

Evaluation of Ecological Site Classes and Community Classes for Regional Scale Modeling of Conservation Effects on Grazing Lands: MLRA 69

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INTRODUCTION

The Grazing Lands Component of the Conservation Effects Assessment Project (CEAP-GL) is evaluating the development and use of Ecological Site Classes and Community Classes within Major Land Resource Areas for regional and national scale modeling of conservation effects. National Resources Inventory (NRI) data is correlated to proposed Ecological Site Classes to provide data for the Agricultural Policy/Environmental eXtender (APEX) model and other models. The Rangeland Hydrology and Erosion Model (RHEM) is used to assess runoff and erosion differences between Community Classes, and is appropriate for inclusion in ecological site descriptions and this broader ecological site class work.

CLASSIFICATION HIERARCHY AND DEFINITIONS

Ecological Site Class

Ecological Site Classes are proposed subdivisions of a Major Land Resource Area (MLRA) or Land Resource Unit (LRU). They are similar in concept to a general soil survey map unit – a general grouping of ecological sites by major landforms, broad soil characteristics, and vegetation types. An Ecological Site Class differs from other kinds of land in the kinds and amounts of vegetation produced, in the responses to disturbances, in recovery mechanisms, and management responses.

Plant Functional Groups

The Plant Functional/Structural Group indicator is defined in [Interpreting Indicators of Rangeland Health](#) (version 4) as, “A suite or group of species that because of similar shoot or root structure, photosynthetic pathways, nitrogen fixing ability, life cycle, etc., are grouped together on an ecological site basis.”

The presence, dominance and relative proportions of plant functional groups affect soil, hydrologic and biotic variables including:

- the kinds and amounts of canopy and foliar cover
- amount and arrangement of bare ground and litter cover
- plant spacing and basal cover
- runoff and erosion rates
- structure and arrangement of vegetation which then influences the potential to carry fire and regulate fire intensity
- grazing preferences and distribution
- wildlife habitat values

The change in presence, dominance and/or proportion of plant functional groups is the primary attribute used to characterize States and Community Phases within an Ecological Site Description. Standardized plant functional groups were developed based on growth forms and flowering period. All plant species found in the MLRA were assigned to a plant functional group. Non-native species were assigned to functional groups designated with (I) - indicating the functional group represents introduced species. Production by functional group was then calculated for each NRI Primary Sampling Unit (PSU) community in the MLRA.

Community Class

A Community Class is a proposed plant community classification for an Ecological Site Class. The name of the Community Class is derived using the seven (7) dominant plant functional groups, listed in descending order by annual aboveground production on a dry weight basis. A Community Class is differentiated from other Community Classes by the presence and relative dominance of plant functional groups, and/or by significant differences in annual production. Refer to Appendix E for a list of common species and their assigned functional groups used for this project.

Plant Community

An actual plant community found at a given location, at a point in time.



Figure 1. A wet meadow in Major Land Resource Area 69.

MAJOR LAND RESOURCE AREA 69 - UPPER ARKANSAS VALLEY ROLLING PLAINS

Major Land Resource Area (MLRA) 69 is part of the Western Great Plains Range and Irrigation Region (Region G) shown in yellow (Figure 2). MLRA 69, shown in orange, occurs on the eastern slope of the Rocky Mountains in southeastern Colorado. The MLRA is just over 7.6 million acres in size. The Arkansas River flow east from here into Kansas. This Major Land Resource Area is characterized as a dissected plain created in Cretaceous and Quaternary sediment deposits from rivers that drained the young Rocky Mountains. There are several areas capped with lava. Sand dunes are also present. Elevations range from 3600 feet to 6230 feet above mean sea level.

Plant communities in this MLRA are dominated by shortgrass prairie species such as blue grama, James' galleta, buffalograss, with midgrasses such as needleandthread, purple threeawn, western wheatgrass, squirreltail and alkali sacaton. Shrubs include sand sagebrush, fourwing saltbush, broom snakeweed, soapweed yucca, and cane cholla. Trees include oneseed juniper, Gambel oak, and eastern cottonwood. Refer to Appendix E for scientific plant names and additional plant classification data used throughout.

Climate

The following climate information and map (Figure 3) is from the MLRA 69 Loamy Plains Ecological Site Description which characterizes MLRA 69.

Land Resource Unit A, in the Arkansas River Valley, is the hottest and driest portion of the MLRA. Mean annual precipitation (MAP) is 10-12 inches. LRU B is the largest extent; MAP is 12-14 inches. The climate information provided below are combined averages across the extent of LRU A and B. The mean annual air temperature is 50-54°F, and the combined MAP is 10-14 inches. Approximately 75% 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 annually. Winds are estimated to average 6 to 7 miles per hour annually. Daytime winds are generally stronger than nighttime and 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 162 days. The average date of first freeze (28°F or below) in the fall is October 16 and the average last freeze in the spring is April 21. The average length of the frost-free period (below 32°F) is 140 days. The average date for first frost in the fall (32°F), is October 9. The last frost in the spring is May 1. July is the hottest month and January is the coldest. It is not uncommon for temperature to exceed 100°F during the summer. Summer humidity is low and evaporation is high.

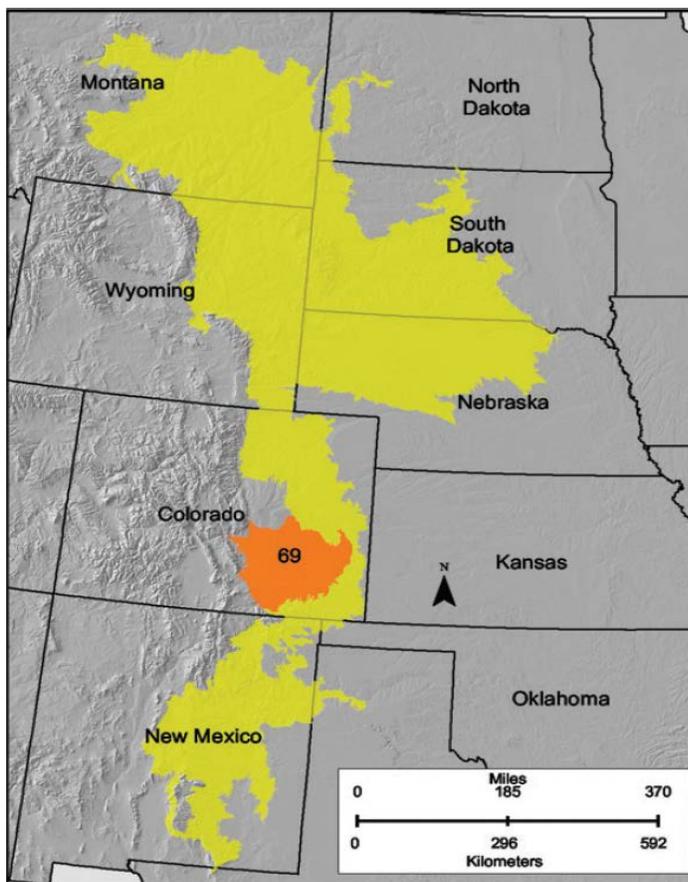


Figure 2. LRR G and MLRA 69 map. Source: Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296 (2006).

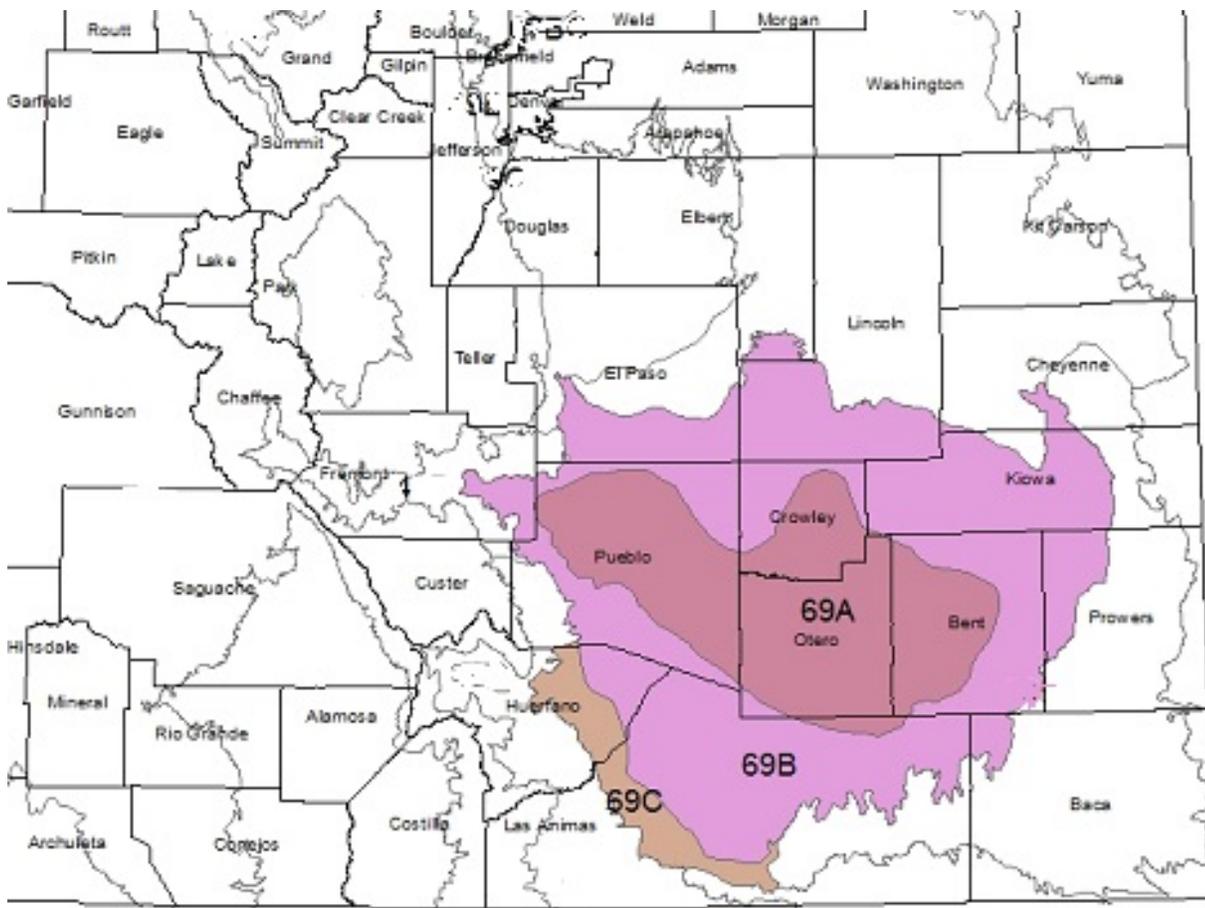


Figure 3. Location of Land Resource Units A, B, and C within MLRA 69. Source: Colorado NRCS.

The winters are characterized with frequent northerly winds, producing severe cold with temperatures dropping to -30°F. Southeastern Colorado was strongly affected by extended drought conditions in the Dust Bowl period of the 1930's, with recurrent drought cycles in the 1950's and 1970's. Extreme to exceptional drought conditions have revisited the area from 2002 to 2012, with brief interludes of near-normal to normal precipitation years. Dust storms reminiscent of the Dust Bowl era may still form during drought years, in windy periods. 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 and specific climate stations of interest, visit the Western Regional Climate Center website at <http://www.wrcc.dri.edu/>.

Averages

Frost-free period (days):	152
Freeze-free period (days):	173
Mean annual precipitation (inches):	13.12

Table 1. Monthly Precipitation (Inches)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	0.53	0.52	1.30	1.86	2.46	2.12	2.95	2.93	1.28	1.41	0.71	0.50
Medium	0.31	0.28	0.80	1.08	1.48	1.34	1.93	2.01	0.78	0.59	0.26	0.27
Low	0.12	0.13	0.43	0.50	0.74	0.83	0.93	1.17	0.46	0.20	0.10	0.16

Table 2. Monthly Temperature (°F)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	46.1	49.6	59.0	67.6	77.0	87.3	92.9	90.1	82.5	70.1	56.3	45.5
Low	15.4	18.9	27.1	35.2	45.9	55.3	60.9	59.4	49.7	36.4	24.6	16

The soil temperature regime is thermic to mesic and the soil moisture regime is aridic to ustic.

Representative Climate Stations

(1) CHERAW 1 N [USC00051539], Otero County CO 81050. Period of record 1981-2010

(2) EADS [USC00052446], Kiowa County CO 81036. Period of record 1981-2010

(3) LA JUNTA [USC00054724], Otero County CO 81050. Period of record 1981-2010*

* This climate station was used for the Rangeland Hydrology and Erosion Model (RHEM) evaluations for this project.

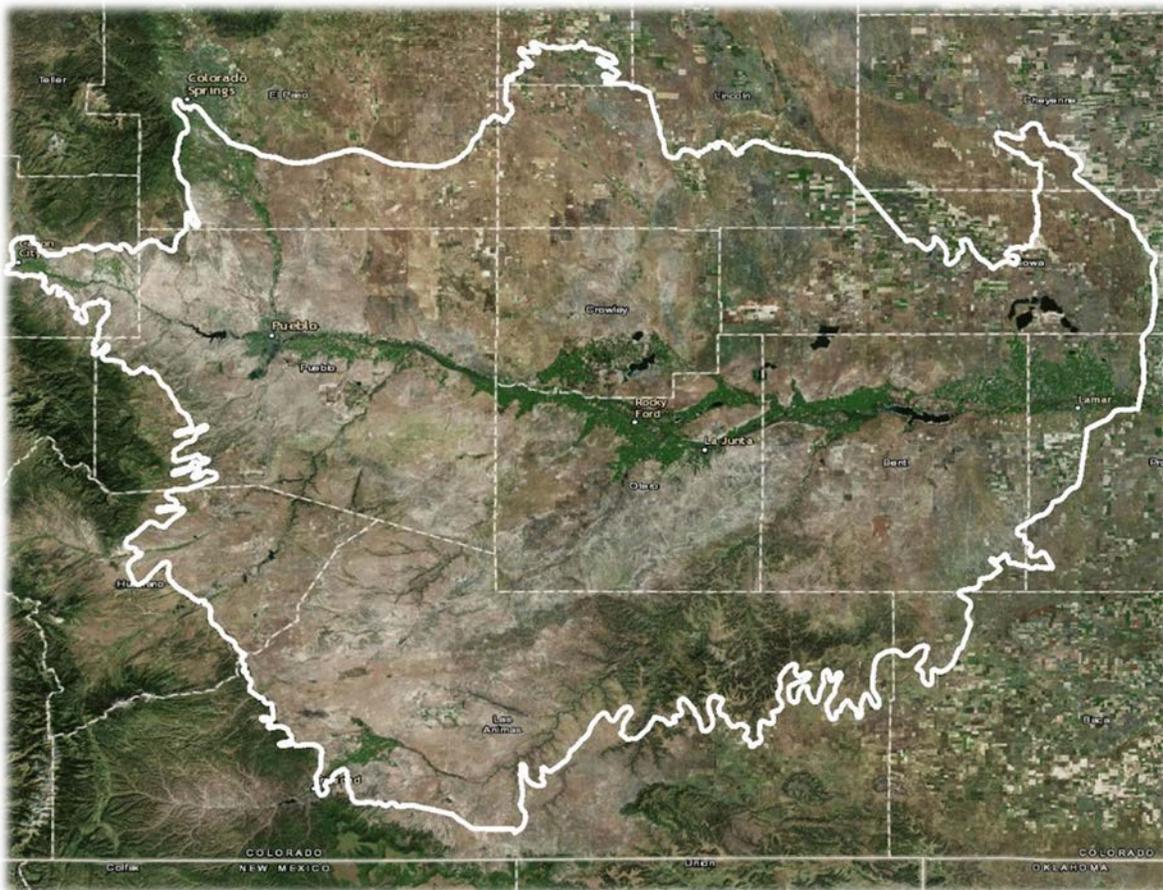


Figure 4. Satellite view of MLRA 69. Source: ArcGIS World Imagery, Earthstar Geographics, ESRI, HERE, DeLorme.

AGRICULTURAL OPERATIONS

Farming occurs primarily along the Arkansas River, and on the gentler plains north of the river. Many farmers run a few cows. The majority of the Major Land Resource Area is grazed shortgrass prairie. The kind and size of operations are variable because of the 10 to 19-inch range in rainfall. Operation sizes and irrigation needs increase as precipitation decreases.

The major crops grown include wheat, corn, grain sorghum, alfalfa and cotton. Grain corn is typically planted in June and harvested in October - November. Winter wheat is planted mostly in September, and then harvested from May to mid-July. Alfalfa hay is cut from June through September. USDA Agricultural Statistics reports 2014 average yields for this part of the state as follows: winter wheat (16 bushels/ac); grain sorghum (19 bushels/ac); corn (178 bushels/ac); alfalfa (2-3 tons/ac).

The average size of a livestock operation ranges from about 300 acres to over 6000 acres. A typical operation is about 800 acres in size. Livestock are grazed on the native rangelands throughout the year, with some farm-ranch operations grazing livestock on wheat fields, crop residues or feeding on dry lots from December through February.

Common cattle breeds are black and red Angus, and Hereford. Weaning weights average 450 lbs. for heifers and 550 lbs. for steers.



Figure 5. Irrigated crop production along the Arkansas River.

RESOURCE MANAGEMENT SYSTEMS

Conservation Practices Applied

Table 3 shows the kinds and amounts of conservation practices that the landowners in MLRA 69 are implementing on grazing lands. The table shows the most common conservation practices applied with NRCS assistance on grazed rangeland during fiscal years 2006-2011.

Table 3. Conservation practices applied from 2006-2011 (NRCS).

Practice Code	Practice Name (units)	Practice Count	Amount Applied	Acres Benefitted
382	Fence (ft)	418	2,141,567	374,168
614	Watering Facility (no.)	384	543	479,237
516	Pipeline (ft)	338	1,638,963	460,436
314	Brush Management (ac)	269	30,051	364,598
528	Prescribed Grazing (ac)	199	156,409	155,461
ANM18	Retrofit watering facility for wildlife escape (no)	142	144	683,049
PLT02	Monitor key grazing areas to improve grazing management (ac)	101	139,846	139,846
WQL03	Rotation of supplement and feeding areas	67	108,060	108,060
ANM17	Monitoring nutritional status of livestock using the NUTBAL PRO System (ac)	65	83,192	83,192
533	Pumping Plant (no)	50	51	40,024
642	Water Well (no)	45	45	33,618
410	Grade Stabilization Structure (no)	44	49	30,144
550	Range Planting (ac)	32	1,041	3,125
ANM26	Managing Calving to Coincide with Forage Availability (ac)	21	18,108	18,129
ANM09	Grazing management to improve wildlife habitat (ac)	21	24,789	24,789
666	Forest Stand Improvement (ac)	14	286	15,248
548	Grazing Land Mechanical Treatment (ac)	14	396	396
WQL12	Managing livestock access to water bodies/courses (ac)	14	17,243	17,243

Prescribed Grazing

Prescribed grazing is one of the most common conservation practices applied to address resource concerns on rangelands in this Major Land Resource Area. High intensity, short duration grazing systems have been the most successful in addressing resource concerns on grazed rangeland in this MLRA. The objective of this kind of grazing strategy is to limit livestock grazing during the growing season to only a few days a year on any given area. Regularly providing 90-120 days of rest during the hot part of the growing season has been found to be the best strategy for maintaining the species diversity in these grasslands. In areas with Lesser Prairie Chicken, grazing is deferred from March 15 to July 15 to provide nesting cover. Conservative stocking rates range from 40 to 80 acres per animal unit yearlong. The ecological site descriptions provide initial stocking guidelines (AUMs/ac) for community phases using 25% harvest efficiency and 912.5 lbs. of ingestible air-dry vegetation per animal unit month.

Watering Facilities

Most livestock water is provided by wells. Livestock pipelines, storage tanks and troughs are used to distribute grazing and provide water to wildlife. Ponds generally do not provide a reliable water source.

Brush Management

The invasive woody species targeted for brush management in this MLRA are typically saltcedar, Russian olive, and occasionally sand sagebrush. Most brush management is done using chemicals.

- Saltcedar and Russian olive are normally treated with imazapyr. Multiple treatments are required. The Colorado Cooperative Extension Service does not have any recommendations for treatment available online. Normally, saltcedar is sprayed in late summer to early fall before the leaves start turning yellow.
- Sand sagebrush is controlled occasionally with 2, 4-D following label directions.

Range Planting

Range planting is not common in MLRA 69. There is typically a sufficient seed source for the desirable species to become re-established with good grazing management on rangeland. Treatment size averages less than 40 acres. Seeding is recommended when cropland is being converted back to native species. The Colorado NRCS Plant Materials Technical Note 59 recommends seeding cool season plants from November 1 to April 30, and warm season plants from November 1 to May 31. Species adapted for seeding in this MLRA include sideoats grama, blue grama, buffalograss, little bluestem, big bluestem, wheatgrasses, alkali sacaton, tall fescue, and western wheatgrass.

Prescribed Burning

Prescribed Burning is not commonly used in this MLRA. But it is an important part of the ecology, and an important tool for maintaining early successional habitat for Mountain Plover.

Fencing

Typical fencing installations are either electric or standard barbed wire. Two-wire electric fencing is typically used for interior pasture fencing in the high intensity grazing systems. Three- and four-strand barbed wire fences are used in other areas.

Herbaceous Weed Control

Canada thistle is being successfully treated with biological control methods using a rust fungus. For musk thistle, the Colorado Cooperative Extension recommends application of a variety of chemicals to the rosette stage in the spring or fall. Cheatgrass occurs in this MLRA as an episodic species that does not seem to have any significant impacts on the function of the native plant communities.

Upland Wildlife Habitat Management

Wildlife in MLRA 69 includes a wide variety of grassland birds, deer, pronghorn antelope, badger, coyote, swift fox, jackrabbit, ground squirrel, and a variety of reptiles and amphibians. Species of concern include the lesser prairie chicken and mountain plover. Prescribed grazing and watering facilities provide the most common habitat improvements for wildlife species.



Figure 6. Cattle grazing on shortgrass prairie in MLRA 69.

ECOLOGICAL SITE CLASSES AND COMMUNITY CLASSES

In January 2016, there were seventeen (17) ecological sites correlated to soil map unit components in MLRA 69. Those have been grouped into seven (7) Ecological Site Classes by working with the State and local NRCS soil and rangeland management scientists in MLRA 69. Grouping was based on landscape position, soil characteristics, plant community composition, plant production and the response to climate, disturbance, use, and management. The groupings are as follows:

Bottom Ecological Site Class

- Sandy Bottomland R069XY031CO
- Saline Overflow R069XY037CO

Breaks Ecological Site Class

- Limestone Breaks R069XY058CO
- Sandstone Breaks R069XY053CO

Loamy Upland Ecological Site Class

- Alkaline Plains R069XY047CO
- Clayey Plains R069XY042CO
- Loamy Plains R069XY006CO
- Sandy Plains R069XY026CO
- Shaly Plains R069XY046CO

Rocky Slopes Ecological Site Class

- Gravel Breaks R069XY064CO
- Gypsum Breaks R069XY080CO
- Shale Breaks R069XY048CO

Saline Upland Ecological Site Class

- Salt Flat R069XY033CO
- Sandy Salt Flat R069XY032CO

Sandy Upland Ecological Site Class

- Choppy Sands R069XY021CO
- Deep Sand R069XY019CO

Wet Bottomland, Saline Ecological Site Class

- Salt Meadow R069XY030CO

Each NRI Primary Sampling Unit (PSU) in the MLRA was correlated to a plant Community Class where possible. PSU data were not used when the species present or vegetative production was questionable. Additional Community Classes that are not currently represented in the ecological site descriptions were added when present in the NRI data (these most commonly were non-native dominated communities). Community Class names are derived using the top seven (7) plant functional groups, listed in descending order of annual aboveground air-dry production. The production for the plant functional groups is calculated from the NRI PSUs that are correlated to the Community Class. Refer to Appendix E for plant taxonomy.

All species and plant community production shown as pounds per acre (lbs/ac) in the following ecological site class descriptions refers to annual aboveground production, air-dried.

BOTTOM ECOLOGICAL SITE CLASS



Figure 7. MLRA 69, Bottom Ecological Site Class.

General Description

The Bottom ecological site class occurs on floodplains which receive occasional to frequent flooding and run-on moisture from adjacent uplands. Surface water and/or subsurface flows may be present from several hours to several weeks following rainfall events or snowmelt. This ecological site class does not have access to seasonal or yearlong shallow water tables. Flooding is the dominant erosion/deposition process for this ecological site class. Potential plant community production is higher than that of adjacent uplands, and the response to management may be more rapid because of the availability of additional water. This ecological site class is high in wildlife diversity.

Geomorphic Features

Landscape Position: Floodplains
Slope (percent): 0-3

Representative Soil Features

Soil Depth:	Deep to Very Deep	Permeability Class:	Moderately Rapid
Parent Material Kind:	Alluvium	Chemistry:	None
Parent Material Origin:	Mixed	Available Water Capacity:	1 to 5 inches
Surface Texture:	Sandy Loam to Sand	Drainage Class:	Well to Somewhat
Surface Texture Modifier:	None to Gravelly		Excessively Well
Subsurface Texture Group:	Sandy		Drained

State and Transition Model

<p>1. Perennial – Annual Herbaceous</p> <p>1.1 Summer Tallgrass, Summer Midgrass, Summer Rhizomatous Grass, Summer Perennial Forb, Evergreen Shrub, Spring Rhizomatous Grass, Spring Perennial Forb</p> <p>1600 lbs/ac</p>	<p>1 to 2: Continuous heavy grazing, drought, lack of fire</p> <p>2 to 1: brush management, prescribed burning, prescribed grazing</p>	<p>2. Herbaceous – Woody</p> <p>2.1 Spring Perennial Forb, Summer Perennial Forb, Summer Shortgrass, Evergreen Shrub, Spring Midgrass, Summer Rhizomatous Grass, Summer Midgrass</p> <p>837 lbs/ac</p>
<p>1 to 4: plow, disk, plant</p>	<p>2 to 4: plow, disk, plant</p> <p>3 to 1: herbaceous weed control, range planting prescribed grazing</p>	<p>2 to 3: prescribed grazing, lack of fire, or brush management</p> <p>3 to 2: brush management, prescribed burning, range planting, prescribed grazing</p>
<p>4. Cultivated Cropland</p> <p>Average County Yields winter wheat 16 bushels/ac grain sorghum 19 bushels/ac corn 178 bushels/ac alfalfa 2-3 tons/ac</p>	<p>3 to 4: plow, disk, plant</p>	<p>3. Woody – Herbaceous</p> <p>3.1 Spring Annual Forb(I), Summer Midgrass, Spring Annual Forb, Spring Perennial Forb, Spring Annual Grass, Summer Annual Forb, Summer Shortgrass</p> <p>2499 lbs/ac</p>
<p>4 to 6: abandonment</p> <p>6 to 4: plow, disk, plant</p>	<p>4 to 5: range planting, prescribed grazing</p> <p>5 to 4: plow, disk, plant</p>	
<p>6. Abandoned Cropland</p> <p>6.1 Annual Forb, Perennial Forb, Summer Shortgrass, Summer Midgrass</p> <p>300 lbs/ac</p>	<p>6 to 5: range planting, prescribed grazing</p>	<p>5. Seeded Rangeland</p> <p>5.1 Summer Midgrass, Summer Shortgrass, Perennial Forb, Evergreen Shrub, Deciduous Shrub</p> <p>2000 lbs/ac</p>

Figure 8. State and Transition Model MLRA 69 Bottom ecological site class.

Vegetation Dynamics

Community Class 1.1 in the State and Transition Model (Figure 8) was derived from the reference communities in the ecological sites correlated to the Bottom ecological site class. The reference state for this ecological site class has an estimated average air-dry annual production of 1600 lbs/acre. Sand bluestem, switchgrass, Indiangrass, alkali sacaton, western wheatgrass, switchgrass, blue grama, vine mesquite, sand dropseed, western wheatgrass, little bluestem, western sandcherry, sand sagebrush, and eastern cottonwood are prominent plant species. With continuous heavy grazing and lack of natural fire intervals, the site will likely transition to an herbaceous – woody state with an increase in sand sagebrush, broom snakeweed, and eastern redcedar. With moderate grazing and regular seasonal deferment, prescribed fire, and mechanical or chemical brush management, the site may be returned to within reference characteristics. However, with heavy continuous grazing without adequate recovery periods, the site is likely to transition to a state dominated by introduced annuals such as Russian thistle and kochia. If the land is converted to cropland, it can transition into the seeded rangeland state directly or following abandonment by applying range planting or critical area planting. Prescribed grazing will be required to help ensure establishment and to maintain the plant community.

NRI Primary Sampling Units (PSUs) were correlated to these community classes where possible. Community Class production, functional group dominance, and dominant species based on available NRI data are shown in Table 4. Ground and canopy cover from the NRI PSUs was then used to estimate erosion and percent runoff using RHEM.

Table 4. NRI Community Class Data and RHEM Results - MLRA 69 Bottom Ecological Site Class.

Comm Class ID	Community Class Name	Dominant Species (Symbol, Lbs/Ac)	Production Lbs/Ac	Soil Loss T/Ac/Yr	% Runoff	# PSUs
069X.2.1.1	Summer Shortgrass, Summer Midgrass, Summer Annual Forb, Spring Perennial Forb, Spring Annual Forb(I), Summer Tallgrass, Summer Perennial Forb	blue grama (BOGR2)(486), sand dropseed (SPCR)(205), common sunflower (HEAN3)(26), lemon scurfpea (PSLA3)(24), Russian thistle (SAKA)(23), prairie sandreed (CALO)(19), Cuman ragweed (AMPS)(8)	800	0.82	9	1
069X.2.2.1	Spring Perennial Forb, Summer Perennial Forb, Summer Shortgrass, Evergreen Shrub, Spring Midgrass, Summer Rhizomatous Grass, Summer Midgrass	woolly locoweed (ASMO7)(248), leafy false goldenweed (OOFO)(194), blue grama (BOGR2)(157), sand sagebrush (ARF12)(23), broom snakeweed (GUSA2)(23), eastern redcedar (JUVI)(22), Indian ricegrass (ACHY)(21)	837	0.97	19	4
069X.2.3.1	Spring Annual Forb(I), Summer Midgrass, Spring Annual Forb, Spring Perennial Forb, Spring Annual Grass, Summer Annual Forb, Summer Shortgrass	Russian thistle (SAKA)(926), prickly Russian thistle (SATR12)(564), kochia (BASC5)(538), alkali sacaton (SPAI)(115), lambsquarters (CHAL7)(66), sandmat (CHAMA15)(53), sand dropseed (SPCR)(47)	2499	0.18	10	5

Supporting Information

No literature was found that dealt with the Bottom ecological site class.

BREAKS ECOLOGICAL SITE CLASS



Figure 9. MLRA 69 - Breaks ecological site class, general landscape.

General Description

This ecological site class occurs in an upland position where there is an abrupt change in elevation between two relatively flat plains or plateaus. It is not associated with floodplain terraces. It does not receive run-on moisture from adjacent sites. The site class is characterized as escarpments of calcareous sandstone and limestone in MLRA 69. It includes areas of rock outcrop and shallow soils at the summits and the associated steep colluvial slopes. Soils are typically very shallow to shallow at the summit, and moderately deep to very deep on the colluvial slopes. The soils are gravelly to extremely channery and stony loams and sandy loams. Site stability is bedrock controlled. As wind and water erosion occur, the coarse fragments in the soil profile are exposed at the surface, helping to armor and protect the surface from wind and water erosion.

Geomorphic Features

Landscape Position: Ridges, Escarpments, Hills
Slope (percent): 2-60

Representative Soil Features

Soil Depth:	Very Shallow to Very Deep	Permeability Class: Moderate to Impermeable
Parent Material Kind:	Alluvium, Colluvium	Chemistry: None to Calcareous throughout
Parent Material Origin:	Limestone, Sandstone	Available Water Capacity: 0.4 to 4.0 inches
Surface Texture:	Loam to Sandy Loam	
Surface Texture Modifier:	Gravelly, Channery, Stony	
Subsurface Texture Group:	Loamy to Sandy	
Drainage Class:	Well Drained	

State and Transition Model

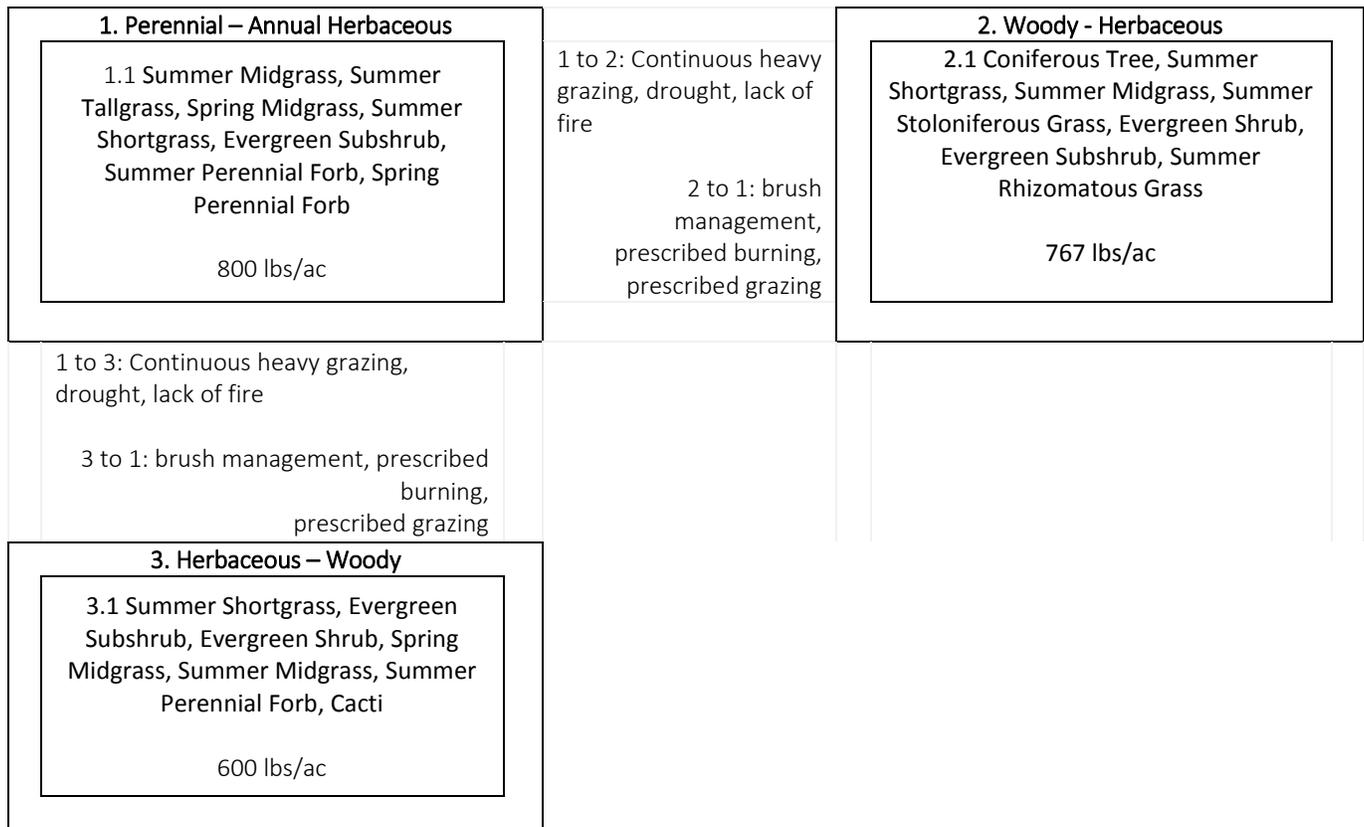


Figure 10. State and Transition Model, MLRA 69, Breaks ecological site class.

Vegetation Dynamics

Community Class 1.1 in the State and Transition Model (Figure 10) is derived by combining the reference communities in the ecological sites correlated to the Breaks ecological site class. The reference state of this ecological site class produces approximately 1082 lbs/ac of sideoats grama, little bluestem, western wheatgrass, and blue grama. To maintain this state, it is necessary to practice grazing management that provides recovery after each grazing period, and periodic fire. With continuous heavy grazing and lack of fire, the site will transition to a woody – herbaceous state (Community Class 2.1). In Land Resource Unit A which has lower precipitation, the woody species will likely include shrubs such as fourwing saltbush, cane cholla, and soapweed yucca (Community 2.1). In Land Resource Unit B, with higher precipitation, the woody species will likely include oneseed juniper, Gambel oak, and alderleaf mountain mahogany (Community 3.1). With brush management and or prescribed burning, and long term prescribed grazing, these communities can transition back to the reference community.

NRI PSUs were correlated to these community classes where possible. Community Class production, functional group dominance, and dominant species based on available NRI data are shown in Table 5. Ground and canopy cover from the PSUs was then used to estimate erosion and runoff using RHEM.

Table 5. NRI Community Class Data and RHEM Results - MLRA 69 Breaks Ecological Site Class.

Comm Class ID	Community Class Name	Dominant Species (Symbol, Lbs/Ac)	Production Lbs/Ac	Soil Loss T/Ac/Yr	% Runoff	# PSUs
069X.12.1.1	Summer Shortgrass, Summer Rhizomatous Grass, Summer Midgrass, Spring Annual Forb, Spring Midgrass, Spring Perennial Forb, Evergreen Subshrub	blue grama (BOGR2)(194), James' galleta (PLJA)(66), purple threeawn (ARPU9)(45), western wheatgrass (PASM)(38), needleandthread (HECO26)(32), broom snakeweed (GUSA2)(30), squirreltail (ELEL5)(29)	1082	0.60	10.63	8
069X.12.2.1	Coniferous Tree, Summer Shortgrass, Summer Midgrass, Summer Stoloniferous Grass, Evergreen Shrub, Evergreen Subshrub, Summer Rhizomatous Grass	oneseed juniper (JUMO)(867), sideoats grama (BOCU)(82), blue grama (BOGR2)(48), Gambel oak (QUGA)(31), Arizona threeawn (ARAR6)(30), squirreltail (ELEL5)(22), alderleaf mountain mahogany (CEMO2)(16)	767	0.13	7.57	8
069X.12.3.1	Summer Shortgrass, Evergreen Subshrub, Evergreen Shrub, Spring Midgrass, Summer Midgrass, Summer Perennial Forb, Cacti	blue grama (BOGR2)(100), broom snakeweed (GUSA2)(81), Indian ricegrass (ACHY)(55), fourwing saltbush (ATCA2)(54), cane cholla (CYIMI)(42), soapweed yucca (YUGL)(28), sand sagebrush (ARFI2)(24)	600	0.17	10.39	7



Figure 12. MLRA 69, Breaks ecological site class; Community Class 2.1.

Supporting Information

No literature was found that dealt with the Breaks ecological site class.

LOAMY UPLAND ECOLOGICAL SITE CLASS



Figure 13. MLRA 69, Loamy Upland ecological site class.

General Description

This ecological site class is in an upland position on gently sloping plains. The plant communities do not benefit from run-on moisture from adjacent sites. The soils are deep and sandy loam to clayey textured. When the rainfall rate exceeds infiltration, the excess water flows across the surface and concentrates in low areas, or to areas with higher ground cover, or areas with higher infiltration rates, and/or it flows off of the site. Sheet and rill erosion are the dominant erosional process on this ecological site class. The level terrain allows easy travel for grazing animals. This is the most extensive ecological site class in the MLRA. These characteristics make it the most important site class for grazing animals, including wildlife, in MLRA 69.

Geomorphic Features

Landscape Position: Plains, Flat Ridges, Hills
Slope (percent): 1-25

Representative Soil Features

Soil Depth: Moderately Deep to Deep
Parent Material Kind: Mixed
Parent Material Origin: Mixed
Surface Texture: Clay to Sandy Loam
Surface Texture Modifier: None to extremely gravelly
Subsurface Texture Group: Clayey to Loamy
Drainage Class: Moderately Well Drained to Well Drained
Permeability Class: Very Slow to Moderately Rapid
Chemistry: None to Strongly Alkaline
Available Water Capacity: 3-12 inches

State and Transition Model

<p>1. Perennial - Annual Herbaceous</p> <p>1.1 Summer Tallgrass, Summer Midgrass, Summer Shortgrass, Spring Rhizomatous Grass, Spring Perennial Forb, Summer Rhizomatous Grass, Spring Midgrass</p> <p>910 lbs/ac</p>	<p>1 to 5: continuous heavy grazing</p> <p>5 to 1: herbaceous weed control, prescribed grazing</p>	<p>5. Annual – Perennial Herbaceous</p> <p>5.1 Spring Annual Forb(I), Summer Annual Forb, Summer Shortgrass, Summer Midgrass, Summer Rhizomatous Grass, Spring Perennial Forb, Spring Annual Forb</p> <p>1963 lbs/ac</p>
<p>1 to 2: plow, disk, plant</p>	<p>1 to 6: continuous heavy grazing, lack of fire</p> <p>6 to 1: brush management, prescribed burning, prescribed grazing</p> <p>5 to 2: plow, disk, plant</p>	<p>5 to 6: continuous heavy grazing, lack of fire</p> <p>6 to 5: brush management, prescribed burning without prescribed grazing</p>
<p>2. Cultivated Cropland</p> <p>Average County Yields winter wheat 16 bushels/ac grain sorghum 19 bushels/ac corn 178 bushels/ac alfalfa 2-3 tons/ac</p>	<p>6 to 2: plow, disk, plant</p>	<p>6. Woody –Herbaceous</p> <p>6.1 Evergreen Shrub, Summer Shortgrass, Evergreen Subshrub, Summer Rhizomatous Grass, Spring Rhizomatous Grass, Summer Midgrass, Spring Perennial Forb</p> <p>1042 lbs/ac</p>
<p>2 to 3: abandonment</p> <p>3 to 2: plow, disk, plant</p>	<p>2 to 4: range planting, prescribed grazing</p> <p>4 to 2: plow, disk, plant</p>	
<p>3. Abandoned Cropland</p> <p>3.1 Annual Forb, Perennial Forb, Summer Shortgrass, Summer Midgrass</p> <p>175 lbs/ac</p>	<p>3 to 4: range planting, prescribed grazing</p>	<p>4. Seeded Rangeland</p> <p>4.1 Summer Midgrass, Summer Shortgrass, Summer Rhizomatous Grass, Perennial Forb, Evergreen Shrub, Deciduous Shrub</p> <p>800 lbs/ac</p>

Figure 14. State and Transition Model, MLRA 69, Loamy Upland ecological site class.

Vegetation Dynamics

Community Class 1.1 in the State and Transition Model (Figure 14) is derived by combining the reference communities in the ecological sites correlated to the Loamy Upland ecological site class. The Perennial Herbaceous reference plant community on this ecological site class will produce approximately 910 lbs/acre. Important species include blue grama, western wheatgrass, buffalograss, and green needlegrass. With continuous heavy grazing the

site will transition to a mix of annual and perennial grasses and forbs, dominated by Russian thistle, and kochia. With herbaceous weed control and several years of prescribed grazing, the site can transition back to the Perennial Herbaceous state. If fire is not present for extended periods and the site is continuously grazed, the site may transition to a Woody - Herbaceous state (state 6). If brush management or prescribed burning are applied without prescribed grazing, the site can transition to the Annual – Perennial Herbaceous state (state 5). If long term prescribed grazing is used in conjunction with brush management and/or prescribed burning, the site may transition back to the reference state (state 1). With plowing and tillage, the site will transition to a Cultivated Cropland state (state 2) and with abandonment will transition to an Abandoned Cropland state (state 3). Production will decrease to 175 lbs/acre. With range planting, the site may transition to a seeded state with production averaging 800 lbs/acre. Commonly seeded species include western wheatgrass, blue grama, sideoats grama, and winterfat.

NRI PSUs were correlated to these community classes where possible. Community Class production, functional group dominance, and dominant species based on available NRI data are shown in Table 6. Ground and canopy cover from the PSUs was then used to estimate erosion and runoff using RHEM.

Table 6. NRI Community Class Data and RHEM Results - MLRA 69 Loamy Upland Ecological Site Class

Comm Class ID	Community Class Name	Dominant Species (Symbol, Lbs/Ac)	Production Lbs/Ac	Soil Loss T/Ac/Yr	% Runoff	# PSUs
069X.6.1.1	Summer Shortgrass, Summer Midgrass, Summer Rhizomatous Grass, Spring Rhizomatous Grass, Spring Annual Forb(I), Summer Perennial Forb, Spring Perennial Forb	blue grama (BOGR2)(419), James' galleta (PLJA)(87), sand dropseed (SPCR)(83), purple threeawn (ARPU9)(49), western wheatgrass (PASM)(46), alkali sacaton (SPAI)(41), broom snakeweed (GUSA2)(24)	1039	0.22	11.73	116
069X.6.3.1	Summer Shortgrass, Summer Midgrass, Spring Perennial Forb, Evergreen Shrub, Summer Rhizomatous Grass, Summer Perennial Forb, Summer Annual Forb	blue grama (BOGR2)(46), sand dropseed (SPCR)(26), hairy false goldenaster (HEVI4)(16), purple threeawn (ARPU9)(15), sand sagebrush (ARFI2)(12), scarlet globemallow (SPCO)(8), hairy grama (BOHI2)(5)	174	0.56	10.58	8
069X.6.5.1	Spring Annual Forb(I), Summer Annual Forb, Summer Shortgrass, Summer Midgrass, Summer Rhizomatous Grass, Spring Perennial Forb, Spring Annual Forb	prickly Russian thistle (SATR12)(408), kochia (BASC5)(318), Russian thistle (SAKA)(313), blue grama (BOGR2)(157), common sunflower (HEAN3)(119), sand dropseed (SPCR)(61), James' galleta (PLJA)(55)	1963	0.25	13.60	42
069X.6.6.1	Evergreen Shrub, Summer Shortgrass, Evergreen Subshrub, Summer Rhizomatous Grass, Spring Rhizomatous Grass, Summer Midgrass, Spring Perennial Forb	fourwing saltbush (ATCA2)(222), blue grama (BOGR2)(158), broom snakeweed (GUSA2)(107), Pleuraphis spp. (PLEUR12)(91), sand sagebrush (ARFI2)(64), rubber rabbitbrush (ERNA10)(42), Buffalograss (BODA2)(37)	1042	0.33	16.59	9

Supporting Information

The following publications support the State and Transition Model (STM). The first publication is a case study that explores the grazing management on a Colorado ranch that comes to similar outcomes to that of which the STM would suggest. The second publication examines mule deer, elk, and cattle diets and finds similar vegetation characteristics as the STM.

Grissom, G. and Steffens, T. 2013. Adaptive grazing management at Rancho Largo Cattle Company. *Rangelands* 35(5):35-44.

This article is a case study of a rancher in southeastern Colorado seeking to pay a mortgage on 14,020 acres of shortgrass steppe. Initially, the ranch managers were under the impression that maximizing stock numbers would lead to economic success. Eventually, they adapted an efficiency model that included a method-driven grazing system that proved to be unprofitable but struck an interest in grazing ecology. The objectives of this article were to demonstrate: 1) how managers adapt grazing systems and how management paradigms evolve; 2) how the ranch managers' 17 years of experience were consistent with scientific progress on grazing management. The study took place in La Junta, Colorado on loamy plains and sandy plains ecological sites in Major Land Resource Area 69 [both of which have been grouped together in this Loamy Upland ecological site class]. Precipitation measurements were taken throughout the study as were grazing records and annual economic records. All stockers and yearlings were valued at current market prices in the analysis. Ecological assessment evolved throughout the study from general observation to residual cover, litter, and major grass species composition. Percentages of blue grama and western wheatgrass were recorded, as were recruitment of additional species. Long term methods included GPS and photography.

The photomapping found vegetation components of galleta, green needlegrass, fourwing saltbush, New Mexico feathergrass, sand dropseed, sideoats grama, silver bluestem, vine mesquite, and winterfat. Grazing management was divided into the following three time periods: 1) the early years with a focus on economics and stocking rates; 2) the transition years with the shaping of ecological focus; 3) the late years of adaptive grazing decisions based on plant recovery goals.

The early years incorporated high stocking rates which were associated with poor conception rates and low gross margin per head. A few other management adjustments were made in terms of cattle breeds, replacement heifers, supplements, calving season dates, and rotational grazing system. However, when poor financial performance did not change, management strategies were reevaluated. This included a reduction in stocking rates, which eventually led to an increase in conception rates. Additionally, various other grazing strategies, including deferral, were employed. This time in the study led to two conclusions: 1) successful grazing management requires ecological assessment to increase awareness of necessary adaptation; 2) successful grazing management necessitates specific ecological goals. In 2000, it was discovered that the ranch had a poor water cycle as a result of low residual plant cover and litter, and a blue grama (shortgrass) dominated plant community. Therefore, a new goal of improving water capture, infiltration, and storage was created. This included a focus on plant species diversity, specifically the recruitment of western wheatgrass through short-term assessment of grazing at different times of the year.

Through these observations, it was found that western wheatgrass needed season-long deferment and short grazing periods to reach maturity. Further, it was observed that recovery was not strictly a function of time, but instead dependent on ecological conditions and growth characteristics of individual species. This led to further adapted management specific to plant species, grazing seasons, and cattle behavior that could cause progress in improving the water cycle, and species diversity.

Ultimately, there was stark contrast between the early years and the late years. The early years were marked with low residual herbage, litter, plant diversity, and high economic stress. The later years showed improved species diversity, higher residual cover and litter, higher animal performance, and higher gross margin per head.

Hansen, R.M. and L.D. Reid. 1975. Diet overlap of deer, elk, and cattle in southern Colorado. *Journal of Range Management* 28(1): 43-47.

This study took place on a private ranch east of Fort Garland, Colorado. The objective of the study was to estimate seasonal dietary overlaps of mule deer, elk, and cattle on free range via fecal analysis. Aerial photography suggested that the ranch annually supports approximately 2,500 elk, 4,000 deer, and 2,000 cattle (summer grazing). There are approximately five distinct range types throughout the ranch, with vegetation on rolling hills and steep slopes consisting of big sagebrush, rabbitbrush species, broom snakeweed, western wheatgrass, blue grama, smooth brome, prairie Junegrass, Indian ricegrass, mountain muhly, and fescues. Additionally, there is pinyon-juniper type, mountain meadows, conifer-aspen type, and open park types with a variety of vegetation.

The methods of the experiment included evaluation of botanical diet composition via microhistological fecal analysis from each of the three herbivores. The technician was trained to identify the fragments of the varying plant species in the different study areas.

The results found that the major foods of mule deer were big sagebrush, pinyon pine, fringed sagewort, true mountain mahogany, brome, sedge, fescue, bluegrass, and rabbitbrush in varying seasons. The elk diets on varying seasons included western wheatgrass, brome, needlegrass, bluegrass, winterfat, true mountain mahogany, fescue, sedge, and juniper. The cattle diets consisted of danthonia, fescue, bluegrass, sedge, and blue grama. Mule deer and elk tended to graze range plants similarly when the vegetation went dormant. Mule deer and cattle had the most overlap of diets in sedge, bluegrass, fescue, and true mountain mahogany. Ultimately, this study helps in understanding stocking rates that ensure sustained forage for livestock and wildlife.

ROCKY SLOPES ECOLOGICAL SITE CLASS



Figure 15. MLRA 69, Rocky Slopes ecological site class.

General Description

This ecological site class occurs on gravelly, channery and cobbly hills and slopes. It does not receive run-on moisture from adjacent sites. Soil depth ranges from very shallow near summits and ridgetops to very deep on side-slopes and toe-slopes. Soil texture ranges from clay loam to sandy loam. Water erosion is the primary erosional process on this site. Site stability is controlled by the rock fragments on the soil surface and in the soil profile. As wind and water erosion occur, the coarse fragments in the soil profile are exposed at the surface, which armors the surface and protects the site from wind and water erosion.

Geomorphic Features

Landscape Position: Hill, Ridge, Pediment Slopes
Slope (percent): 5-30 percent

Representative Soil Features

Soil Depth: Shallow to Deep
Parent Material Kind: Alluvium, Colluvium
Parent Material Origin: Mixed
Surface Texture: Loamy Sand to Clay
Surface Texture Modifier: None to Extremely Gravelly
Subsurface Texture Group: Loamy to Sandy
Drainage Class: Well Drained to Excessively Well Drained
Permeability Class: Very Slow to Moderately Rapid
Chemistry: None to strongly alkaline or gypsic
Available Water Capacity: 2 - 6 inches

States and Transition Model

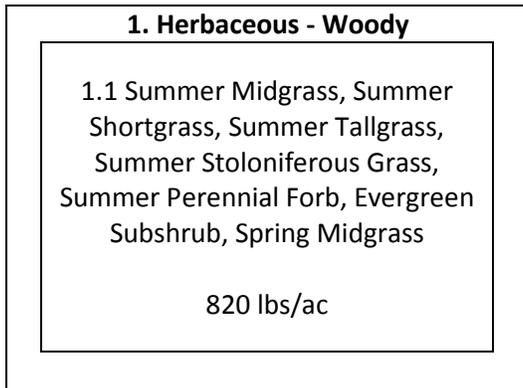


Figure 16. State and Transition Model, MLRA 69, Rocky Slopes ecological site class.

Vegetation Dynamics

Community Class 1.1 in the State and Transition Model (Figure 16) is derived by combining the reference communities in the Ecological Sites correlated to this ecological site class. The native plant community in this ecological site class is predominantly warm season shortgrasses and midgrasses, including blue grama, hairy grama, James' galleta, sand dropseed, alkali sacaton, and sideoats grama. Grazing pressure is reduced on the steeper portions of this ecological site class. All of the available NRI PSUs represent the reference plant community.

NRI PSUs were correlated to these community classes where possible. Community Class production, functional group dominance, and dominant species based on available NRI data are shown in Table 7. Ground and canopy cover from the PSUs was then used to estimate erosion and runoff using RHEM.

Table 7. NRI Community Class Data and RHEM Results - MLRA 69 Rocky Slopes Ecological Site Class.

Comm Class ID	Community Class Name	Dominant Species (Symbol, Lbs/Ac)	Production Lbs/Ac	Soil Loss T/Ac/Yr	% Runoff	# PSUs
069X.9.1.1	Summer Shortgrass, Summer Midgrass, Summer Rhizomatous Grass, Cacti, Summer Perennial Forb, Spring Perennial Forb, Evergreen Subshrub	blue grama (BOGR2)(258), hairy grama (BOHI2)(78), James' galleta (PLJA)(71), cane cholla (CYIMI)(53), sand dropseed (SPCR)(40), alkali sacaton (SPAI)(38), sideoats grama (BOCU)(37)	820	0.49	8.21	7

Supporting Information

No literature was found that dealt with this ecological site class.

SALINE UPLAND ECOLOGICAL SITE CLASS



Figure 17. MLRA 69, Saline Upland ecological site class.

General Description

The Saline Upland ecological site class occurs in an upland position on alluvial fans and terraces. It does not receive significant run-on moisture from adjacent sites. The soils are moderately deep to deep loams and clay loams with saline or saline-sodic chemistries. Salt tolerant species such as alkali sacaton, inland saltgrass, fourwing saltbush and green rabbitbrush are common.

Geomorphic Features

Landscape Position: Alluvial Fans, Terraces
Slope (percent): 0-3

Representative Soil Features

Soil Depth: Moderately Deep to Very Deep
Parent Material Kind: Alluvium
Parent Material Origin: Mixed
Surface Texture: Clay Loam to Sandy Loam
Surface Texture Modifier: None
Subsurface Texture Group: Loamy to Clayey
Drainage Class: Moderately Well Drained to Well Drained
Permeability Class: Moderately Slow to Very Slow
Chemistry: Saline to Saline-Sodic
Available Water Capacity: 4-7 inches

State and Transition Model

<p>1. Perennial – Annual Herbaceous</p> <p>1.1 Summer Midgrass, Summer Tallgrass, Summer Shortgrass, Spring Rhizomatous Grass, Summer Rhizomatous Grass, Spring Midgrass, Summer Perennial Forb</p> <p>1150 lbs/ac</p>	<p>1 to 5: continuous heavy grazing</p> <p>5 to 1: herbaceous weed control, prescribed grazing</p>	<p>5. Annual – Perennial Herbaceous</p> <p>5.1 Spring Annual Forb(I), Summer Perennial Forb(I), Spring Perennial Forb(I), Summer Midgrass, Spring Perennial Forb, Summer Annual Forb(I)</p> <p>2900 lbs/ac</p>
<p>1 to 2: plow, disk, plant</p>	<p>1 to 6: continuous heavy grazing, lack of fire</p> <p>6 to 1: brush management, prescribed burning, prescribed grazing</p> <p>5 to 2: plow, disk, plant</p>	<p>5 to 6: continuous heavy grazing, lack of fire</p> <p>6 to 5: brush management, prescribed burning without prescribed grazing</p>
<p>2. Cultivated Cropland</p> <p>Average County Yields winter wheat 16 bushels/ac grain sorghum 19 bushels/ac corn 178 bushels/ac alfalfa 2-3 tons/ac</p>	<p>6 to 2: plow, disk, plant</p>	<p>6. Woody –Herbaceous</p> <p>6.1 Evergreen Subshrub, Summer Midgrass, Evergreen Shrub, Spring Perennial Forb, Spring Rhizomatous Grass, Summer Annual Forb(I), Summer Shortgrass</p> <p>1273 lbs/ac</p>
<p>2 to 3: abandonment</p> <p>3 to 2: plow, disk, plant</p>	<p>2 to 4: range planting, prescribed grazing</p> <p>4 to 2: plow, disk, plant</p>	
<p>3. Abandoned Cropland</p> <p>3.1 Annual Forb, Perennial Forb, Summer Shortgrass, Summer Midgrass</p> <p>300 lbs/ac</p>	<p>3 to 4: range planting, prescribed grazing</p>	<p>4. Seeded Rangeland</p> <p>4.1 Summer Midgrass, Summer Shortgrass, Summer Rhizomatous Grass, Perennial Forb, Evergreen Shrub, Deciduous Shrub</p> <p>800lbs/ac</p>

Figure 18. State and Transition Model, MLRA 69, Saline Upland ecological site class.

Vegetation Dynamics

Community Class 1.1 in the State and Transition Model (Figure 18) is derived by combining the reference communities in the ecological sites correlated to this Saline Upland ecological site class. The reference plant community in this ecological site class produces approximately 1150 lbs/ac. Alkali sacaton, western wheatgrass, blue grama, and James' galleta are the common grasses. Shrubs include fourwing saltbush and shadscale saltbush. With continuous heavy grazing the site will transition to a mix of annual and perennial grasses and forbs, dominated by field bindweed, Russian thistle, and kochia. With herbaceous weed control and several years of prescribed grazing the site can transition back to the Perennial-Annual Herbaceous state (state 1). If fire is not present for extended periods and the site is continuously grazed, the site may transition to a Woody-Herbaceous state (state 6). If brush management or prescribed burning are applied without prescribed grazing, the site can transition to the Annual – Perennial Herbaceous state (state 5). If long term prescribed grazing is used in conjunction with brush management and/or prescribed burning, then the site may transition back to the reference state (state 1). If the site is plowed or tilled for crop production, it enters the Cultivated Cropland state (state 2). If the cultivated cropland is abandoned, native species such as purple threeawn, ring muhly, and sand dropseed will occupy the site, but production will be reduced to 300 lbs/ac/year (state 3). Alternatively, if the site is planted to native species, it can transition to a seeded state dominated by native species, but with slightly less production (state 4).

NRI PSUs were correlated to these community classes where possible. Community Class production, functional group dominance, and dominant species based on available NRI data are shown in Table 8. Ground and canopy cover from the PSUs was then used to estimate erosion and runoff using RHEM. Those results are also displayed in Table 8.

Table 8. NRI Community Class Data and RHEM Results - MLRA 69 Saline Upland Ecological Site Class

Comm Class ID	Community Class Name	Dominant Species (Symbol, Lbs/Ac)	Production Lbs/Ac	Soil Loss T/Ac/Yr	% Runoff	# PSUs
069X.24.1.1	Summer Midgrass, Summer Rhizomatous Grass, Spring Annual Forb(I), Spring Rhizomatous Grass, Evergreen Shrub, Spring Perennial Forb, Evergreen Subshrub	alkali sacaton (SPAI)(367), James' galleta (PLJA)(158), western wheatgrass (PASM)(89), sweetclover (MEOF)(58), kochia (BASC5)(53), fourwing saltbush (ATCA2)(43), squirreltail (ELEL5)(43)	1069	0.22	16.92	5
069X.24.5.1	Spring Annual Forb(I), Summer Perennial Forb(I), Spring Perennial Forb(I), Summer Midgrass, Spring Perennial Forb, Summer Annual Forb(I)	kochia (BASC5)(2506), field bindweed (COAR4)(112), whitetop (CADR)(111), Russian thistle (SAKA)(76), alkali sacaton (SPAI)(75), prickly Russian thistle (SATR12)(18), clover (TRIFO)(0)	2900	0.21	32.73	4
069x.24.6.1	Evergreen Subshrub, Summer Midgrass, Evergreen Shrub, Spring Perennial Forb, Spring Rhizomatous Grass, Summer Annual Forb(I), Summer Shortgrass	shadscale saltbush (ATCO)(782), alkali sacaton (SPAI)(264), fourwing saltbush (ATCA2)(91), sand dropseed (SPCR)(30), copper globemallow (SPAN3)(26), James' seaheath (FRJA)(23), western wheatgrass (PASM)(17)	12730	0.14	14.90	1

Supporting Information

The following publication supports the STM. The study observes vegetation characteristics through drought, and results show that the plant response is similar to what the STM predicts would occur as a result of disturbance.

Rondeau, R.J., Pearson, K.T., and Kelso, S. 2013. Vegetation response in a Colorado grassland-shrub community to extreme drought: 1999-2010. *The American Midland Naturalist* 170: 14-25.

This study was conducted in Pueblo, Colorado from 1999-2010 to examine vegetation changes following extreme drought, via observation of vegetation species cover, density and frequency. The original study design was intended to detect vegetation changes after the cessation of grazing, with seven plots on areas that were grazed up until 1998 and six plots on areas ungrazed since 1942. The authors searched for consistency in vegetative response to observed long term weather trend or potential climate change. Previous analysis indicated that there were no differences due to grazing in shrub or dominant grass measures at the beginning of this study.

From 1999-2001 the site was in pre-drought, from 2002-2003 it was extreme drought, and 2004-2010 was post-drought. The focus of the study was on the major vegetation species including blue grama, alkali sacaton, galleta grass, sand dropseed, purple threeawn, rabbitbrush, sand sagebrush, greasewood, and tree cholla.

Within the mixed grassland shrub prairie, 13 plots of 100m² were randomly located and marked with rebar. Additional stakes were placed in the four cardinal directions. In each plot, percent canopy of shrubs and grasses were measured, along with percent bare ground and litter. Additionally, density of shrubs and frequency of grasses were measured using belt transects.

The results found that shrub density did not change significantly over the study, but shrub cover did increase more than 30% (mostly rabbitbrush) with a sharp drop during the drought. With the close of the drought, shrubs recovered and increased 12% beyond that of 1999. The grass cover decreased significantly with the lowest cover occurring in the extreme drought. Seven years post-drought, recovery of grasses was not evident. Bare ground did not increase, as litter took its place. The drought did alter the relative proportions of the dominant species. Blue grama was 41% higher in cover than alkali sacaton pre-drought. At post-drought, blue grama was 37% less than alkali sacaton, with frequency experiencing similar losses. Galleta grass cover decreased over the course of the study, but its frequency slightly increased. The frequency of sand dropseed fluctuated greatly and purple threeawn decreased without full recovery.

SANDY UPLAND ECOLOGICAL SITE CLASS



Figure 19. MLRA 69, Sandy Upland ecological site class.

General Description

The Sandy Upland ecological site class occurs on gently sloping plains and rolling dunes. The soils are deep and sandy. Infiltration rates normally exceed precipitation rates, resulting in little surface flow or runoff on this site. Water-holding capacity is limited due to texture. Wind erosion is the dominant erosional process on this site class when vegetation cover is reduced.

Geomorphic Features

Landscape Position: Dunes, Hills, Plains
Slope (percent): 1-35

Representative Soil Features

Soil Depth: Deep to Very Deep
Parent Material Kind: Aeolian, Alluvium
Parent Material Origin: Mixed
Surface Texture: Sandy Loam to Sand
Surface Texture Modifier: None
Subsurface Texture Group: Sandy
Drainage Class: Excessively Well Drained
Permeability Class: Rapid to Very Rapid
Chemistry: None
Available Water Capacity: 1-4 inches

State and Transition Model

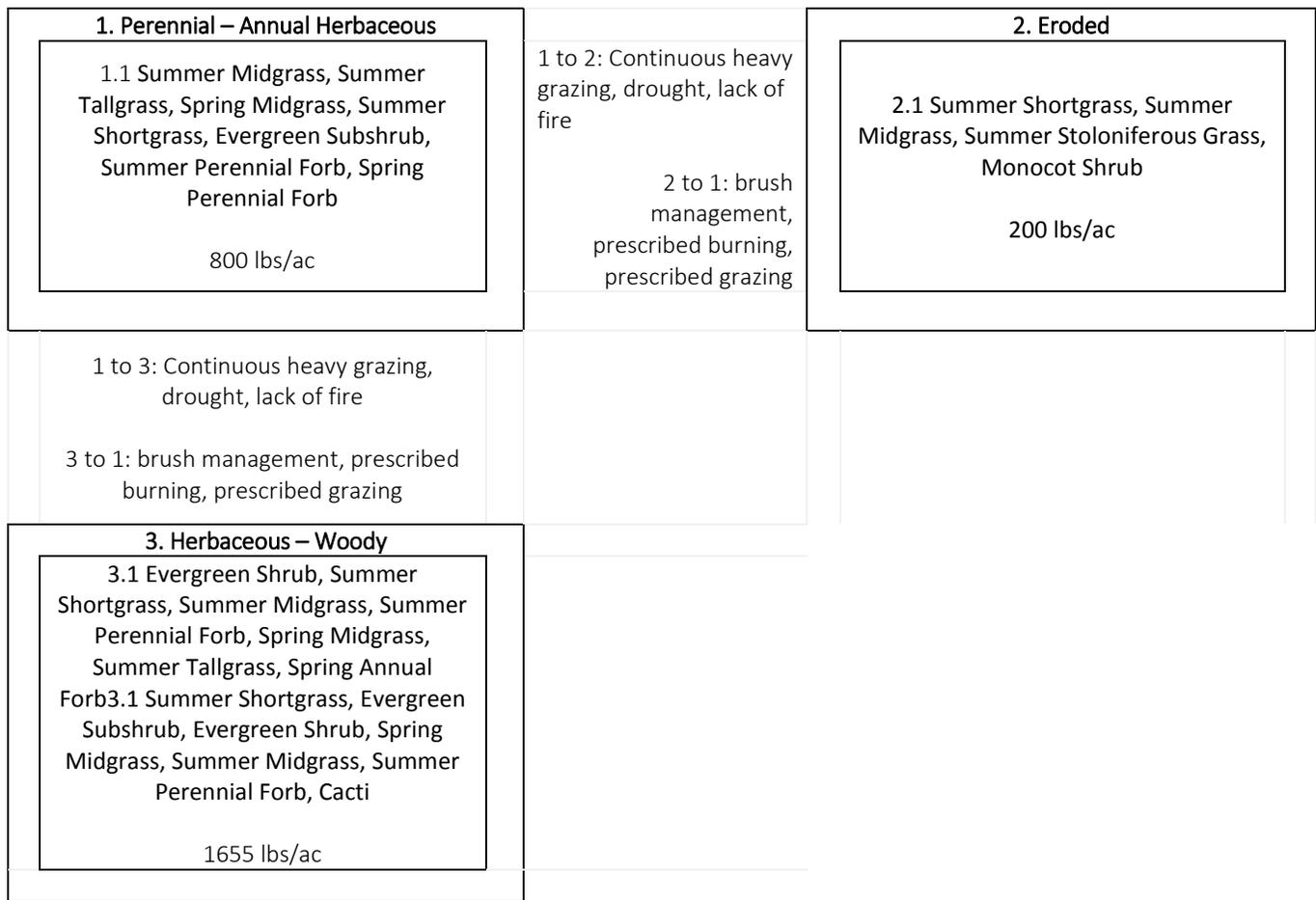


Figure 20. State and Transition Model, MLRA 69, Sandy Upland ecological site class.

Vegetation Dynamics

Community Class 1.1 in the State and Transition Model (Figure 20) is derived by combining the reference communities in the ecological sites correlated to this ecological site class. The reference community for the Sandy Upland ecological site class produces approximately 1400 lbs/ac/yr. Prominent grasses include sand bluestem, needleandthread, switchgrass, and blue grama. With continuous season long heavy grazing, the site may transition to an Eroded state (state 2). This state would have an average production of 200 lbs/ac/yr with blue grama, sandhill muhly, purple threeawn, and soapweed yucca. To return to within-reference conditions (state 1), the site may require critical area planting and grazing with deferral periods long enough to provide for regrowth. With continuous heavy grazing and lack of a regular fire interval, the site may transition to an Herbaceous-Woody state (state 3) with sand sagebrush as the dominant species and average production of 1655 lbs/ac/yr. Restoration to the reference community can be achieved with brush management, prescribed fire, and prescribed grazing.

NRI PSUs were correlated to these community classes where possible. Community Class production, functional group dominance, and dominant species based on available NRI data are shown in Table 9. Ground and canopy cover from the PSUs was then used to estimate erosion and runoff using RHEM.

Table 9. NRI Community Class Data and RHEM Results - MLRA 69 Sandy Upland Ecological Site Class.

Comm Class ID	Community Class Name	Dominant Species (Symbol, Lbs/Ac)	Production Lbs/Ac	Soil Loss T/Ac/Yr	% Runoff	# PSUs
069X.7.1.1	Summer Shortgrass, Summer Midgrass, Summer Annual Forb, Evergreen Shrub, Spring Annual Forb(I), Spring Midgrass, Spring Perennial Forb	blue grama (BOGR2)(328), sand dropseed (SPCR)(254), sand sagebrush (ARF12)(132), Russian thistle (SAKA)(116), needle and thread (HECO26)(95), curlycup gumweed (GRSQ)(59), purple threeawn (ARPU9)(51)	1450	0.10	5.06	17
069X.7.3.1	Evergreen Shrub, Summer Shortgrass, Summer Midgrass, Summer Perennial Forb, Spring Midgrass, Summer Tallgrass, Spring Annual Forb	sand sagebrush (ARF12)(911), blue grama (BOGR2)(345), sand dropseed (SPCR)(115), needle and thread (HECO26)(68), gilia beardtongue (PEAM)(48), sand bluestem (ANHA)(20), prairie sandreed (CALO)(19)	1655	0.05	3.26	2

Supporting Information

The following publications support the STM. The first publication examined various range site characteristics and found similar vegetation characteristics and management suggestions to that of the STM. The second publication studied seed germination in both a laboratory and in a field experiment. Although, this publication doesn't prove anything about the STM, it does offer some suggestions for management within this type of range site.

Heerwagen, Arnold. 1958. Management as related to range site in the central plains of eastern Colorado. Journal of Range Management 11(1): 5-9.

This publication examines sites in eastern Colorado; their diverse plant cover, and their management issues. The publication dissects some of the Soil Conservation Service range sites in the Great Plains and examines whether the sites are one encompassed range type or whether it consists of a mixture of shortgrasses and midgrasses. Therefore, a comparison of climax plant groups on deep sand, sandy loam, and silt loam uplands in differences of plant cover and key species was completed.

Sandhill rangelands were described as having favorable soil moisture contents resulting from high water intake and low plant wilting coefficients. When in excellent range condition, this site supports tallgrasses and midgrasses. The dominant vegetation consists of sand bluestem, prairie sandreed, little bluestem, and needleandthread grass.

The medium-textured upland rangelands are hardlands and croplands with high soil water-holding capacities. These sites are naturally shortgrasses and have a dominant vegetation of buffalograss. Other species include western wheatgrass, sideoats grama, needleandthread, perennial threeawn, and sand dropseed. These species will increase with grazing use and are relatively abundant on disturbed areas and abandoned cropland.

The sandy plains rangelands are finer textured subsoils and are row croplands for agriculturists. The plant cover is a mixture of midgrasses, shortgrasses, and some tallgrasses. These include, little bluestem, sideoats grama, blue grama, prairie sandreed, needleandthread, hairy grama, and sand bluestem. With declining range conditions, sand dropseed, and perennial threeawns may dominate a site.

Herbage yield studies indicate significant differences in forage production between the different kinds of rangeland. Therefore, management strategies will differ in each site. With loamy upland rangelands, grazing management

should be based on the establishment and maintenance of plant cover dominated by blue grama. Maintenance of shortgrasses is challenging with continuous grazing use. Sandhill rangelands, when grazing is properly managed, can be very profitable via productive stands of tallgrasses and midgrasses. Declines in productivity are marked by blue grama, hairy grama, sand dropseed increases and is susceptible to severe wind erosion. Therefore, management needs to be directed toward soil stability. Management of the sandy plains necessitates practices be focused on midgrasses and tallgrasses. With a decline in rangeland conditions, sites will have an increase in shortgrasses that will not provide adequate forage production or plant cover.

Conclusions of this study indicate the following: 1) Knowledge of potential plant cover is critical to determining grazing practices; 2) examination of range sites in eastern Colorado reveals significant differences in kind and amount of plant cover; 3) range site evaluations assist in determining the place for shortgrasses, midgrasses, and tallgrasses in various kinds of rangelands; 4) deep sands support a plant cover with dominance of tallgrasses and midgrasses. Shortgrasses dominate medium-textured upland soils and sandy loams support a mixture of midgrasses, shortgrasses and tallgrasses; 5) in order to attain optimum forage and livestock production, grazing management strategies on these range sites should be based off of the reestablishment and/or maintenance of the kind of plant cover characteristic of the sites.

Shaidae, G., B.E. Dahl, and R.M. Hansen. 1969. Germination and emergence of different age seeds of six grasses. *Journal of Range Management* 22(4): 240-243.

In this study, six grass varieties of different ages were tested for germination and percentage field emergence. Two-hundred pure live seeds of each species were selected with 100 being used in the laboratory, and 100 in the field. The species included sand bluestem, sideoats grama, blue grama, switchgrass, and yellow Indiangrass.

For the laboratory experiment, the 100 seeds were divided into five replicates of 20 seeds each and placed on blotters for "covered petri dish tests". These were placed in the germinator. Humidity, temperature, and light were regulated to simulate natural conditions.

The field experiments were done close to Fort Collins, Colorado. The site was moldboard plowed, then harrowed and disked. Five plots were prepared for hand-planting. Each of the species had three or four harvest years, and were randomly located in blocks.

The results found that best age of seed for planting differed greatly among the species in the laboratory. Additionally, the results from the laboratory and field tests were not always consistent. One-year-old seeds of sand bluestem, blue grama and A-6606 switchgrass; two-year-old sideoats grama and yellow Indiangrass; and seven-year-old Grenville switchgrass seeds had emerged best at the end of the field test. Except for sandhill bluestem, seeds two years and older emerged faster, a factor that may be important in successful field establishment.

WET BOTTOMLAND, SALINE ECOLOGICAL SITE CLASS



Figure 21. MLRA 69, Wet Bottomland, Saline ecological site class that was restored using Herbaceous Weed Control and High Intensity – Short Duration grazing.

General Description

The Wet Bottomland, Saline ecological site class occurs in floodplains and drainageways. This site receives run-on and/or subsurface water flows from adjacent uplands. It has a shallow water table (within 5 feet) available for plant growth at least seasonally in most years. Surface water may be present all or part of the year. Wetland soils and obligate wetland vegetation may be present. Flooding and/or ponding occurs occasionally to frequently. Potential plant community production is significantly higher than that of adjacent uplands, and the response to management is more rapid because of the availability of water. This ecological site class is very high in wildlife diversity.

Geomorphic Features

Landscape Positions: Floodplains, Floodplain steps, Draws
Slope (percent): 0-3

Representative Soil Features

Soil Depth: Deep to Very Deep
Parent Material Kind: Alluvium
Parent Material Origin: Mixed
Surface Texture: Silty Clay Loam to Clay Loam
Surface Texture Modifier: None
Subsurface Texture Group: Clayey
Drainage Class: Poorly Drained to Somewhat Poorly Drained
Permeability Class: Slow to Moderately Rapid
Chemistry: Saline to Saline-Sodic
Available Water Capacity: 4-8 inches

State and Transition Model

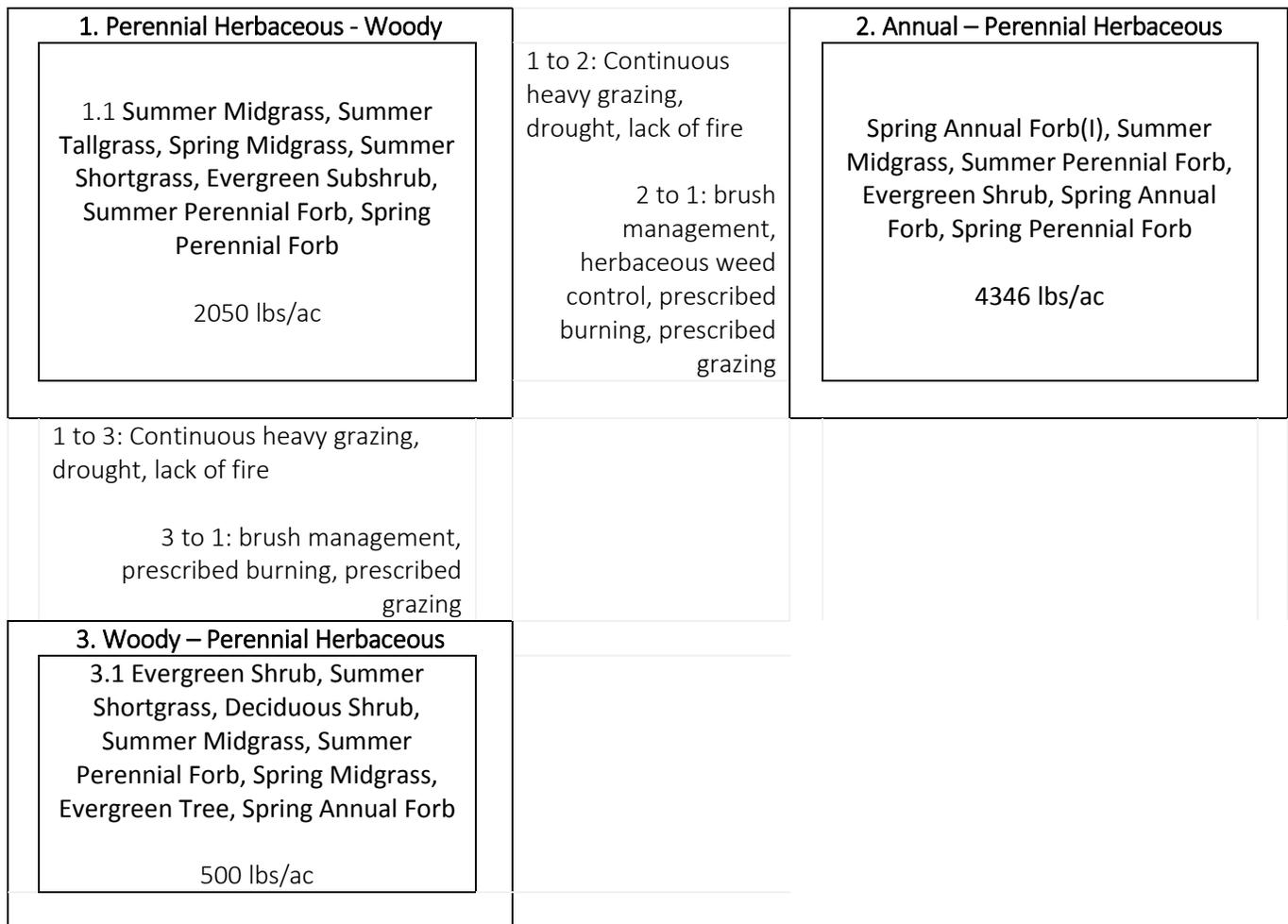


Figure 21. State and Transition Model, MLRA 69, Wet Bottomland, Saline ecological site class.

Vegetation Dynamics

The native plant community on this ecological site class produces about 2050 lbs/ac/year of aboveground growth on an air-dry weight basis. This is predominantly tall and midgrasses such as big bluestem, Indiangrass, alkali sacaton, switchgrass, prairie cordgrass, and western wheatgrasses. With continuous heavy grazing the site will transition to mix of non-native annuals, midgrasses, forbs, and shrubs. Application of herbaceous weed control, plus high intensity-short duration grazing management will return the site to the grass-dominated plant community class. With continuous heavy grazing and lack of a regular fire interval, invasive woody species such as saltcedar and Russian olive invade the site, causing it to transition to the Woody – Herbaceous state. Application of brush control, plus high intensity-short duration grazing management will return the site to the grass-dominated plant community class.

NRI PSUs were correlated to these community classes where possible. Community Class production, functional group dominance, and dominant species based on available NRI data are shown in Table 10. Ground and canopy cover from the PSUs was then used to estimate erosion and runoff using RHEM.

Table 10. NRI Community Class Data and RHEM Results - MLRA 69, Wet Bottomland, Saline ecological site class.

Comm Class ID	Community Class Name	Dominant Species (Symbol, Lbs/Ac)	Production Lbs/Ac	Soil Loss T/Ac/Yr	% Runoff	# PSUs
069X.13.1.1	Summer Midgrass, Spring Annual Forb(I), Deciduous Tree, Summer Rhizomatous Grass, Summer Annual Forb, Summer Perennial Forb, Spring Rhizomatous Grass	alkali sacaton (SPAI)(1190), prickly Russian thistle (SATR12)(475), eastern cottonwood (PODE3)(407), vine mesquite (PAOB)(204), sand dropseed (SPCR)(173), common sunflower (HEAN3)(114), kochia (BASC5)(84)	2820	0.01	10.62	2
069X.13.2.1	Spring Annual Forb(I), Summer Midgrass, Summer Perennial Forb, Evergreen Shrub, Spring Annual Forb, Spring Perennial Forb	kochia (BASC5)(3378), alkali sacaton (SPAI)(464), Mojave seablite (SUMO)(303), prickly Russian thistle (SATR12)(136), rubber rabbitbrush (ERNA10)(52), buffalobur nightshade (SORO)(5), sandmat (CHAMA15)(4)	4346	0.27	17.59	2

Supporting Information

No literature was found that dealt with this ecological site class.

APPENDIX A. MLRA 69, ECOLOGICAL SITE CLASSES SHOWING THE ECOLOGICAL SITES, ECOLOGICAL SITE IDS, AND PLANT COMMUNITY CLASSES THAT WERE CORRELATED TO EACH SITE CLASS.

MLRA	Ecological Site Class Name	Ecological Site Names	Ecological Site ID
69	Bottom	Sandy Bottomland	R069XY031CO
		Saline Overflow	R069XY037CO
		Plant Community Class Names, from NRI data	Plant Community Class ID
		Summer Shortgrass, Summer Midgrass, Summer Annual Forb, Spring Perennial Forb, Spring Annual Forb(I), Summer Tall Grass, Summer Perennial Forb	069X.2.1.1
		Spring Perennial Forb, Summer Perennial Forb, Summer Shortgrass, Evergreen Shrub, Spring Midgrass, Summer Rhizomatous Grass, Summer Midgrass	069X.2.2.1
		Spring Annual Forb(I), Summer Midgrass, Spring Annual Forb, Spring Perennial Forb, Spring Annual Grass, Summer Annual Forb, Summer Shortgrass	069X.2.3.1
MLRA	Ecological Site Class Name	Ecological Site Names	Ecological Site ID
69	Breaks	Limestone Breaks	R069XY058CO
		Sandstone Breaks	R069XY053CO
		Plant Community Class Names, from NRI data	Plant Community Class ID
		Summer Shortgrass, Summer Rhizomatous Grass, Summer Midgrass, Spring Annual Forb, Spring Midgrass, Spring Perennial Forb, Evergreen Subshrub	069X.12.1.1
		Coniferous Tree, Summer Shortgrass, Summer Midgrass, Summer Stoloniferous Grass, Evergreen Shrub, Evergreen Subshrub, Summer Rhizomatous Grass	069X.12.2.1
		Summer Shortgrass, Evergreen Subshrub, Evergreen Shrub, Spring Midgrass, Summer Midgrass, Summer Perennial Forb, Cacti	069X.12.3.1

MLRA	Ecological Site Class Name	Ecological Site Names	Ecological Site ID
69	Loamy Upland	Alkaline Plains	R069XY047CO
		Clayey Plains	R069XY042CO
		Loamy Plains	R069XY006CO
		Sandy Plains	R069XY026CO
		Shaly Plains	R069XY046CO
		Plant Community Class Names, from NRI data	Plant Community Class ID
		Summer Shortgrass, Summer Midgrass, Summer Rhizomatous Grass, Spring Rhizomatous Grass, Spring Annual Forb(I), Summer Perennial Forb, Spring Perennial Forb	069X.6.1.1
		Summer Shortgrass, Summer Midgrass, Spring Perennial Forb, Evergreen Shrub, Summer Rhizomatous Grass, Summer Perennial Forb, Summer Annual Forb	069X.6.3.1
		Spring Annual Forb(I), Summer Annual Forb, Summer Shortgrass, Summer Midgrass, Summer Rhizomatous Grass, Spring Perennial Forb, Spring Annual Forb	069X.6.5.1
		Evergreen Shrub, Summer Shortgrass, Evergreen Subshrub, Summer Rhizomatous Grass, Spring Rhizomatous Grass, Summer Midgrass, Spring Perennial Forb	069X.6.6.1
MLRA	Ecological Site Class Name	Ecological Site Names	Ecological Site ID
69	Rocky Slopes	Gravel Breaks	R069XY064CO
		Gypsum Breaks	R069XY080CO
		Shale Breaks	R069XY048CO
		Plant Community Class Names, from NRI data	Plant Community Class ID
		Summer Shortgrass, Summer Midgrass, Summer Rhizomatous Grass, Cacti, Summer Perennial Forb, Spring Perennial Forb, Evergreen Subshrub	069X.9.1.1

MLRA	Ecological Site Class Name	Ecological Site Names	Ecological Site ID
69	Saline Upland	Salt Flat	R069XY033CO
		Sandy Salt Flat	R069XY032CO
		Plant Community Class Names, from NRI data	Plant Community Class ID
		Summer Midgrass, Summer Rhizomatous Grass, Spring Annual Forb(I), Spring Rhizomatous Grass, Evergreen Shrub, Spring Perennial Forb, Evergreen Subshrub	069X.24.1.1
		Spring Annual Forb(I), Summer Perennial Forb(I), Spring Perennial Forb(I), Summer Midgrass, Spring Perennial Forb, Summer Annual Forb(I)	069X.24.5.1
		Evergreen Subshrub, Summer Midgrass, Evergreen Shrub, Spring Perennial Forb, Spring Rhizomatous Grass, Summer Annual Forb(I), Summer Shortgrass	069X.24.6.1
MLRA	Ecological Site Class Name	Ecological Site Names	Ecological Site ID
69	Sandy Upland	Choppy Sands	R069XY021CO
		Deep Sand	R069XY019CO
		Plant Community Class Names, from NRI data	Plant Community Class ID
		Summer Shortgrass, Summer Midgrass, Summer Annual Forb, Evergreen Shrub, Spring Annual Forb(I), Spring Midgrass, Spring Perennial Forb	069X.7.1.1
		Evergreen Shrub, Summer Shortgrass, Summer Midgrass, Summer Perennial Forb, Spring Midgrass, Summer Tall Grass, Spring Annual Forb	069X.7.3.1
MLRA	Ecological Site Class Name	Ecological Site Names	Ecological Site ID
69	Wet Bottomland	Salt Meadow	R069XY030CO
		Plant Community Class Names, from NRI data	Plant Community Class ID
		Summer Midgrass, Spring Annual Forb(I), Deciduous Tree, Summer Rhizomatous Grass, Summer Annual Forb, Summer Perennial Forb, Spring Rhizomatous Grass	069X.13.1.1
		Spring Annual Forb(I), Summer Midgrass, Summer Perennial Forb, Evergreen Shrub, Spring Annual Forb, Spring Perennial Forb	069X.13.2.1

APPENDIX B. MLRA 69, ECOLOGICAL SITE CLASS AND COMMUNITY CLASS SUMMARY

Site Class Name	State	Comm Class ID	ESD Comm Class	ESD Lbs/ Ac	NRI Community Class	NRI Dominant Species (Symbol, Lbs/Ac)	NRI Lbs/ Ac	# PSUs
Bottom	Perennial - Annual Herbaceous	069X.2.1.1	Summer Tallgrass, Summer Midgrass, Summer Rhizomatous Grass, Summer Perennial Forb, Evergreen Shrub, Spring Rhizomatous Grass, Spring Perennial Forb	1600	Summer Shortgrass, Summer Midgrass, Summer Annual Forb, Spring Perennial Forb, Spring Annual Forb(I), Summer Tallgrass, Summer Perennial Forb	blue grama (BOGR2)(486), sand dropseed (SPCR)(205), common sunflower (HEAN3)(26), lemon scurfpea (PSLA3)(24), Russian thistle (SAKA)(23), prairie sandreed (CALO)(19), Cuman ragweed (AMPS)(8)	800	1
Bottom	Perennial Herbaceous - Woody	069X.2.2.1			Spring Perennial Forb, Summer Perennial Forb, Summer Shortgrass, Evergreen Shrub, Spring Midgrass, Summer Rhizomatous Grass, Summer Midgrass	woolly locoweed (ASMO7)(248), leafy false goldenweed (OOF0)(194), blue grama (BOGR2)(157), sand sagebrush (ARF12)(23), broom snakeweed (GUSA2)(23), eastern redcedar (JUVI)(22), Indian ricegrass (ACHY)(21)	837	4
Bottom	Woody - Perennial Herbaceous	069X.2.3.1			Spring Annual Forb(I), Summer Midgrass, Spring Annual Forb, Spring Perennial Forb, Spring Annual Grass, Summer Annual Forb, Summer Shortgrass	Russian thistle (SAKA)(926), prickly Russian thistle (SATR12)(564), kochia (BASC5)(538), alkali sacaton (SPAI)(115), lambsquarters (CHAL7)(66), sandmat (CHAMA15)(53), sand dropseed (SPCR)(47)	2499	5
Bottom	Cultivated Cropland	069X.2.4.1			Cultivated Crops	winter wheat 16 bushels/ac, grain sorghum 19 bushels/ac, corn 178 bushels/ac, alfalfa 2-3 tons/ac		
Bottom	Seeded Rangeland	069X.2.5.1			Seeded Rangeland - Summer Midgrass, Summer Shortgrass, Perennial Forb, Evergreen Shrub, Deciduous Shrub		2000	
Bottom	Abandoned Cropland	069X.2.6.1			Abandoned Cropland - Annual Forb, Perennial Forb, Summer Shortgrass, Summer Midgrass		300	
Breaks	Perennial - Annual Herbaceous	069X.12.1.1	Summer Midgrass, Summer Tallgrass, Spring Midgrass, Summer Shortgrass, Evergreen Subshrub, Summer Perennial Forb, Spring Perennial Forb	799	Summer Shortgrass, Summer Rhizomatous Grass, Summer Midgrass, Spring Annual Forb, Spring Midgrass, Spring Perennial Forb, Evergreen Subshrub	blue grama (BOGR2)(179), James' galleta (PLJA)(93), purple threeawn (ARPU9)(75), mealy goosefoot (CHIN2)(67), western wheatgrass (PASM)(57), needle and thread (HECO26)(46), squirreltail (ELEL5)(45)	1082	8

Site Class Name	State	Comm Class ID	ESD Comm Class	ESD Lbs/ Ac	NRI Community Class	NRI Dominant Species (Symbol, Lbs/Ac)	NRI Lbs/ Ac	# PSUs
Breaks	Woody - Perennial Herbaceous	069X.12.2.1			Coniferous Tree, Summer Shortgrass, Summer Midgrass, Summer Stoloniferous Grass, Evergreen Shrub, Evergreen Subshrub, Summer Rhizomatous Grass	oneseed juniper (JUMO)(358), blue grama (BOGR2)(147), sideoats grama (BOCU)(34), black grama (BOER4)(22), purple threeawn (ARPU9)(15), alderleaf mountain mahogany (CEMO2)(14), Arizona madrone (ARAR2)(12)	767	8
Breaks	Perennial Herbaceous - Woody	069X.12.3.1			Summer Shortgrass, Evergreen Subshrub, Evergreen Shrub, Spring Midgrass, Summer Midgrass, Summer Perennial Forb, Cacti	blue grama (BOGR2)(103), broom snakeweed (GUSA2)(77), Indian ricegrass (ACHY)(47), fourwing saltbush (ATCA2)(46), cane cholla (CYIMI)(39), slimflower scurfpea (PSTE5)(31), soapweed yucca (YUGL)(26)	599	7
Loamy Upland	Perennial - Annual Herbaceous	069X.6.1.1	Summer Tallgrass, Summer Midgrass, Summer Shortgrass, Spring Rhizomatous Grass, Spring Perennial Forb, Summer Rhizomatous Grass, Spring Midgrass	910	Summer Shortgrass, Summer Midgrass, Summer Rhizomatous Grass, Spring Rhizomatous Grass, Spring Annual Forb(I), Summer Perennial Forb, Spring Perennial Forb	blue grama (BOGR2)(419), James' galleta (PLJA)(87), sand dropseed (SPCR)(83), purple threeawn (ARPU9)(49), western wheatgrass (PASM)(46), alkali sacaton (SPA1)(41), broom snakeweed (GUSA2)(24)	1039	116
Loamy Upland	Cultivated Cropland	069X.6.2.1			Cultivated Crops	winter wheat 16 bushels/ac, grain sorghum 19 bushels/ac, corn 178 bushels/ac, alfalfa 2-3 tons/ac		
Loamy Upland	Abandoned Cropland	069X.6.3.1			Abandoned Cropland - Annual Forb, Perennial Forb, Summer Shortgrass, Summer Midgrass	blue grama (BOGR2)(46), sand dropseed (SPCR)(26), hairy false goldenaster (HEVI4)(16), purple threeawn (ARPU9)(15), sand sagebrush (ARFI2)(12), scarlet globemallow (SPCO)(8), hairy grama (BOHI2)(5)	174	8
Loamy Upland	Seeded Rangeland	069X.6.4.1			Seeded Rangeland - Summer Midgrass, Summer Shortgrass, Perennial Forb, Evergreen Shrub, Deciduous Shrub		800	
Loamy Upland	Annual - Perennial Herbaceous	069X.6.5.1			Spring Annual Forb(I), Summer Annual Forb, Summer Shortgrass, Summer Midgrass, Summer Rhizomatous Grass, Spring Perennial Forb, Spring Annual Forb	prickly Russian thistle (SATR12)(408), kochia (BASC5)(318), Russian thistle (SAKA)(313), blue grama (BOGR2)(157), common sunflower (HEAN3)(119), sand dropseed (SPCR)(61), James' galleta (PLJA)(55)	1963	42
Loamy Upland	Woody - Perennial Herbaceous	069X.6.6.1			Evergreen Shrub, Summer Shortgrass, Evergreen Subshrub,	fourwing saltbush (ATCA2)(222), blue grama (BOGR2)(158), broom	1042	9

Site Class Name	State	Comm Class ID	ESD Comm Class	ESD Lbs/ Ac	NRI Community Class	NRI Dominant Species (Symbol, Lbs/Ac)	NRI Lbs/ Ac	# PSUs
					Summer Rhizomatous Grass, Spring Rhizomatous Grass, Summer Midgrass, Spring Perennial Forb	snakeweed (GUSA2)(107), Pleuraphis spp. (PLEUR12)(91), sand sagebrush (ARFI2)(64), rubber rabbitbrush (ERNA10)(42), Buffalograss (BODA2)(37)		
Rocky Slopes	Perennial Herbaceous - Woody	069X.9.1.1	Summer Midgrass, Summer Shortgrass, Summer Tallgrass, Summer Stoloniferous Grass, Summer Perennial Forb, Evergreen Subshrub, Spring Midgrass		Summer Shortgrass, Summer Midgrass, Summer Rhizomatous Grass, Cacti, Summer Perennial Forb, Spring Perennial Forb, Evergreen Subshrub	blue grama (BOGR2)(258), hairy grama (BOHI2)(78), James' galleta (PLJA)(71), cane cholla (CYIMI)(53), sand dropseed (SPCR)(40), alkali sacaton (SPAI)(38), sideoats grama (BOCU)(37)	822	7
Saline Upland	Perennial - Annual Herbaceous	069X.24.1.1	Summer Midgrass, Summer Tallgrass, Summer Shortgrass, Spring Rhizomatous Grass, Summer Rhizomatous Grass, Spring Midgrass, Summer Perennial Forb	1149	Summer Midgrass, Summer Rhizomatous Grass, Spring Annual Forb(I), Spring Rhizomatous Grass, Evergreen Shrub, Spring Perennial Forb, Evergreen Subshrub	alkali sacaton (SPAI)(367), James' galleta (PLJA)(158), western wheatgrass (PASM)(89), sweetclover (MEOF)(58), Kochia (BASC5)(53), fourwing saltbush (ATCA2)(43), squirreltail (EELS5)(43)	1069	5
Saline Upland	Cultivated Cropland	069X.24.2.1			Cultivated Crops	winter wheat 16 bushels/ac, grain sorghum 19 bushels/ac, corn 178 bushels/ac, alfalfa 2-3 tons/ac		
Saline Upland	Abandoned Cropland	069X.24.3.1			Abandoned Cropland - Annual Forb, Perennial Forb, Summer Shortgrass, Summer Midgrass		300	
Saline Upland	Seeded Rangeland	069X.24.4.1			Seeded Rangeland - Summer Midgrass, Summer Shortgrass, Perennial Forb, Evergreen Shrub, Deciduous Shrub		800	
Saline Upland	Annual - Perennial Herbaceous	069X.24.5.1			Spring Annual Forb(I), Summer Perennial Forb(I), Spring Perennial Forb(I), Summer Midgrass, Spring Perennial Forb, Summer Annual Forb(I)	kochia (BASC5)(2506), field bindweed (COAR4)(112), whitetop (CADR)(111), Russian thistle (SAKA)(76), alkali sacaton (SPAI)(75), prickly Russian thistle (SATR12)(18), clover (TRIFO)(0)	2901	4
Saline Upland	Woody - Perennial Herbaceous	069X.24.6.1			Evergreen Subshrub, Summer Midgrass, Evergreen Shrub, Spring Perennial Forb, Spring Rhizomatous Grass, Summer Annual Forb(I), Summer Shortgrass	shadscale saltbush (ATCO)(782), alkali sacaton (SPAI)(264), fourwing saltbush (ATCA2)(91), sand dropseed (SPCR)(30), copper globemallow (SPAN3)(26), James' seaheath (FRJA)(23), western wheatgrass (PASM)(17)	1273	1

Site Class Name	State	Comm Class ID	ESD Comm Class	ESD Lbs/ Ac	NRI Community Class	NRI Dominant Species (Symbol, Lbs/Ac)	NRI Lbs/ Ac	# PSUs
Sandy Upland	Perennial - Annual Herbaceous	069X.7.1.1	Summer Tallgrass, Summer Perennial Forb, Spring Midgrass, Summer Midgrass, Spring Perennial Forb, Summer Shortgrass, Deciduous Shrub	1324	Summer Shortgrass, Summer Midgrass, Summer Annual Forb, Evergreen Shrub, Spring Annual Forb(I), Spring Midgrass, Spring Perennial Forb	blue grama (BOGR2)(328), sand dropseed (SPCR)(254), sand sagebrush (ARFI2)(132), Russian thistle (SAKA)(116), needle and thread (HECO26)(95), curlycup gumweed (GRSQ)(59), purple threeawn (ARPU9)(51)	1449	17
Sandy Upland	Eroded	069X.7.2.1			Eroded - Summer Shortgrass, Summer Midgrass, Summer Stoloniferous Grass, Monocot Shrub		200	
Sandy Upland	Perennial Herbaceous - Woody	069X.7.3.1			Evergreen Shrub, Summer Shortgrass, Summer Midgrass, Summer Perennial Forb, Spring Midgrass, Summer Tallgrass, Spring Annual Forb	sand sagebrush (ARFI2)(911), blue grama (BOGR2)(345), sand dropseed (SPCR)(115), needle and thread (HECO26)(68), gilia beardtongue (PEAM)(48), sand bluestem (ANHA)(20), prairie sandreed (CALO)(19)	1656	2
Wet Bottomland, Saline	Perennial Herbaceous - Woody	069X.13.1.1	Summer Tallgrass, Summer Midgrass, Spring Rhizomatous Grass, Summer Rhizomatous Grass, Spring Shortgrass, Summer Perennial Forb, Evergreen Shrub	2049	Summer Midgrass, Spring Annual Forb(I), Deciduous Tree, Summer Rhizomatous Grass, Summer Annual Forb, Summer Perennial Forb, Spring Rhizomatous Grass	alkali sacaton (SPAI)(1190), prickly Russian thistle (SATR12)(475), eastern cottonwood (PODE3)(407), vine mesquite (PAOB)(204), sand dropseed (SPCR)(173), common sunflower (HEAN3)(114), kochia (BASC5)(84)	2820	2
Wet Bottomland, Saline	Annual - Perennial Herbaceous	069X.13.2.1			Spring Annual Forb(I), Summer Midgrass, Summer Perennial Forb, Evergreen Shrub, Spring Annual Forb, Spring Perennial Forb	kochia (BASC5)(3378), alkali sacaton (SPAI)(464), Mojave seablite (SUMO)(303), prickly Russian thistle (SATR12)(136), rubber rabbitbrush (ERNA10)(52), buffalobur nightshade (SORO)(5), sandmat (CHAMA15)(4)	4346	2
Wet Bottomland, Saline	Woody - Perennial Herbaceous	069X.13.3.1			Evergreen Shrub, Summer Shortgrass, Deciduous Shrub, Summer Midgrass, Summer Perennial Forb, Spring Midgrass, Evergreen Tree, Spring Annual Forb		500	

Appendix C. MLRA 69, NRI Cover Data by Community Class

Site Class Name	Comm Class ID	Percent Cover Values									Avg Plant Ht (ft)	Avg % Slope
		Bunch-grass	Sodgrass	Shrub	Forb + AnnGrass	Lichen	BareGrnd	Rock	Litter	Basal		
Bottom	069X.2.1.1	8	2	4	5	0	80	0	11	9	1.4	0.5
	Summer Shortgrass, Summer Midgrass, Summer Annual Forb, Spring Perennial Forb, Spring Annual Forb(I), Summer Tallgrass, Summer Perennial Forb											
Bottom	069X.2.2.1	13	5	7	9	0	60	7	29	8	1.2	2
	Spring Perennial Forb, Summer Perennial Forb, Summer Shortgrass, Evergreen Shrub, Spring Midgrass, Summer Rhizomatous Grass, Summer Midgrass											
Bottom	069X.2.3.1	7	6	19	43	0	58	0	37	7	1.3	1.1
	Spring Annual Forb(I), Summer Midgrass, Spring Annual Forb, Spring Perennial Forb, Spring Annual Grass, Summer Annual Forb, Summer Shortgrass											
Breaks	069X.12.1.1	14	12	14	12	0	41	22	23	18	1.4	6
	Summer Shortgrass, Summer Rhizomatous Grass, Summer Midgrass, Spring Annual Forb, Spring Midgrass, Spring Perennial Forb, Evergreen Subshrub											
Breaks	069X.12.2.1	7	5	21	4	7	44	10	33	15	3	6.6
	Coniferous Tree, Summer Shortgrass, Summer Midgrass, Summer Stoloniferous Grass, Evergreen Shrub, Evergreen Subshrub, Summer Rhizomatous Grass											
Breaks	069X.12.3.1	7	5	18	7	4	45	19	24	13	1.3	5.3
	Summer Shortgrass, Evergreen Subshrub, Evergreen Shrub, Spring Midgrass, Summer Midgrass, Summer Perennial Forb, Cacti											
Loamy Upland	069X.6.1.1	15	13	7	9	8	48	4	29	21	1.1	2.7
	Summer Shortgrass, Summer Midgrass, Summer Rhizomatous Grass, Spring Rhizomatous Grass, Spring Annual Forb(I), Summer Perennial Forb, Spring Perennial Forb											
Loamy Upland	069X.6.3.1	18	6	3	5	0	60	7	30	12	1	2.8
	Summer Shortgrass, Summer Midgrass, Spring Perennial Forb, Evergreen Shrub, Summer Rhizomatous Grass, Summer Perennial Forb, Summer Annual Forb											
Loamy Upland	069X.6.5.1	10	11	16	26	7	58	6	27	15	1.2	2.2
	Spring Annual Forb(I), Summer Annual Forb, Summer Shortgrass, Summer Midgrass, Summer Rhizomatous Grass, Spring Perennial Forb, Spring Annual Forb											
Loamy Upland	069X.6.6.1	5	16	16	5	0	56	54	28	10	1.1	4.3
	Evergreen Shrub, Summer Shortgrass, Evergreen Subshrub, Summer Rhizomatous Grass, Spring Rhizomatous Grass, Summer Midgrass, Spring Perennial Forb											
Rocky Slopes	069X.9.1.1	17	8	8	12	8	35	25	17	22	1	16.9
	Summer Shortgrass, Summer Midgrass, Summer Rhizomatous Grass, Cacti, Summer Perennial Forb, Spring Perennial Forb, Evergreen Subshrub											
Saline Upland	069X.24.1.1	39	7	12	6	1	43	3	41	15	1.7	1.7
	Summer Midgrass, Summer Rhizomatous Grass, Spring Annual Forb(I), Spring Rhizomatous Grass, Evergreen Shrub, Spring Perennial Forb, Evergreen Subshrub											
Saline Upland	069X.24.5.1	3	0	48	10	0	73	1	25	3	1.5	1.7
	Spring Annual Forb(I), Summer Perennial Forb(I), Spring Perennial Forb(I), Summer Midgrass, Spring Perennial Forb, Summer Annual Forb(I)											
Saline Upland	069x.24.6.1	16	1	45	0	0	43	1	49	7	1.4	3
	Evergreen Subshrub, Summer Midgrass, Evergreen Shrub, Spring Perennial Forb, Spring Rhizomatous Grass, Summer Annual Forb(I), Summer Shortgrass											

Site Class Name	Comm Class ID	Bunch-grass	Percent Cover Values								Avg Plant Ht (ft)	Avg % Slope
			Sodgrass	Shrub	Forb + AnnGrass	Lichen	BareGrnd	Rock	Litter	Basal		
Sandy Upland	069X.7.1.1	18	6	14	12	2	50	0	37	13	1.4	3.8
Summer Shortgrass, Summer Midgrass, Summer Annual Forb, Evergreen Shrub, Spring Annual Forb(I), Spring Midgrass, Spring Perennial Forb												
Sandy Upland	069X.7.3.1	20	5	3	3	0	70	0	22	9	1	2
Evergreen Shrub, Summer Shortgrass, Summer Midgrass, Summer Perennial Forb, Spring Midgrass, Summer Tallgrass, Spring Annual Forb												
Wet Bottomland, Saline	069X.13.1.1	55	13	9	14	0	33	0	44	24	1.9	0.4
Summer Midgrass, Spring Annual Forb(I), Deciduous Tree, Summer Rhizomatous Grass, Summer Annual Forb, Summer Perennial Forb, Spring Rhizomatous Grass												
Wet Bottomland, Saline	069X.13.2.1	10	0	56	7	0	38	0	57	6	1.9	1.5
Spring Annual Forb(I), Summer Midgrass, Summer Perennial Forb, Evergreen Shrub, Spring Annual Forb, Spring Perennial Forb												

APPENDIX D. MLRA 69, REPRESENTATIVE SOIL MAP UNIT COMPONENTS

Bottom Ecological Site Class

Area Symbol	Soil Survey Area Name	Map Unit	Component	Component Acres
CO061	Kiowa County, Colorado	1	Absted	27893
CO061	Kiowa County, Colorado	24	Manzanola	23504
CO626	Pueblo Area, Colorado, Parts of Pueblo and Custer Counties	Ha	Haversid	22110
CO625	El Paso County Area, Colorado	28	Ellicott	22063
CO625	El Paso County Area, Colorado	101	Ustic Torrifluents	20486
CO628	Las Animas County Area, CO, Parts of Huerfano and Las Animas Counties	MzA	Manzanola	17598

Breaks Ecological Site Class

Area Symbol	Soil Survey Area Name	Map Unit	Component	Component Acres
CO628	Las Animas County Area, Colorado, Parts of Huerfano and Las Animas Counties	TsD	Travessilla	152646
CO628	Las Animas County Area, Colorado, Parts of Huerfano and Las Animas Counties	TsF	Travessilla	99373
CO089	Otero County, Colorado	PeE	Penrose	50981
CO011	Bent County, Colorado	ToC	Travessilla	50287
CO011	Bent County, Colorado	TsD	Travessilla	47569
CO628	Las Animas County Area, CO, Parts of Huerfano and Las Animas Counties	PeD	Penrose	45678

Loamy Upland Ecological Site Class

Area Symbol	Soil Survey Area Name	Map Unit	Component	Component Acres
CO626	Pueblo Area, Colorado, Parts of Pueblo and Custer Counties	MaB	Manvel	111157
CO099	Prowers County, Colorado	CmAB	Colby	86621
CO011	Bent County, Colorado	WIB	Wilid	82113
CO089	Otero County, Colorado	MaB	Manvel	81909
CO061	Kiowa County, Colorado	44	Wilid	68660
CO089	Otero County, Colorado	Mv	Minnequa	61892
CO099	Prowers County, Colorado	WyB	Wilid	58849

Rocky Slopes Ecological Site Class

Area Symbol	Soil Survey Area Name	Map Unit	Component	Component Acres
CO628	Las Animas County Area, Colorado, Parts of Huerfano and Las Animas Counties	TsF	Ustic Haplocalcids	19875
CO626	Pueblo Area, Colorado, Parts of Pueblo and Custer Counties	CaE	Cascajo	15148
CO628	Las Animas County Area, O, Parts of Huerfano and Las Animas Counties	PeF	Midway	13833
CO628	Las Animas County Area, CO, Parts of Huerfano and Las Animas Counties	TsF	Midway	9937

Area Symbol	Soil Survey Area Name	Map Unit	Component	Component Acres
CO626	Pueblo Area, Colorado, Parts of Pueblo and Custer Counties	SaE	Schamber	7465
CO625	El Paso County Area, Colorado	82	Schamber	7270
CO089	Otero County, Colorado	Cg	Cascajo	5438

Saline Upland Ecological Site Class

Area Symbol	Soil Survey Area Name	Map Unit	Component	Component Acres
CO073	Lincoln County, Colorado	102	Arvada	50279
CO626	Pueblo Area, Colorado, Parts of Pueblo and Custer Counties	LnA	Limon	29688
CO089	Otero County, Colorado	LoB	Limon	8971
CO625	El Paso County Area, Colorado	47	Limon	7955
CO626	Pueblo Area, Colorado, Parts of Pueblo and Custer Counties	LoA	Limon	7319
CO626	Pueblo Area, Colorado, Parts of Pueblo and Custer Counties	LvB	Limon	6077
CO073	Lincoln County, Colorado	146	Limon	5904

Sandy Upland Ecological Site Class

Area Symbol	Soil Survey Area Name	Map Unit	Component	Component Acres
CO625	El Paso County Area, Colorado	106	Wigton	19398
CO011	Bent County, Colorado	VtE	Valent	15390
CO061	Kiowa County, Colorado	6	Bijou	10526
CO625	El Paso County Area, Colorado	103	Valent	10177
CO099	Prowers County, Colorado	VtE	Valent	5984
CO011	Bent County, Colorado	Du	Dune land	5410

Wet Bottomland, Saline Ecological Site Class

Area Symbol	Soil Survey Area Name	Map Unit	Component	Component Acres
CO626	Pueblo Area, Colorado, Parts of Pueblo and Custer Counties	Lm	Las Animas	7319
CO011	Bent County, Colorado	RkB	Rocky Ford	6190
CO011	Bent County, Colorado	La	Las	4963
CO089	Otero County, Colorado	CwA	Cheraw	4694
CO061	Kiowa County, Colorado	12	Fluvaquents, nearly level	4495
CO011	Bent County, Colorado	Lc	Las variant	4005
CO628	Las Animas County Area, Colorado, Parts of Huerfano and Las Animas Counties	BwA	Bloom	3296

APPENDIX E. MLRA 69, COMMON PLANTS AND FUNCTIONAL GROUPS

Common Name	Accepted Symbol	Scientific Name	Functional Group Name
alderleaf mountain mahogany	CEMO2	<i>Cercocarpus montanus</i>	Evergreen Shrub
alfalfa	MESA	<i>Medicago sativa</i>	Spring Perennial Forb(I)
alkali sacaton	SPAI	<i>Sporobolus airoides</i>	Summer Midgrass
annual buckwheat	ERAN4	<i>Eriogonum annuum</i>	Summer Annual Forb
annual ragweed	AMAR2	<i>Ambrosia artemisiifolia</i>	Summer Annual Forb
Arizona madrone	ARAR2	<i>Arbutus arizonica</i>	Evergreen Tree
Arizona threeawn	ARAR6	<i>Aristida arizonica</i>	Summer Midgrass
aspen	POPUL	<i>Populus</i>	Rhizomatous Deciduous Tree
Bermudagrass	CYDA	<i>Cynodon dactylon</i>	Summer Stoloniferous Grass
big bluestem	ANGE	<i>Andropogon gerardii</i>	Summer Tallgrass
big sagebrush	ARTR2	<i>Artemisia tridentata</i>	Evergreen Shrub
black grama	BOER4	<i>Bouteloua eriopoda</i>	Summer Stoloniferous Grass
blanket flower	GAILL	<i>Gaillardia</i>	Spring Annual Forb
blazingstar	MENTZ	<i>Mentzelia</i>	Spring Perennial Forb
blue grama	BOGR2	<i>Bouteloua gracilis</i>	Summer Shortgrass
bluegrass	POA	<i>Poa</i>	Spring Perennial Grass
bractless blazingstar	MENU	<i>Mentzelia nuda</i>	Spring Perennial Forb
broom snakeweed	GUSA2	<i>Gutierrezia sarothrae</i>	Evergreen Subshrub
buffalobur nightshade	SORO	<i>Solanum rostratum</i>	Spring Annual Forb
Buffalograss	BODA2	<i>Buchloe dactyloides</i>	Summer Rhizomatous Grass
Canada thistle	CIAR4	<i>Cirsium arvense</i>	Summer Perennial Forb(I)
Canadian horseweed	COCA5	<i>Conyza canadensis</i>	Spring Annual Forb
cane cholla	CYIMI	<i>Opuntia imbricata</i>	Cacti
cheatgrass	BRTE	<i>Bromus tectorum</i>	Spring Annual Grass(I)
Colorado four o'clock	MIMU	<i>Mirabilis multiflora</i>	Spring Perennial Forb
Colorado greenthread	THAM4	<i>Thelesperma ambiguum</i>	Spring Perennial Forb
Columbia needlegrass	ACNE9	<i>Achnatherum nelsonii</i>	Spring Midgrass
common sunflower	HEAN3	<i>Helianthus annuus</i>	Summer Annual Forb
coneflower	RATIB	<i>Ratibida</i>	Summer Perennial Forb
Conyza	CONYZ	<i>Conyza</i>	Spring Annual Forb
corn	ZEMA	<i>Zea mays</i>	Crop
cotton	GOHI	<i>Gossypium hirsutum</i>	Crop
crested wheatgrass	AGCR	<i>Agropyron cristatum</i>	Spring Midgrass(I)
curlycup gumweed	GRSQ	<i>Grindelia squarrosa</i>	Summer Annual Forb
Danthonia	DANTH	<i>Danthonia</i>	Spring Perennial Grass
devil's claw	PRLO	<i>Proboscidea louisianica</i>	Summer Annual Forb
eastern cottonwood	PODE3	<i>Populus deltoides</i>	Deciduous Tree
eastern redcedar	JUVI	<i>Juniperus virginiana</i>	Evergreen Tree
Eucalyptus	EUCAL	<i>Eucalyptus</i>	Evergreen Tree(I)
false buffalograss	MUSQ3	<i>Monroa squarrosa</i>	Summer Annual Forb
fescue	FESTU	<i>Festuca</i>	Spring Perennial Grass
fetid marigold	DYPA	<i>Dyssodia papposa</i>	Summer Annual Forb

Common Name	Accepted Symbol	Scientific Name	Functional Group Name
field bindweed	COAR4	Convolvulus arvensis	Summer Perennial Forb(I)
fineleaf hymenopappus	HYFI	Hymenopappus filifolius	Spring Perennial Forb
fleabane	ERIGE2	Erigeron	Summer Perennial Forb
fourwing saltbush	ATCA2	Atriplex canescens	Evergreen Shrub
fringed sagewort	PAAU3	Packera aurea	Spring Perennial Forb
Gambel oak	QUGA	Quercus gambelii	Deciduous Tree
Gilia	GILIA	Gilia	Summer Perennial Forb
gilia beardtongue	PEAM	Penstemon ambiguus	Summer Perennial Forb
globemallow	SPHAE	Sphaeralcea	Spring Perennial Forb
golden crownbeard	VEEN	Verbesina encelioides	Summer Annual Forb
grain sorghum	SOBI2	Sorghum bicolor	Crop
greasewood	SAVE4	Sarcobatus vermiculatus	Evergreen Shrub
great ragweed	AMTR	Ambrosia trifida	Summer Annual Forb
green needlegrass	NAVI4	Nassella viridula	Spring Midgrass
green prairie coneflower	RATA	Ratibida tagetes	Summer Perennial Forb
green rabbitbrush	ERTE18	Ericameria teretifolia	Evergreen Shrub
hairy false goldenaster	HEVI4	Heterotheca villosa	Spring Perennial Forb
hairy grama	BOHI2	Bouteloua hirsuta	Summer Shortgrass
horehound	MAVU	Marrubium vulgare	Spring Perennial Forb(I)
horsebrush	TETRA3	Tetradymia	Deciduous Subshrub
horsetail milkweed	ASSU2	Asclepias subverticillata	Summer Perennial Forb
Indian ricegrass	ACHY	Achnatherum hymenoides	Spring Midgrass
Indiangrass	SORGH	Sorghastrum	Summer Tallgrass
inland saltgrass	DISP	Distichlis spicata	Summer Rhizomatous Grass
intermediate wheatgrass	THIN6	Thinopyrum intermedium	Spring Rhizomatous Grass(I)
James' galleta	PLJA	Pleuraphis jamesii	Summer Rhizomatous Grass
James' prairie clover	DAJA	Dalea jamesii	Evergreen Subshrub
Japanese brome	BRAR5	Bromus japonicus	Spring Annual Grass(I)
juniper	JUNIP	Juniperus	Coniferous Tree
kochia	BASC5	Kochia scoparia	Spring Annual Forb(I)
Kochia	BASSI	Kochia	Evergreen Subshrub
lambsquarters	CHAL7	Chenopodium album	Spring Annual Forb
leafy false goldenweed	OOF0	Oonopsis foliosa	Summer Perennial Forb
lemon scurfpea	PSLA3	Psoralidium lanceolatum	Spring Perennial Forb
lemonscent	PEAN	Pectis angustifolia	Spring Annual Forb
little barley	HOPU	Hordeum pusillum	Spring Annual Grass
little bluestem	SCSCS	Schizachyrium scoparium var. scoparium	Summer Midgrass
little hogweed	POOL	Portulaca oleracea	Summer Annual Forb(I)
Meadow Brome	BRAA2	Bromus commutatus	Summer Annual Grass(I)
mealy goosefoot	CHIN2	Chenopodium incanum	Spring Annual Forb
Mojave seablite	SUMO	Suaeda moquinii	Summer Perennial Forb
mountain muhly	MUMO	Muhlenbergia montana	Summer Midgrass
musk thistle	CANU4	Carduus nutans	Spring Perennial Forb(I)

Common Name	Accepted Symbol	Scientific Name	Functional Group Name
needleandthread	HECO26	Hesperostipa comata	Spring Midgrass
needlegrass	HESPE11	Hesperostipa	Spring Midgrass
New Mexico feathergrass	HENE5	Hesperostipa neomexicana	Spring Midgrass
oneseed juniper	JUMO	Juniperus monosperma	Coniferous Tree
othake	PASP	Palafoxia sphacelata	Summer Annual Forb
pine dropseed	BLTR	Blepharoneuron tricholepis	Spring Shortgrass
pinyon pine	PIED	Pinus Edulis	Conifereous Tree
plains greasbush	GLPL	Glossopetalon planitierum	Deciduous Shrub
plains muhly	MUCU3	Muhlenbergia cuspidata	Summer Midgrass
Pleuraphis spp.	PLEUR12	Pleuraphis	Summer Rhizomatous Grass
poverty threeawn	ARDI5	Aristida divaricata	Summer Midgrass
povertyweed	IVAX	Iva axillaris	Spring Perennial Forb
prairie sandreed	CALO	Calamovilfa longifolia	Summer Tallgrass
prairie sunflower	HEPE	Helianthus petiolaris	Summer Annual Forb
prickly lettuce	LASE	Lactuca serriola	Spring Annual Forb(I)
prickly Russian thistle	SATR12	Salsola tragus	Spring Annual Forb(I)
prostrate knotweed	POAV	Polygonum aviculare	Summer Annual Forb(I)
puncturevine	TRTE	Tribulus terrestris	Spring Annual Forb(I)
purple threeawn	ARPU9	Aristida purpurea	Summer Midgrass
rabbitbrush	CHRYS9	Chrysothamnus	Evergreen Shrub
rabbitbrush	CHRYS9	Chrysothamnus	Evergreen Shrub
redstem stork's bill	ERCI6	Erodium cicutarium	Spring Annual Forb(I)
ring muhly	MUTO2	Muhlenbergia torreyi	Spring Rhizomatous Grass
rubber rabbitbrush	ERNA10	Ericameria nauseosa	Evergreen Shrub
Russian olive	ELAN	Elaeagnus angustifolia	Evergreen Tree(I)
Russian thistle	SAKA	Salsola kali	Spring Annual Forb(I)
Russian wildrye	PSJU3	Psathyrostachys juncea	Spring Midgrass(I)
saltcedar	TARA	Tamarix ramosissima	Deciduous Tree(I)
saltgrass	DISP	Distichlis spicata	Summer Rhizomatous Grass
saltgrass	DISTI	Distichlis	Summer Rhizomatous Grass
sand bluestem	ANHA	Andropogon hallii	Summer Tallgrass
sand dropseed	SPCR	Sporobolus cryptandrus	Summer Midgrass
sand sagebrush	ARFI2	Artemisia filifolia	Evergreen Shrub
sandhill muhly	MUPU2	Muhlenbergia pungens	Summer Rhizomatous Grass
sandmat	CHAMA15	Chamaesyce	Spring Perennial Forb
sedge	CAREX	Carex	Spring Perennial Grasslike
shadscale saltbush	ATCO	Atriplex confertifolia	Evergreen Subshrub
sideoats grama	BOCU	Bouteloua curtipendula	Summer Midgrass
silver bluestem	BOSA	Bothriochloa saccharoides	Summer Midgrass
silverleaf nightshade	SOEL	Solanum elaeagnifolium	Spring Perennial Forb
silverscale saltbush	ATAR2	Atriplex argentea	Summer Annual Forb
slender wheatgrass	ELTR7	Elymus trachycaulus	Spring Midgrass
slimflower scurfpea	PSTE5	Psoralidium tenuiflorum	Summer Perennial Forb
slimspike threeawn	ARLO16	Aristida longispica	Spring Annual Grass

Common Name	Accepted Symbol	Scientific Name	Functional Group Name
smooth brome	BRIN2	Bromus inermis	Spring Rhizomatous Grass(I)
soapweed yucca	YUGL	Yucca glauca	Monocot Shrub
spearleaf stonecrop	SELA	Sedum lanceolatum	Summer Perennial Forb
spurge	EUPHO	Euphorbia	Summer Perennial Forb
squirreltail	ELEL5	Elymus elymoides	Spring Midgrass
sundrops	CALYL	Calylophus	Spring Perennial Forb
sunflower	HELIA3	Helianthus	Summer Annual Forb
sweetclover	MEOF	Melilotus officinalis	Spring Annual Forb(I)
switchgrass	PAVI2	Panicum virgatum	Summer Tallgrass
tall fescue	SCAR7	Lolium arundinaceum	Spring Rhizomatous Grass
tarragon	ARDR4	Artemisia dracunculus	Summer Perennial Forb
tenpetal blazingstar	MEDE2	Mentzelia decapetala	Summer Perennial Forb
thistle	CIRSI	Cirsium	Summer Perennial Forb
Threeawn	ARIST	Aristida	Summer Midgrass
thymeleaf sandmat	CHSE6	Chamaesyce serpyllifolia	Summer Annual Forb
tree cholla	CYIMI	Cylindropuntia imbricata var. imbricata	Cacti
tumble windmill grass	CHVE2	Chloris verticillata	Summer Annual Grass
twogrooved milkvetch	ASBI2	Astragalus bisulcatus	Spring Perennial Forb
upright prairie coneflower	RACO3	Ratibida columnifera	Summer Perennial Forb
vine mesquite	PAOB	Panicum obtusum	Summer Rhizomatous Grass
wavyleaf thistle	CIUN	Cirsium undulatum	Summer Perennial Forb
western ragweed	AMPS	Ambrosia psilostachya	Summer Perennial Forb
western sandcherry	PRPUB	Prunus pumila var. besseyi	Deciduous Shrub
western wheatgrass	PASM	Pascopyrum smithii	Spring Rhizomatous Grass
wheat	TRITI	Triticum	Spring Annual Grass(I)
wheatgrass	AGROP2	Agropyron	Spring Perennial Grass
white heath aster	SYER	Symphyotrichum ericoides	Summer Perennial Forb
white sagebrush	ARLU	Artemisia ludoviciana	Summer Perennial Forb
white sweetclover	MEOF	Melilotus alba	Spring Annual Forb(I)
whitetop	CADR	Cardaria draba	Spring Perennial Forb(I)
winterfat	KRLA2	Krascheninnikovia lanata	Evergreen Subshrub
woolly locoweed	ASMO7	Astragalus mollissimus	Spring Perennial Forb
yellow owl's-clover	ORLU2	Orthocarpus luteus	Spring Annual Forb
yellowray Fremont's-gold	SYFR	Syntrichopappus fremontii	Spring Annual Forb

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