393** | **672** | **1008** |

**Figure 9. Plant community growth curve (percent production by month). CO6901, Warm-season/cool-season co-dominant; MLRA-69; upland fine textured soils..**

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 5 | 10 | 20 | 30 | 20 | 10 | 3 | 2 | 0 | 0 |

## Community 1.2
## Bouteloua gracilis-Pleuraphis jamesii (blue grama-galleta).

This plant community developed with heavy, season-long grazing without adequate recovery time during the growing season and lack of fire. The dominant grass is typically blue grama with increased amounts of galleta. New Mexico feathergrass can increase with spring rest or recurring summer herbivory. Sideoats grama and little bluestem are still present as secondary grasses in the community. Big bluestem, Indiangrass, switchgrass, needle and thread, and western wheatgrass have been significantly reduced. Forbs and shrubs that have increased are mat loco, sessile nailwort, Hood’s phlox, hairy goldaster, Cuman ragweed, slimflower scurfpea, small soapweed, and broom snakeweed. Purple prairie clover, American vetch, winterfat, fourwing saltbush, currants, and skunkbush sumac have been reduced. Oneseed juniper and pinyon have increased. Plant frequency, production, and litter levels are lower compared to the reference plant community. Soil erosion may be a concern at this point, especially on high travel or impact areas. Some flow paths may be connected. Water cycle and nutrient cycle are beginning to be affected by the reduction of key grasses, forbs, and shrubs. Total annual production can vary from 200 to 500 pounds of air-dry vegetation per acre and averages 300 pounds during an average year.

### Dominant plant species

- oneseed juniper (*Juniperus monosperma*), tree
- twoneedle pinyon (*Pinus edulis*), tree
- soapweed yucca (*Yucca glauca*), shrub
- broom snakeweed (*Gutierrezia sarothrae*), shrub
- blue grama (*Bouteloua gracilis*), grass
- James' galleta (*Pleuraphis jamesii*), grass

**Figure 10. Plant community growth curve (percent production by month). CO6903, Warm-season dominant, cool-season sub-dominant; MLRA-69; upland fine textured soils..**

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 5 | 15 | 35 | 25 | 15 | 5 | 0 | 0 | 0 |

## Community 1.3
## Bouteloua curtipendula-Hesperostipa neomexicana (sideoats grama-New Mexico feathergrass) Low Plant Density Community.

This plant community developed under years of non-use and lack of fire. Plant species resemble the reference plant community but species frequency and production are reduced. Eventually, litter levels become high enough to cause stagnation and mortality of various species such as little bluestem, sideoats grama, big bluestem, Indiangrass, and blue grama. Bunchgrasses typically develop dead centers and rhizomatous grasses form small communities because of a lack of stimulation by grazing animals. Initially, high surface litter levels will minimize erosion. Advanced stages of non-use or lack of fire can result in lower vigor plants, causing an increase in bare areas. These areas are susceptible to water erosion, especially on steeper slopes. Total annual production can vary from 250 to 950 pounds of air-dry vegetation per acre.

**Dominant plant species**

- oneseed juniper (*Juniperus monosperma*), tree
- twoneedle pinyon (*Pinus edulis*), tree
- Bigelow sage (*Artemisia bigelovii*), shrub
- James' seaheath (*Frankenia jamesii*), shrub
- winterfat (*Krascheninnikovia lanata*), shrub
- fourwing saltbush (*Atriplex canescens*), shrub
- sideoats grama (*Bouteloua curtipendula*), grass
- New Mexico feathergrass (*Hesperostipa neomexicana*), grass
- little bluestem (*Schizachyrium scoparium*), grass

**Figure 11. Plant community growth curve (percent production by month). CO6902, Warm-season/cool-season co-dominant, excess litter; MLRA-69; upland fine textured soils..**

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 3 | 7 | 22 | 33 | 18 | 12 | 5 | 0 | 0 | 0 |

## Pathway 1.1A
## Community 1.1 to 1.2

Recurring heavy, seasonal herbivory without adequate recovery opportunity between grazing events and lack of fire shift this plant community to the 1.2 community.

## Pathway 1.1B
## Community 1.1 to 1.3

Non-use and no fire moves this plant community to the 1.3 community. Lack of disturbance causes the plants to become less vigorous, crowns of plants begin to die, and plant canopy begins to open up with more bare ground apparent.

## Pathway 1.2A
## Community 1.2 to 1.1

A grazing system with a forage and livestock balance and prescribed fire will return this community to the reference community.

**Conservation practices**

| |
|---|
| Prescribed Burning |
| Prescribed Grazing |

## Pathway 1.3A

### Community 1.3 to 1.1

A grazing system with a forage and livestock balance and prescribed fire will return this community to the reference community.

**Conservation practices**

| |
|---|
| Prescribed Burning |
| Prescribed Grazing |

## State 2
## Blue Grama Dominant State

The Blue Grama Dominant State is represented by one plant community phase. The tallgrasses and more palatable forbs and shrubs have been replaced by less palatable species. A major shift in species composition and plant functional groups has taken place. Nutrient and water cycles have been negatively affected due to the loss of nitrogen fixing forbs and deeper-rooted plants. Bare ground and soil erosion have increased. Rills and pedestaled plants with exposed roots are apparent. The loss of dominant and subdominant structural/functional groups reduces the biodiversity and productivity.

**Dominant plant species**

- oneseed juniper (*Juniperus monosperma*), tree
- twoneedle pinyon (*Pinus edulis*), tree
- broom snakeweed (*Gutierrezia sarothrae*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- blue grama (*Bouteloua gracilis*), grass
- hairy grama (*Bouteloua hirsuta*), grass
- James' galleta (*Pleuraphis jamesii*), grass

### Community 2.1
### Bouteloua gracilis (blue grama) Community.

The dominant grass is blue grama. Hairy grama, Fendler's threeawn, and galleta have increased. Tallgrasses and palatable forbs and shrubs have been removed. Little bluestem and sideoats grama may exist in remnant amounts on steeper slopes. Forbs and shrubs that continue to increase are mat loco, sessile nailwort, Hood’s phlox, broom snakeweed, and small soapweed. Oneseed juniper and pinyon have increased significantly. A major shift in species composition and plant functional groups has taken place. Nutrient and water cycles have been negatively affected due to the loss of nitrogen fixing forbs and deeper-rooted plants. Bare ground has increased and soil erosion is a concern. Rills and pedestaled plants with exposed roots are apparent. Production ranges from 75 to 300 pounds of air-dry vegetation per acre per year and averages approximately 150 pounds.

**Dominant plant species**

- oneseed juniper (*Juniperus monosperma*), tree
- twoneedle pinyon (*Pinus edulis*), tree
- broom snakeweed (*Gutierrezia sarothrae*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- blue grama (*Bouteloua gracilis*), grass

**Figure 12. Plant community growth curve (percent production by month). CO6904, Warm-season dominant; MLRA-69; upland fine textured soils..**

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 15 | 45 | 25 | 15 | 0 | 0 | 0 | 0 |

## State 3
## Eroded State

This state has one community. Annuals have replaced most of the perennial grasses. Litter levels have been reduced substantially. Soil erosion and bare ground have increased and may be severe on steeper slopes. Biological integrity, watershed function, and soil stability are all impaired. This state is characterized by an impairment of all ecological functions.

**Dominant plant species**

- oneseed juniper (*Juniperus monosperma*), tree
- twoneedle pinyon (*Pinus edulis*), tree
- broom snakeweed (*Gutierrezia sarothrae*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- plains pricklypear (*Opuntia polyacantha*), shrub
- cheatgrass (*Bromus tectorum*), grass
- James' galleta (*Pleuraphis jamesii*), grass
- Russian thistle (*Salsola*), other herbaceous
- burningbush (*Bassia scoparia*), other herbaceous

## Community 3.1
## Bromus tectorum-Salsola (cheatgrass-russian thistle) Eroded Community.

Bare ground has significantly increased. Remnant amounts of blue grama, hairy grama, and galleta may exist in localized areas. Small soapweed, broom snakeweed, and pricklypear cactus may remain. Annuals invading or increasing are cheatgrass, burningbush, and Russian thistle. Litter levels have been reduced substantially. Soil erosion has increased due to the increase of bare ground and may be severe on steeper slopes. Biological integrity, watershed function, and soil stability are all impaired. Total annual production can vary from 50 to 150 pounds of air-dry vegetation per acre.

**Dominant plant species**

- oneseed juniper (*Juniperus monosperma*), tree
- twoneedle pinyon (*Pinus edulis*), tree
- broom snakeweed (*Gutierrezia sarothrae*), shrub
- soapweed yucca (*Yucca glauca*), shrub
- plains pricklypear (*Opuntia polyacantha*), shrub
- cheatgrass (*Bromus tectorum*), grass
- James' galleta (*Pleuraphis jamesii*), grass
- Russian thistle (*Salsola*), other herbaceous
- burningbush (*Bassia scoparia*), other herbaceous

**Figure 13. Plant community growth curve (percent production by month). CO6903, Warm-season dominant, cool-season sub-dominant; MLRA-69; upland fine textured soils..**

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 5 | 15 | 35 | 25 | 15 | 5 | 0 | 0 | 0 |

## Transition T1A
## State 1 to 2

Heavy, continuous grazing without adequate recovery periods between grazing events and lack of fire shift this state to the Blue Grama Dominant State.

## Restoration pathway R2A
## State 2 to 1

Prescribed grazing that allows for adequate recovery periods between grazing events and prescribed fire move this state to the Reference State. This transition may take upwards of 20 years or more to achieve.

**Conservation practices**

| |
|---|
| Prescribed Burning |
| Prescribed Grazing |

### Transition T2A
### State 2 to 3

Heavy, continuous grazing without adequate recovery periods between grazing events and lack of fire shift this state to the Eroded State.

## Additional community tables

**Table 6. Community 1.1 plant community composition**

| Group | Common Name | Symbol | Scientific Name | Annual Production (Kg/Hectare) | Foliar Cover (%) |
|---|---|---|---|---|---|
| **Grass/Grasslike** | | | | | |
| 1 | | | | 471–538 | |
| | sideoats grama | BOCU | *Bouteloua curtipendula* | 135–168 | – |
| | New Mexico feathergrass | HENE5 | *Hesperostipa neomexicana* | 101–135 | – |
| | little bluestem | SCSC | *Schizachyrium scoparium* | 101–135 | – |
| | blue grama | BOGR2 | *Bouteloua gracilis* | 67–101 | – |
| | James' galleta | PLJA | *Pleuraphis jamesii* | 22–45 | – |
| | western wheatgrass | PASM | *Pascopyrum smithii* | 6–34 | – |
| | switchgrass | PAVI2 | *Panicum virgatum* | 0–22 | – |
| | needle and thread | HECOC8 | *Hesperostipa comata ssp. comata* | 6–22 | – |
| | green needlegrass | NAVI4 | *Nassella viridula* | 6–22 | – |
| | hairy grama | BOHI2 | *Bouteloua hirsuta* | 6–22 | – |
| | sun sedge | CAINH2 | *Carex inops ssp. heliophila* | 6–22 | – |
| | Grass, perennial | 2GP | *Grass, perennial* | 6–22 | – |
| | Indian ricegrass | ACHY | *Achnatherum hymenoides* | 6–22 | – |
| | big bluestem | ANGE | *Andropogon gerardii* | 0–22 | – |
| | plains muhly | MUCU3 | *Muhlenbergia cuspidata* | 6–11 | – |
| | ring muhly | MUTO2 | *Muhlenbergia torreyi* | 0–6 | – |
| | little barley | HOPU | *Hordeum pusillum* | 0–6 | – |
| | prairie Junegrass | KOMA | *Koeleria macrantha* | 0–6 | – |
| | pinyon ricegrass | PIFI | *Piptochaetium fimbriatum* | 0–6 | – |
| | sand dropseed | SPCR | *Sporobolus cryptandrus* | 0–6 | – |
| | slim tridens | TRMUE | *Tridens muticus var. elongatus* | 0–6 | – |
| | Fendler's threeawn | ARPUF | *Aristida purpurea var. fendleriana* | 0–6 | – |
| | prairie sandreed | CALO | *Calamovilfa longifolia* | 0–6 | – |
| | squirreltail | ELELE | *Elymus elymoides ssp. elymoides* | 0–6 | – |
| | hairy woollygrass | ERPI5 | *Erioneuron pilosum* | 0–6 | – |
| | threadleaf sedge | CAFI | *Carex filifolia* | 0–6 | – |
| | black grama | BOER4 | *Bouteloua eriopoda* | 0–6 | – |
| **Forb** | | | | | |
| 2 | | | | 67–101 | |

| | | | | | |
|---|---|---|---|---|---|
| | Forb, perennial | 2FP | *Forb, perennial* | 6–22 | – |
| | Forb, perennial | 2FP | *Forb, perennial* | 6–22 | – |
| | dotted blazing star | LIPU | *Liatris punctata* | 6–11 | – |
| | purple prairie clover | DAPU5 | *Dalea purpurea* | 6–11 | – |
| | American vetch | VIAM | *Vicia americana* | 6–11 | – |
| | dotted blazing star | LIPU | *Liatris punctata* | 6–11 | – |
| | purple prairie clover | DAPU5 | *Dalea purpurea* | 6–11 | – |
| | American vetch | VIAM | *Vicia americana* | 6–11 | – |
| | Rocky Mountain zinnia | ZIGR | *Zinnia grandiflora* | 0–6 | – |
| | sulphur-flower buckwheat | ERUM | *Eriogonum umbellatum* | 0–6 | – |
| | hairy false goldenaster | HEVI4 | *Heterotheca villosa* | 0–6 | – |
| | tenpetal blazingstar | MEDE2 | *Mentzelia decapetala* | 0–6 | – |
| | plains blackfoot | MELE2 | *Melampodium leucanthum* | 0–6 | – |
| | crownleaf evening primrose | OECO2 | *Oenothera coronopifolia* | 0–6 | – |
| | leafy false goldenweed | OOFOF | *Oonopsis foliosa var. foliosa* | 0–6 | – |
| | white locoweed | OXSE | *Oxytropis sericea* | 0–6 | – |
| | broadbeard beardtongue | PEAN4 | *Penstemon angustifolius* | 0–6 | – |
| | spiny phlox | PHHO | *Phlox hoodii* | 0–6 | – |
| | slimflower scurfpea | PSTE5 | *Psoralidium tenuiflorum* | 0–6 | – |
| | upright prairie coneflower | RACO3 | *Ratibida columnifera* | 0–6 | – |
| | scarlet globemallow | SPCO | *Sphaeralcea coccinea* | 0–6 | – |
| | desert princesplume | STPIP | *Stanleya pinnata var. pinnata* | 0–6 | – |
| | Cuman ragweed | AMPS | *Ambrosia psilostachya* | 0–6 | – |
| | tarragon | ARDR4 | *Artemisia dracunculus* | 0–6 | – |
| | white sagebrush | ARLU | *Artemisia ludoviciana* | 0–6 | – |
| | spiny milkvetch | ASKE | *Astragalus kentrophyta* | 0–6 | – |
| | woolly locoweed | ASMO7 | *Astragalus mollissimus* | 0–6 | – |
| | Indian paintbrush | CASTI2 | *Castilleja* | 0–6 | – |
| | James' cryptantha | CRCIJ | *Cryptantha cinerea var. jamesii* | 0–6 | – |
| | Rocky Mountain zinnia | ZIGR | *Zinnia grandiflora* | 0–6 | – |
| | sulphur-flower buckwheat | ERUM | *Eriogonum umbellatum* | 0–6 | – |
| | hairy false goldenaster | HEVI4 | *Heterotheca villosa* | 0–6 | – |
| | tenpetal blazingstar | MEDE2 | *Mentzelia decapetala* | 0–6 | – |
| | plains blackfoot | MELE2 | *Melampodium leucanthum* | 0–6 | – |
| | crownleaf evening primrose | OECO2 | *Oenothera coronopifolia* | 0–6 | – |
| | leafy false goldenweed | OOFOF | *Oonopsis foliosa var. foliosa* | 0–6 | – |
| | white locoweed | OXSE | *Oxytropis sericea* | 0–6 | – |
| | broadbeard beardtongue | PEAN4 | *Penstemon angustifolius* | 0–6 | – |
| | spiny phlox | PHHO | *Phlox hoodii* | 0–6 | – |
| | slimflower scurfpea | PSTE5 | *Psoralidium tenuiflorum* | 0–6 | – |

| | | | | | |
|---|---|---|---|---|---|
| | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| | upright prairie coneflower | RACO3 | *Ratibida columnifera* | 0–6 | – |
| | scarlet globemallow | SPCO | *Sphaeralcea coccinea* | 0–6 | – |
| | desert princesplume | STPIP | *Stanleya pinnata var. pinnata* | 0–6 | – |
| | Cuman ragweed | AMPS | *Ambrosia psilostachya* | 0–6 | – |
| | tarragon | ARDR4 | *Artemisia dracunculus* | 0–6 | – |
| | white sagebrush | ARLU | *Artemisia ludoviciana* | 0–6 | – |
| | spiny milkvetch | ASKE | *Astragalus kentrophyta* | 0–6 | – |
| | woolly locoweed | ASMO7 | *Astragalus mollissimus* | 0–6 | – |
| | Indian paintbrush | CASTI2 | *Castilleja* | 0–6 | – |
| | James' cryptantha | CRCIJ | *Cryptantha cinerea var. jamesii* | 0–6 | – |
| **Shrub/Vine** | | | | | |
| 3 | | | | 67–101 | |
| | Bigelow sage | ARBI3 | *Artemisia bigelovii* | 22–45 | – |
| | James' seaheath | FRJA | *Frankenia jamesii* | 6–22 | – |
| | winterfat | KRLA2 | *Krascheninnikovia lanata* | 6–22 | – |
| | Shrub (>.5m) | 2SHRUB | *Shrub (>.5m)* | 6–22 | – |
| | fourwing saltbush | ATCA2 | *Atriplex canescens* | 6–22 | – |
| | alderleaf mountain mahogany | CEMO2 | *Cercocarpus montanus* | 0–11 | – |
| | skunkbush sumac | RHTR | *Rhus trilobata* | 0–11 | – |
| | wax currant | RICE | *Ribes cereum* | 0–11 | – |
| | soapweed yucca | YUGL | *Yucca glauca* | 0–6 | – |
| | golden currant | RIAU | *Ribes aureum* | 0–6 | – |
| | plains pricklypear | OPPO | *Opuntia polyacantha* | 0–6 | – |
| | broom snakeweed | GUSA2 | *Gutierrezia sarothrae* | 0–6 | – |
| | prairie sagewort | ARFR4 | *Artemisia frigida* | 0–6 | – |
| | tree cholla | CYIMI | *Cylindropuntia imbricata var. imbricata* | 0–6 | – |
| | rubber rabbitbrush | ERNAG | *Ericameria nauseosa ssp. nauseosa var. glabrata* | 0–6 | – |
| **Tree** | | | | | |
| 4 | | | | 0–6 | |
| | oneseed juniper | JUMO | *Juniperus monosperma* | 0–6 | – |
| | twoneedle pinyon | PIED | *Pinus edulis* | 0–6 | – |

## Animal community

WILDLIFE INTERPRETATIONS:
The loamy soils and grasses, forbs, and shrubs found on this ecological site provides habitat for numerous wildlife species. Historic large grazers that influenced these plant communities were bison, elk, and pronghorn. Changes over time have resulted in the loss of bison, the reduction in elk numbers, and pronghorn population swings. Domestic grazers now share these habitats with wildlife. The grassland communities of eastern Colorado are home to many bird species. Changes in the composition of the plant community when moving from the reference plant community to other communities on this ecological site may result in species shifts in the bird community. The occasional wetland or spring found on this ecological site provides essential seasonal water needed for reproductive habitat by some reptiles and amphibians. Because of a lack of permanent water, fish are not commonly expected on this ecological site. Mule and white-tailed deer may use this ecological site. The gray wolf and wild bison used this ecological site in historic times. The wolf is thought to be extirpated from Eastern Colorado

Bison are currently found only as domestic livestock.

Reference Plant Community:
The grasses, forbs, and shrubs in this plant community provide habitat for many reptiles including western rattlesnake, bullsnake, and racer. If water is available for breeding, spadefoot toads and tiger salamanders may be found here. The structural diversity in the plant community on this site provides habitat for Cassin's sparrow and lark bunting. Ferruginous and Swainson's hawks are commonly seen on this site. Small mammals such as white-tailed jackrabbit, badger, swift fox, plains pocket gopher, and several species of mice are common. Pronghorn is a typical ungulate.

1.2 Community:
All wildlife found in the reference plant community are expected in this plant community. The loss of some of the vegetative structural diversity makes it less attractive to some species.

1.3, 2.1, 3.1 Communities:
Reptiles using these plant communities are similar to the reference community species. As bare ground increases, conditions improve for Texas horned lizard. Increases in broom snakeweed and small soapweed cause the bird community to shift from Cassin's sparrow to the grasshopper sparrow. Most mammals will be similar to the reference plant community, however black-tailed jackrabbit use may increase because of the increased bare ground and weedy forbs.

GRAZING INTERPRETATIONS:
The following table lists suggested initial stocking rates for an animal unit (1000 pound beef cow) under continuous grazing (yearlong grazing or growing-season-long grazing) based on normal growing conditions. However, continuous grazing is not recommended. These estimates should only be used as preliminary guidelines in the initial stages of the conservation planning process. Often, the existing plant composition does not entirely match any particular plant community described in this ecological site description. Therefore, field inventories are always recommended to document plant composition, total production, and palatable forage production. Carrying capacity estimates that reflect on-site conditions should be calculated using field inventories.

If the following production estimates are used, they should be adjusted based on animal kind or class and on the specific palatability of the forage plants in the various plant community descriptions. Under a properly stocked, properly applied, prescribed grazing management system that provides adequate recovery periods following each grazing event, improved harvest efficiencies eventually result in increased carrying capacity. See USDA-NRCS Colorado Prescribed Grazing Standard and Specification Guide (528).

The stocking rate calculations are based on the total annual forage production in a normal year multiplied by 25 percent harvest efficiency divided by 912.5 pounds of ingested air-dry vegetation for an animal unit per month (AUM).

Plant Community Production (lbs./acre) and Stocking Rate (AUM/acre)

(Reference Plant Community) - (600) (0.16)

1.2 Community - (300) (0.08)

These stocking rates are guidelines and grazing plans should be developed from an on-site visit.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangelands in this area provide yearlong forage under prescribed grazing for cattle, sheep, horses, and other herbivores.

## Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group B, with localized areas in hydrologic group A. Infiltration is moderate to high and runoff potential for this site is moderate depending on soil hydrologic group and ground cover. Areas where ground cover is less than 50 percent have the greatest potential to have reduced infiltration and higher runoff (refer to NRCS Section 4, National Engineering Handbook (NEH-4) for runoff quantities and hydrologic curves).

## Recreational uses

This site provides hunting, hiking, photography, bird watching, and other opportunities. The wide varieties of plants that bloom from spring until fall have an aesthetic value that appeals to visitors.

## Wood products

Fence posts or fire wood from juniper and pinyon trees.

## Other products

This site is commonly mined for the production of cement in Fremont and Pueblo counties.

General Data (MLRA and Revision Notes, Hierarchical Classification, Ecological Site Concept, Physiographic, Climate, and Water Features, and Soils Data):Updated. All “Required” items are complete to Provisional level.

Community Phase Data (Ecological Dynamics, STM, Transition and Recovery Pathways, Reference Plant Community, Species Composition List, Annual Production Table):

Updated. All “Required” items are complete to Provisional level.

LRU Concepts are still being debated. Further refinement of LRU concepts should be revisited with the technical team at the next “Approved” level.

Further discussion is needed to determine whether a “Shallow Limestone” site (lesser slopes) needs to be developed. There is currently a broad slope range (0 to 45 percent) in the existing “Limestone Breaks” site.

Community Phase Data (Ecological Dynamics, STM, Transition and Recovery Pathways, Reference Plant Community, Species Composition List, Annual Production Table):

There has been discussion that the Blue Grama Dominated State/Plant Community belongs in the Reference State, if grazing management will restore this community. However, the site authors feel that this should remain a separate state in MLRA 69 due to the lower precipitation, higher evapotranspiration rates, and in this case, shallow soils. It is felt that this restoration cannot be achieved within a 40 year planning horizon.

It is likely the "Low Plant Density, Decadent Plant Community exists on steeper and less accessible slopes. This is due to increased plant decadence (not excessive litter accumulation). The current concept is to leave this community in, but the topic needs future discussion.

NOTE: Annual Production Table and Species Composition List are from the “Previously Approved ESD. These will need review for future updates at the next Approved level.

Each Alternative State/Community:

-Complete to Provisional level. Narrative for each state/community has been updated.

Supporting Information (Site Interpretations, Associated and Similar Sites, Inventory Data References, Agency/State Correlation, References):

Updated. All “Required” items complete to Provisional level.

Supporting Information:

Updated. All “Required” items complete to Provisional level.

Animal Community Wildlife Interpretations:First “overview” paragraph retained.
Individual Plant Community phase interpretations are removed and need to be updated at next “Approved” level.

Livestock Interpretations:
Updated to reflect the plant community name revisions. The Stocking rate calculations remain the same because they are based on the “Legacy” Total Annual Production table.
The stocking rate calculations need to be updated when Total Annual Production and Plant Community annual production is revised at the next “Approved” level.

Hydrology:
From “Previously Approved” ESD (2004). This needs to be updated at next “approved” level.

Other Site Interpretation:
Recreational Uses, Wood Products, Other Products, and Plant Preferences table, and Rangeland Health Reference Sheet carried over from “Previously Approved” ESD (2004).

Rangeland Health Reference Sheet:
From “Previously Approved” ESD (2004). This needs to be updated at the “Approved” level.

LRU C Limestone Breaks ESD will be developed at a future date.

“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 and medium 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.” (NI 430_306 ESI and ESD, April, 2015)

## Other information

Relationship to Other Classifications:
NRCS Classification Hierarchy:
Physiographic Divisions of the United States (Fenneman, 1946): Physiographic DivisionPhysiographic ProvincePhysiographic SectionLand Resource RegionMajor Land Resource Area (MLRA)Land Resource Unit (LRU).

USFS Classification Hierarchy:
National Hierarchical Framework of Ecological Units (Cleland et al, 181-200): DomainDivisionProvinceSectionSubsectionLandtype Association LandtypeLandtype Phase.

## Inventory data references

NRI: references to Natural Resource Inventory data
Information presented here has been derived from data collection on private and federal lands using:
• Double Sampling (clipped 2 of 5 plots)*
• Rangeland Health (Pellant et al., 2005)
• Soil Stability (Pellant et al., 2005)
• Line Point Intercept : Foliar canopy, basal cover (Forb, Graminoid, Shrub, subshrub, Lichen, Moss, Rock fragments, bare ground, % Litter) (Herrick et al., 2005)
• Soil pedon descriptions collected on site (Schoeneberger et al., 2012)

*NRCS double-sampling method, CO NRCS Similarity Index Worksheet 528(1).
Additional reconnaissance data collection using numerous ocular estimates and other inventory data; NRCS clipping data for USDA program support; Field observations from experienced range trained personnel. Specific data information is contained in individual landowner/user case files and other files located in county NRCS field offices.

## References

Guyette, R.P., M.C. Stambaugh, D.C. Dey, and R. Muzika. 2012. Predicting Fire Frequency with Chemistry and Climate. Ecosystems 15:322–335.

## Other references

Data collection for this ecological site was done in conjunction with the progressive soil surveys within the Upper Arkansas Valley (MLRA 69) of Colorado. The site has been mapped and correlated with soils in the following soil surveys: Baca County, Bent County, Crowley County, El Paso County Area, Fremont County Area, Huerfano County Area, Kiowa County, Las Animas County: Parts of Huerfano and Las Animas, Lincoln County, Otero County, Prowers County, and Pueblo Area: Parts of Pueblo and Custer Counties.

30 Year Climatic and Hydrologic Normals (1981-2010) Reports. National Water and climate Center: Portland, OR. August 2015

ACIS-USDA Field Office Climate Data (WETS), period of record 1971-2000 http://agacis.rcc-acis.org (powered by WRCC) Accessed March 2016

Andrews, R. and R. Righter. 1992. Colorado Birds. Denver Museum of Natural History, Denver, CO. 442

Armstrong, D.M. 1972. Distribution of mammals in Colorado. Univ. Kansas Museum Natural History Monograph #3. 415.

Butler, LD., J.B. Cropper, R.H. Johnson, A.J. Norman, G.L. Peacock, P.L. Shaver, and K.E. Spaeth. 1997, revised 2003. National Range and Pasture Handbook. National Cartography and Geospatial Center's Technical Publishing Team: Fort Worth, TX. http://www.glti.nrcs.usda.gov/technical/publications/nrph.html Accessed August 2015

Clark, J., E. Grimm, J. Donovan, S. Fritz, D. Engrstom, and J. Almendinger. 2002. Drought cycles and landscape responses to past Aridity on prairies of the Northern Great Plains, USA. Ecology, 83(3), 595-601.

Cleland, D., P. Avers, W.H. McNab, M. Jensen, R. Bailey, T. King, and W. Russell. 1997. National Hierarchical Framework of Ecological Units, published in Ecosystem Management: Applications for Sustainable Forest and Wildlife Resources, Yale University Press

Cooperative climatological data summaries. NOAA. Western Regional Climate Center: Reno, NV. Web. http://www.wrcc.dri.edu/climatedata/climsum Accessed August 2015

Egan, Timothy. 2006. The Worst Hard Time. Houghton Mifflin Harcourt Publishing Company: New York, NY.

Fitzgerald, J.P., C.A. Meaney, and D.M. Armstrong. 1994. Mammals of Colorado. Denver Museum of Natural History, Denver, CO. 467. Hammerson, G.A. 1986. Amphibians and reptiles in Colorado. CO Div. Wild. Publication Code DOW-M-I-3-86. 131.

Herrick, Jeffrey E., J.W. Van Zee, K.M. Haystad, L.M. Burkett, and W.G. Witford. 2005. Monitoring Manual for Grassland, Shrubland, and Savanna Ecosystems, Volume II. U.S. Dept. of Agriculture, Agricultural Research Service. Jornada Experimental Range, Las Cruces, N.M.

Kingery, H., Ed. (1998) Colorado Breeding Birds Atlas. Dist. CO Wildlife Heritage Foundation: Denver, CO. 636.

National Water & Climate Center. USDA-NRCS. USDA Pacific Northwest Climate Hub: Portland, OR. http://www.wcc.nrcs.usda.gov/ Accessed March 2016

National Weather Service Co-op Program. 2010. Colorado Climate Center. Colorado State Univ. Web. http://climate.atmos.colostate.edu/dataaccess.php March 2016

Pellant, M., P. Shaver, D.A. Pyke, J.E. Herrick. (2005) Interpreting Indicators of Rangeland Health, Version 4. BLM National Business Center Printed Materials Distribution Service: Denver, CO.

PLANTS Database. 2015. USDA-NRCS. Web. http://plants.usda.gov/java/ Accessed August 2015. February 2016

PRISM Climate Data. 2015. Prism Climate Group. Oregon State Univ. Corvallis, OR. http://www.prism.oregonstate.edu/ Accessed August 2015.

Rennicke, J. 1990. Colorado Wildlife. Falcon Press, Helena and Billings, MT and CO Div. Wildlife, Denver CO. 138.

Schoeneberger, P.J., D.A. Wysockie, 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.

The Denver Posse of Westerners. 1999. The Cherokee Trail: Bent's Old Fort to Fort Bridger. The Denver Posse of Westerners, Inc. Johnson Printing: Boulder, CO

U.S. Dept. of Agriculture, Agricultural Research Service. September, 1991. Changes in Vegetation and Land Use I eastern Colorado, A Photographic study, 1904-1986.

U.S. Dept. 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. US Department of Agriculture Handbook 296.

U.S. Dept. of Agriculture, Natural Resources Conservation Service. National Geospatial Center of Excellence. Colorado annual Precipitation Map from 1981-2010, Annual Average Precipitation by State

U.S. Dept. of Agriculture, Natural Resources Conservation Service. 2009. Part 630, Hydrology, National Engineering Handbook

U.S. Dept. of Agriculture, Natural Resources Conservation Service. 1972-2012. National Engineering Handbook Hydrology Chapters. http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/?&cid=stelprdb1043063 Accessed August 2015.

U.S. Dept. of Agriculture, Natural Resources Conservation Service. National Soil Survey Handbook title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054242 Accessed July 2015

U.S. Dept. of Agriculture, Soil Survey Division Staff. 1993. Soil Survey Manual.

U.S. Dept. of Agriculture.1973. Soil Survey of Baca County, Colorado.

U.S. Dept. of Agriculture. 1970. Soil Survey of Bent County, Colorado.

U.S. Dept. of Agriculture. 1968. Soil Survey of Crowley County, Colorado.

U.S. Dept. of Agriculture. 1981 Soil Survey of El Paso County Area, Colorado.

U.S. Dept. of Agriculture. 1995. Soil Survey of Fremont County Area, Colorado.

U.S. Dept. of Agriculture. 1983. Soil Survey of Huerfano County Area, Colorado.

U.S. Dept. of Agriculture.1981. Soil Survey of Kiowa County, Colorado.

Western Regional Climate Center. 2022. Climate of Colorado, climate of the eastern plains. https://wrcc.dri.edu/Climate/narrative_co.php (accessed 9 August 2022).

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Those involved in developing earlier versions of this site description include: Ben Berlinger, rangeland management specialist (RMS); Scott Woodall, RMS; Lee Neve, soil scientist; Julie Elliott, RMS; Terri Skadeland, Colorado State biologist; and Herman Garcia, Colorado State RMS.

## 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) | Ben Berlinger, Daniel Nosal, Kimberly Diller |
| Contact for lead author | Ben Berlinger, Area Rangeland Management Specialist, La Junta, CO, |
| Date | 01/12/2005 |
| Approved by | Kirt Walstad |
| Approval date | |
| Composition (Indicators 10 and 12) based on | Annual Production |

## Indicators

1. **Number and extent of rills:** None on gentle slopes, slight on steeper slopes.

2. **Presence of water flow patterns:** None to minimal on gentle slopes (< 15 percent). If present, water flow paths should be broken, irregular in appearance with numerous vegetative barriers. As slope steepness increases, flow paths become more apparent and may be connected.

3. **Number and height of erosional pedestals or terracettes:** None to slight on gentle slopes. Expect some evidence of pedestalled plants when slopes exceed 15 percent.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 5-10 percent or less bare ground, with bare patches generally less than 3-5 inches. Extended drought may increase bare ground to 10-15 percent.

5. **Number of gullies and erosion associated with gullies:** None

6. **Extent of wind scoured, blowouts and/or depositional areas:** None to slight. Steep areas of exposed soil may have small amounts of wind scouring. Wind erosion can occur with disturbances such as wildfire or extended drought.

7. **Amount of litter movement (describe size and distance expected to travel):** Litter movement is associated with water flow patterns and may move as much as 2-5 feet down slope during severe precipitation events, especially on steeper slopes.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability class rating is anticipated to be 3-4 in interspaces at soil surface. These values need verification.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Average SOM ranges from 1-2 percent. Soils are dominantly very shallow to shallow. A-horizon color is grayish-brown with a fine and medium crumb structure. The surface texture is channery loam with areas of exposed limestone bedrock inherent to the site.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Raindrop impact is reduced by the diverse grass, forb, shrub functional/structural groups and root structure. This slows overland flow and provides increased time for infiltration to occur. Extended drought, wildfire or both may reduce basal density, canopy cover, and litter amounts (primarily from tall, warm-season bunch and rhizomatous grasses), resulting in decreased infiltration and increased runoff on steep slopes following intense rainfall events.

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: Warm-season mid bunchgrass >

    Sub-dominant: Cool-season mid bunchgrass > shrubs = warm-season short bunchgrass > warm-season mid sod-formers > leguminous forbs = other forbs >

    Other: cool-season mid rhizomatous grass = warm-season tall bunchgrass > sedges > short trees

    Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** None to slight. Decadence may exist on areas inaccessible to grazing animals.

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14. **Average percent litter cover (%) and depth ( in):** Litter cover during and following extended drought can range from 15-25 percent. On steeper slopes with exposed limestone litter cover can range from 5-15 percent.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 350 lbs./ac. low precipitation years; 600 lbs./ac. average precipitation years; 900 lbs./ac. high precipitation years. After extended drought or the first growing season following wildfire, production may be significantly reduced by 150-300 lbs./ac.

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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:** Invasive plants should not occur in the reference plant community. Cheatgrass, Russian thistle, burningbush, and other non-native annuals may invade following extended drought or fire assuming a seed source is available.

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17. **Perennial plant reproductive capability:** The only limitations are weather-related, wildfire, natural disease, and insects that may temporarily reduce reproductive capability.

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