USDA Natural Resources Conservation Service

Ecological site R067BY022CO
Choppy Sands

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General information

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

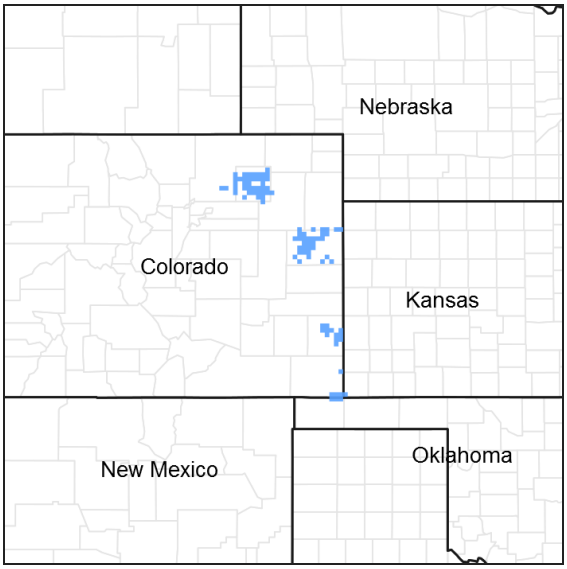


Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 067B–Central High Plains, Southern Part

MLRA 67B occurs in eastern Colorado and consists of rolling plains and river valleys. Some canyonlands occur in the southeast portion. The major rivers are the South Platte and Arkansas which flow from the Rocky Mountains to Nebraska and Kansas. Other rivers in the MLRA include the Cache la Poudre and Republican and associated tributaries. This MLRA is traversed by Interstate 25, 70 and 76; and U.S. Highways 50 and 287. Major land uses include 54 percent rangeland, 35 percent cropland, and 2 percent pasture and hayland. Urban, developed open space, and miscellaneous land occupy approximately 9 percent. Major Cities in this area include Fort Collins, Greeley, Sterling, and Denver. Other cities include Limon, Cheyenne Wells, and Springfield. Land ownership is mostly private. Federal lands include Pawnee and Comanche National Grasslands (U.S. Forest Service), Sand Creek Massacre National Historic Site (National Park Service), and Rocky Mountain Arsenal National Wildlife Refuge (U.S. Fish & Wildlife Service). State Parks include Cherry Creek and Chatfield Reservoirs, and Barr and Jackson Lakes.

This region is periodically affected by severe drought, including the historic “Dust Bowl” of the 1930s. Dust storms may form during drought years in windy periods. Elevations range from 3,400 to 6,000 feet. The Average annual precipitation ranges from 14 to17 inches per year and ranges from 13 inches to over 18 inches, depending upon location. Precipitation occurs mostly during the growing season, often during rapidly developing thunderstorms. Mean annual air temperature (MAAT) is 48 to 52 degrees Fahrenheit. Summer temperatures may exceed 100

degrees Fahrenheit. Winter temperatures may be sub-zero, and snowfall varies from 20 to 40 inches per year. Snow cover frequently melts between snow events.

LRU notes

Land Resource Unit (LRU) A is the northeast portion of MLRA 67B, to an extent of approximately 9 million acres. Most of the LRU is rangeland, and includes the Pawnee National Grassland. Dryland winter wheat/fallow rotations (that may include dryland corn, sunflowers, and sorghum) are grown in most counties. Irrigated cropland is utilized in the South Platte Valley. Small acreage and urban ownership are more concentrated on the Front Range. This LRU is found in portions of Adams, Arapahoe, Elbert, Kit Carson, Larimer, Lincoln, Logan, Washington, and Weld counties. Other counties include Boulder, Cheyenne, Denver, Jefferson, and Yuma. The soil moisture regime is aridic ustic. The mean annual air temperature (MAAT) is 50 degrees Fahrenheit.

LRU B is in the southeast portion of MLRA 67B (2.6 million acres) and includes portions of Baca, Bent, Cheyenne, Kiowa, Las Animas, and Prowers counties. Most of the LRU remains in rangeland and includes the Comanche National Grassland. On the farmed land, a system of dryland winter wheat/fallow rotations (that may include dryland corn, sunflowers, and sorghum) is implemented. Irrigated cropland is found in the Arkansas Valley. The soil moisture regime is aridic ustic and the MAAT is 52 degrees Fahrenheit.

LRU C occurs in portions of Morgan and Weld counties (approximately 1.2 million acres). Most of LRU C is in rangeland. On the farmed land, a system of dryland winter wheat/fallow rotations (that may include dryland corn, sunflowers, and sorghum) is implemented. The soil moisture regime is ustic aridic and the MAAT is 48 degrees Fahrenheit.

Classification relationships

MLRA 67B is in the Colorado Piedmont and Raton Sections of the Great Plains Province (USDA, 2006). The MLRA is further defined by Land Resource Units (LRUs) A, B, and C. Features such as climate, geology, landforms, and key vegetation further refine these concepts and are described in other sections of the Ecological Site Description (ESD). NOTE: To date, these LRUs are DRAFT.

Relationship to Other Hierarchical Classifications:
NRCS Classification Hierarchy: Physiographic Division, Physiographic Province, Physiographic Section, Land Resource Region, Major Land Resource Area, Land Resource Unit (Fenneman, 1946).
USFS Classification Hierarchy: Domain, Division, Province, Section, Subsection,
Land Type Association: Land Type, Land Type Phase (Cleland et al, 1997).

REVISION NOTES:
The Choppy Sands Ecological Site was developed by an earlier version (2004, revised 2007). This earlier version was based on input from NRCS (formerly Soil Conservation service) and historical information obtained from the Choppy Sands Range Site descriptions 1975. This ESD meets the Provisional requirements of the National Ecological Site Handbook (NESH). This ESD will continue refinement towards an Approved status according to the NESH.

Ecological site concept

The Choppy Sands Ecological Site is a run-off site on slopes of greater than 24 percent. It is deeper than 40 inches to bedrock, and there are no rock fragments on the soil or in the subsoil. The site has surface and subsurface soil textures of sand, loamy sand, or sandy loam. The appearance is rough, steep, dune-like, and cat-steps or terracettes are typically present.

Associated sites

R067BY015CO	**Deep Sand** This ecological site is commonly adjacent.
R067BY024CO	**Sandy Plains** This ecological site is commonly adjacent.

Similar sites

R067BY015CO	**Deep Sand** The Deep Sands Ecological Site has less than 24 percent slope and no cat-steps or terracettes.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Prunus pumila var. besseyi* (2) *Amorpha canescens*
Herbaceous	(1) *Andropogon hallii* (2) *Calamovilfa longifolia*

Physiographic features

This site occurs on stabilized to active dunes in dune fields. There are many narrow crests, catsteps or terracettes, and blowouts associated with this site.

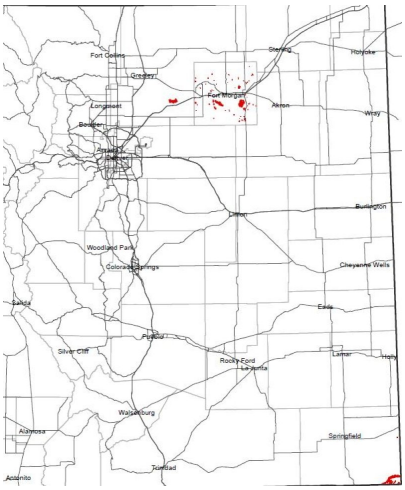


Figure 2. The distribution of the Choppy Sands site in MLRA 67B.

Table 2. Representative physiographic features

Landforms	(1) Dune
Runoff class	Negligible to low
Flooding frequency	None
Ponding frequency	None
Elevation	1,280–1,585 m
Slope	24–60%
Ponding depth	0 cm
Water table depth	203 cm
Aspect	Aspect is not a significant factor

Climatic features

Average annual precipitation across the MLRA extent is 14 to 17 inches, and ranges from 13 to over 18 inches, depending on location. Precipitation increases from north to south. Mean Annual Air Temperature (MAAT) is 50 degrees Fahrenheit in the northern part and increases to 52 degrees Fahrenheit in the southern part. Portions of Morgan and Weld counties are cooler and drier, the MAAT is 48 degrees Fahrenheit, and average precipitation is 13 to14 inches per year.

Two-thirds of the annual precipitation occurs during the growing season from mid-April to late September. Snowfall

averages 30 inches per year, area-wide, but varies by location from 20 to 40 inches per year. Winds are estimated to average 9 miles per hour annually. Daytime winds are generally stronger than at night, and occasional strong storms may bring periods of high winds with gusts to more than 90 mph. High-intensity afternoon thunderstorms may arise. The average length of the freeze-free period (28 degrees Fahrenheit) is 155 days from April 30th to October to 3rd. The average frost-free period (32 degrees Fahrenheit) is 136 days from May 11th to September 24th. July is the hottest month, and December and January are the coldest months. Summer temperatures average 90 degrees Fahrenheit and occasionally exceed 100 degrees Fahrenheit. Summer humidity is low and evaporation is high. Winters are characterized with frequent northerly winds, producing severe cold with temperatures occasionally dropping to -30 degrees Fahrenheit or lower. Blizzard conditions may form quickly. For detailed information, visit the Western Regional Climate Center website:
Western Regional Climate Center Historical Data Western U.S. Climate summaries, NOAA Coop Stations Colorado http://www.wrcc.dri.edu/summary/Climsmco.html.

Table 3. Representative climatic features

Frost-free period (characteristic range)	119-129 days
Freeze-free period (characteristic range)	134-151 days
Precipitation total (characteristic range)	356-432 mm
Frost-free period (actual range)	102-132 days
Freeze-free period (actual range)	126-156 days
Precipitation total (actual range)	356-432 mm
Frost-free period (average)	121 days
Freeze-free period (average)	142 days
Precipitation total (average)	381 mm

Climate stations used

- (1) FT MORGAN [USC00053038], Fort Morgan, CO
- (2) SPRINGFIELD 7 WSW [USC00057866], Springfield, CO
- (3) LIMON WSMO [USW00093010], Limon, CO
- (4) BRIGGSDALE [USC00050945], Briggsdale, CO
- (5) BRIGHTON 3 SE [USC00050950], Brighton, CO
- (6) CHEYENNE WELLS [USC00051564], Cheyenne Wells, CO
- (7) FLAGLER 1S [USC00052932], Flagler, CO
- (8) KIT CARSON [USC00054603], Kit Carson, CO
- (9) BYERS 5 ENE [USC00051179], Byers, CO
- (10) GREELEY UNC [USC00053553], Greeley, CO
- (11) NUNN [USC00056023], Nunn, CO

Influencing water features

There are no influencing water features associated with this ecological site.

Soil features

The soils on this site are very deep, excessively drained soils that formed from eolian sand. They typically have a rapid to very rapid permeability class. The available water capacity is typically very low to low. The soil moisture regime is ustic aridic. The soil temperature regime is mesic.

The surface layer of the soils in this site are typically sand or fine sand. The surface layer ranges from 3 to 8 inches thick. The subsoil is typically sand or fine sand. Soils in this site are typically leached of free carbonates to a depth of 40 inches or more. These soils are susceptible to erosion by wind. The potential for wind erosion accelerates with a decrease in vegetative cover, clay percentage, and/or particle size. Blowouts are common where the surface has been disturbed or is void of vegetation.

Major soil series correlated to this ecological site include: Valent.

Other soil series that have been correlated to this site, but may eventually be re-correlated include: Dune land and Tivoli.

The attributes listed below represent 0-40 inches in depth or to the first restrictive layer.

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

Table 4. Representative soil features

Parent material	(1) Eolian sands
Surface texture	(1) Sand (2) Fine sand
Drainage class	Excessively drained
Permeability class	Rapid to very rapid
Soil depth	203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-101.6cm)	3.81–7.62 cm
Calcium carbonate equivalent (0-101.6cm)	0–5%
Electrical conductivity (0-101.6cm)	0 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0
Soil reaction (1:1 water) (0-101.6cm)	6.6–7.8
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

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

The degree of grazing has a significant impact on the ecological dynamics of the site. This region was historically occupied by large grazing animals, such as bison, elk, pronghorn, and mule deer. Grazing by these large herbivores, along with climatic and seasonal weather fluctuations, had a major influence on the ecological dynamics of the site. Deer and pronghorn are widely distributed throughout the MLRA. Secondary influences of herbivory by species such as prairie dogs and other small rodents, insects, and root-feeding organisms continues to impact the vegetation.

Historically, grazing patterns by herds of large ungulates were driven by water distribution, precipitation events, drought events, and fire. It is believed that grazing periods would have been shorter, followed by longer recovery periods. These large migrating herds impacted the ecological processes of nutrient and hydrologic cycles, by

urination, trampling (incorporation of litter into the soil surface), and breaking of surface crust, (which increases water infiltration).

Today, livestock grazing, especially beef cattle has been a major influence on the ecological dynamics of the site. Grazing management, coupled with the effects of annual climatic variations, largely dictates the plant communities for the site.

Recurrent drought has historically impacted the vegetation of this region. Changes in species composition vary depending upon the duration and severity of the drought cycle and prior grazing management. Drought events since 2002 have significantly increased mortality of blue grama and buffalograss in some locales.

This site developed with occasional fire as part of the ecological processes. Historic fire frequency (pre-industrial) is estimated at 10 to14 years (Guyette, 2012), randomly distributed, and started by lightning at various times throughout the growing season. Early human inhabitants also were likely to start fires for various reasons (deliberate or accidental). It is believed that fires were set as a management tool for attracting herds of large migratory herbivores (Stewart, 2002). The impact of fire over the past 100 years has been relatively insignificant due to the human control of wildfires and the lack of acceptance of prescribed fire as a management tool.

Eastern Colorado was strongly affected by extended drought conditions in the “Dust Bowl” period of the 1930’s, with recurrent drought cycles in the 1950s and 1970s. Extreme to exceptional drought conditions have re-visited the area from 2002 to 2012, with brief interludes of near normal to normal precipitation years. Long-term effects of these latest drought events have yet to be determined. Growth of native cool-season plants begins about April 1 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 in most years, depending on the availability of moisture.

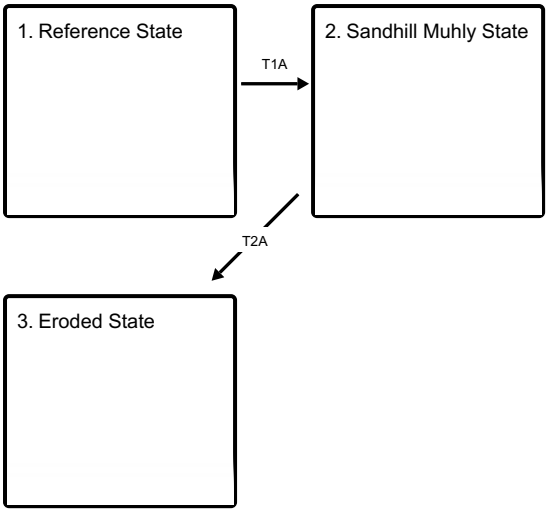
Grazing by large herbivores without adequate recovery periods causes prairie sandreed, sand bluestem, switchgrass, and Indiangrass to decrease. Blue grama, hairy grama, and yucca increase along with sandhill muhly. Prairie sandreed may persist in remnant amounts protected by remaining shrubs. Cool-season grasses and grass-like plants such as needle and thread, Indian ricegrass, and sun sedge decrease in frequency and production. Key shrubs such as western sandcherry and leadplant decrease in frequency and production. Pacific peavine, purple prairie clover, and other highly palatable forbs also decrease. Sand dropseed, Fendler threeawn, lemon scurfpea, hairy goldenaster (aka hairy goldaster), Cuman ragweed (aka western ragweed), annuals, and bare ground increases under heavy, continuous grazing or long- term non-use.

Due to steepness of the slope and soil texture, this site is more susceptible to erosion from disturbances such as drought, overstocking, and heavy, continuous grazing compared to associated sites. Long term, heavy, continuous grazing results in a shift from tallgrass species to mid and shortgrass species. Sand dropseed, sandhill muhly, blue grama, and hairy grama increase while species such as prairie sandreed, sand bluestem, little bluestem, switchgrass, and Indiangrass decrease in frequency and production. The use of grazing management that includes proper stocking and adequate rest and recovery periods following each grazing event during the growing season favors the reference plant community species. Other techniques such as water locations, strategic salt and mineral placement, and herding help to distribute grazing on this site.

The Choppy Sands ecological site is characterized by three states: Reference, Sandhill Muhly, and Eroded. The Reference State is characterized by a dominance of warm-season tallgrasses (prairie sandreed, sand bluestem, and switchgrass). The Sandhill Muhly State is dominated by sandhill muhly and a minor component of herbaceous species. The Eroded State is characterized by annual forbs and grasses (burningbush, Russian thistle, cheatgrass) and early successional plants (blowout grass, sandhill muhly, sand dropseed, Fendler threeawn, and lemon scurfpea).

State and transition model

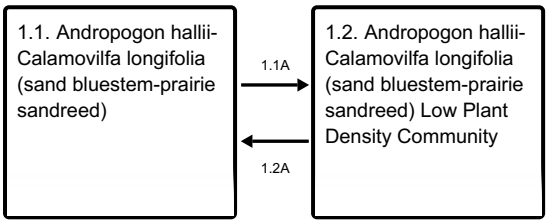
Ecosystem states



T1A - Excessive grazing.

T2A - Excessive grazing.

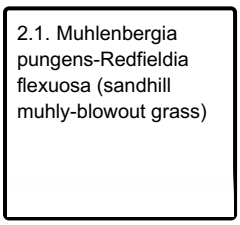
State 1 submodel, plant communities



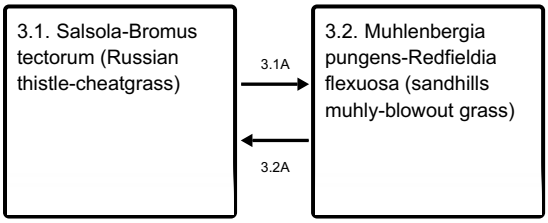
1.1A - Non-use. Lack of fire.

1.2A - Prescribed grazing. Prescribed fire.

State 2 submodel, plant communities



State 3 submodel, plant communities



3.1A - Prescribed grazing.

3.2A - Excessive grazing.

State 1
Reference State

The Reference State is defined by two native plant communities that are a result of periodic fire, drought, ungulate grazers, non-use, and lack of fire. These events are part of the natural disturbance regime and climatic processes

that contribute to the development of the site. The reference plant community consists of tall and mid- warm-season grasses, forbs, and shrubs. Plant community 1.2 results from non-use and a lack of fire, and resembles the plant composition of the reference plant community but with increased litter and decadence of bunchgrasses.

Dominant plant species

- western sandcherry (*Prunus pumila var. besseyi*), shrub
- leadplant (*Amorpha canescens*), shrub
- sand bluestem (*Andropogon hallii*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass

Community 1.1
Andropogon hallii-Calamovilfa longifolia (sand bluestem-prairie sandreed)

This is the interpretive plant community for the Choppy Sands Ecological Site. This plant community evolved with grazing by large herbivores, is well suited for grazing by domestic livestock and can be found on areas that are properly managed with grazing that allows adequate recovery periods following each grazing occurrence during the growing season. The plant community consists chiefly of warm-season tallgrasses. Principle dominants are prairie sandreed, sand bluestem, switchgrass, and Indiangrass. Subdominant grasses include needle and thread, blue grama, and little bluestem. Forbs and shrubs such as pacific peavine, evening primrose, prairie clovers, leadplant, and sandcherry are key species. The potential vegetation is about 75 to 90 percent grasses and grass-like plants, 5 to15 percent forbs and 5 to 15 percent woody plants. Grazing that allows for adequate recovery opportunity and proper stocking maintain this plant community. Continual or repeated spring grazing and summer deferment reduce the cool-season component and increase the warm-seasons. Spring deferment and continual summer grazing increase the cool-seasons and decrease the warm-seasons. This community is resistant to many disturbances except excessive grazing. Plant litter is properly distributed with very little movement off-site, and natural plant mortality is very low. Nutrient cycle, water cycle, energy flow, and community dynamics are all functioning properly. Extensive and diverse rooting systems are present. Carbon sequestration above and below ground is excellent. If continually grazed or over stocked to the point of leaving little stubble or litter, wind erosion becomes a major concern. Production in this community can vary from 750 to 2,000 pounds of air dry vegetation per acre per year depending on the weather and averages 1,600 pounds.

Dominant plant species

- western sandcherry (*Prunus pumila var. besseyi*), shrub
- leadplant (*Amorpha canescens*), shrub
- sand bluestem (*Andropogon hallii*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	897	1423	1692
Forb	84	185	275
Shrub/Vine	84	185	275
Total	**1065**	**1793**	**2242**

Figure 10. Plant community growth curve (percent production by month). CO6709, Warm-season dominant, cool-season subdominant; MLRA-67B; upland coarse textured soils..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	7	25	35	15	10	5	1	0	0

Community 1.2
Andropogon hallii-Calamovilfa longifolia (sand bluestem-prairie sandreed) Low Plant Density Community

This plant community occurs when grazing is removed for long periods of time in the absence of fire. Plant composition is similar to the reference plant community. In time, individual species production and frequency will be lower. Much of the nutrients are tied up in excessive litter and standing dead canopy. The semiarid environment and the absence of animal traffic impairs nutrient cycling. Aboveground litter limits sunlight from reaching plant crowns. Many plants, especially bunchgrasses, die off. Increased litter and absence of grazing or fire reduce seed germination and establishment. This plant community changes rapidly with disturbance. Advanced stages of non-use will place this community at risk of losing many important native species. Long-term non-use will cause plant decadence and mortality to increase and erosion (blowouts, wind scoured areas) may eventually occur if bare ground increases. Once this happens it will require increased energy input in terms of practice cost and management to bring back. Production can vary from 250 to 1,300 pounds of air dry vegetation per acre per year.

Dominant plant species

- western sandcherry (*Prunus pumila var. besseyi*), shrub
- leadplant (*Amorpha canescens*), shrub
- sand bluestem (*Andropogon hallii*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass

Figure 11. Plant community growth curve (percent production by month). CO6711, Warm-season dominant, cool-season subdominant, excess litter; MLRA-67B; upland coarse texture soil..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	2	8	20	35	17	10	5	3	0	0

Pathway 1.1A
Community 1.1 to 1.2

Non-use and lack of prescription fire shifts this plant community to the 1.2 community. Impairment of nutrient cycling is a concern.

Pathway 1.2A
Community 1.2 to 1.1

Grazing that allows for adequate recovery opportunity, proper stocking, and prescribed fire shift this community to the reference plant community. This happens quickly.

Conservation practices

Prescribed Burning
Prescribed Grazing

State 2
Sandhill Muhly State

The Reference State has been driven beyond the limits of ecosystem resilience and has crossed a threshold to the Sandhill Muhly State. The designation of this state denotes changes in plant species composition. This change in plant species affects the hydrology, erosion potential, forage production, and wildlife habitat. Understory plants may be negatively affected by shrubs reducing the availability of light, soil moisture, and soil nutrients. Shrubs can increase causing fine-fuel loads to decrease. Prescribed fire can become an ineffective tool to eradicate or decrease the shrubs due to the lack of fine fuel loads.

Dominant plant species

- soapweed yucca (*Yucca glauca*), shrub
- plains pricklypear (*Opuntia polyacantha*), shrub
- sandhill muhly (*Muhlenbergia pungens*), grass
- blowout grass (*Redfieldia flexuosa*), grass
- Fendler threeawn (*Aristida purpurea var. longiseta*), grass

Community 2.1
Muhlenbergia pungens-Redfieldia flexuosa (sandhill muhly-blowout grass)

Sandhill muhly has increased to the point of being the dominant species. Sandhill muhly is an aggressive warm-season rhizomatous grass that has the capacity to increase in frequency and production rapidly. Fendler threeawn, blowout grass, Indian ricegrass, and lemon scurfpea have also increased. Sand bluestem, switchgrass, prairie sandreed, Indiangrass, western sandcherry, and leadplant have been removed. Species diversity and overall production are reduced significantly. Litter levels are low. Bare ground has increased and blowouts are at risk of forming or enlarging. Carbon reserves have been severely depleted. Community dynamics, nutrient cycle, water cycle, and energy flow has been severely impaired. Production varies from 150 to 700 pounds of air dry vegetation per acre per year and averages 400 pounds.

Dominant plant species

- soapweed yucca (*Yucca glauca*), shrub
- plains pricklypear (*Opuntia polyacantha*), shrub
- sandhill muhly (*Muhlenbergia pungens*), grass
- blowout grass (*Redfieldia flexuosa*), grass
- Fendler threeawn (*Aristida purpurea var. longiseta*), grass

Figure 12. Plant community growth curve (percent production by month). CO6710, Warm-season dominant; MLRA-67B; upland coarse-textured soils..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	0	5	20	40	20	10	5	0	0	0

State 3
Eroded State

The Eroded State is characterized by two plant community phases. An ecological threshold has been crossed as a result of this transition. The designation of the Eroded State denotes changes in infiltration, runoff, aggregate stability, and species composition. The changes in water movement and the plant community affect changes in hydrologic functionality, biotic integrity, and soil and site stability. Infiltration, runoff, and soil erosion vary depending on the vegetation present. Blowouts are common.

Dominant plant species

- cheatgrass (*Bromus tectorum*), grass
- sixweeks fescue (*Vulpia octoflora*), grass
- Russian thistle (*Salsola*), other herbaceous
- burningbush (*Bassia scoparia*), other herbaceous

Community 3.1
Salsola-Bromus tectorum (Russian thistle-cheatgrass)

This early succession plant community can either be the result of continuous grazing applied to an early perennial plant community, or the result of controlled short term animal impact and prescribed grazing applied to a blowout. Production can vary greatly depending on the plant density and weather conditions in any year. Cheatgrass, Japanese brome, burningbush, Russian thistle, sunflower, pigweed, sixweeks fescue, and annual buckwheat are common. Wind erosion and blowouts are concerns. Blowouts are sandy depressions caused by the removal of sediments by wind. Blowouts can occur in all plant communities but most frequently occur in the Eroded State. A blowout forms when a patch of protective vegetation is lost, allowing strong winds to “blow out” sand and form a depression. The areas of blowing sand result in movement and possible enlargement of the dune system. The blowout site is in a primary successional stage due to steep slopes and poor soil development. These extremely sandy sites are very dynamic and result in an unstable soil surface that resists revegetation. Areas of blowouts start to revegetate with annual forbs and grasses with proper periods of recovery and protection from disturbance. These areas are still very susceptible to erosion and can regress rapidly. As blowout areas become more stable with annuals, perennials start to reestablish. Prairie sandreed, sand dropseed, sandhill muhly, and perennial forbs start

to increase. The Choppy Sands ecological site only returns to a productive state after many years of proper grazing management. Production can vary from 0 to 200 pounds per acre of air-dry vegetation per year.

Dominant plant species

- soapweed yucca (*Yucca glauca*), shrub
- plains pricklypear (*Opuntia polyacantha*), shrub
- cheatgrass (*Bromus tectorum*), grass
- sixweeks fescue (*Vulpia octoflora*), grass
- Russian thistle (*Salsola*), other herbaceous
- burningbush (*Bassia scoparia*), other herbaceous

Community 3.2
Muhlenbergia pungens-Redfieldia flexuosa (sandhills muhly-blowout grass)

This plant community evolves with long-term excessive grazing from a more advanced plant community or with prescribed grazing from the annuals community. Blowout grass, Indian ricegrass, sandhill muhly, needle and thread, and lemon scurfpea are some of the first perennials to occupy this community. Wind erosion and blowouts remain a concern. Production can vary from 50 to 300 pounds per acre of air-dry vegetation per year.

Dominant plant species

- soapweed yucca (*Yucca glauca*), shrub
- plains pricklypear (*Opuntia polyacantha*), shrub
- sandhill muhly (*Muhlenbergia pungens*), grass
- blowout grass (*Redfieldia flexuosa*), grass

Pathway 3.1A
Community 3.1 to 3.2

Prescribed grazing that allows adequate recovery opportunity between grazing events will shift the 3.1 community to the 3.2 community.

Conservation practices

Prescribed Grazing

Pathway 3.2A
Community 3.2 to 3.1

Continuous grazing without adequate recovery periods between grazing events will move this plant community toward the Annuals Community. Eventually blowouts can form.

Conservation practices

Prescribed Grazing

Transition T1A
State 1 to 2

Excessive grazing without adequate recovery periods between grazing events shifts this plant community across an ecological threshold to the Sandhill Muhly State. The hydrologic cycle and soil and site stability of the site are the ecological process affected.

Transition T2A
State 2 to 3

Long-term excessive grazing is the driver that causes the loss of state resilience and results in a shift between the

Sandhill Muhly State and the Eroded State. Ecological function has been compromised. The effects of this ecological threshold being crossed include changes in aggregate stability, nutrient availability, plant cover, and hydrologic function. Accelerated wind erosion can cause the formation of blowouts.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**1**			1345–1614	
	sand bluestem	ANHA	*Andropogon hallii*	359–448	–
	prairie sandreed	CALO	*Calamovilfa longifolia*	359–448	–
	switchgrass	PAVI2	*Panicum virgatum*	90–269	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	90–179	–
	little bluestem	SCSC	*Schizachyrium scoparium*	90–126	–
	Indiangrass	SONU2	*Sorghastrum nutans*	34–90	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	0–90	–
	blue grama	BOGR2	*Bouteloua gracilis*	18–90	–
	Grass, perennial	2GP	*Grass, perennial*	18–90	–
	sand dropseed	SPCR	*Sporobolus cryptandrus*	18–54	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	0–36	–
	sandhill muhly	MUPU2	*Muhlenbergia pungens*	18–36	–
	thin paspalum	PASE5	*Paspalum setaceum*	18–36	–
	blowout grass	REFL	*Redfieldia flexuosa*	18–36	–
	Indian ricegrass	ACHY	*Achnatherum hymenoides*	18–36	–
	hairy grama	BOHI2	*Bouteloua hirsuta*	18–36	–
	sideoats grama	BOCU	*Bouteloua curtipendula*	0–36	–
	sun sedge	CAINH2	*Carex inops ssp. heliophila*	18–36	–
	Great Plains flatsedge	CYLU2	*Cyperus lupulinus*	0–18	–
	needleleaf sedge	CADU6	*Carex duriuscula*	0–18	–
	Fendler threeawn	ARPUL	*Aristida purpurea var. longiseta*	0–18	–
Forb					
2	**2**			90–269	
	Forb, perennial	2FP	*Forb, perennial*	18–90	–
	manystem pea	LAPO2	*Lathyrus polymorphus*	18–54	–
	purple prairie clover	DAPUP	*Dalea purpurea var. purpurea*	18–36	–
	broadbeard beardtongue	PEAN4	*Penstemon angustifolius*	18–36	–
	lemon scurfpea	PSLA3	*Psoralidium lanceolatum*	18–36	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	0–18	–
	veiny dock	RUVE2	*Rumex venosus*	0–18	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–18	–
	prairie spiderwort	TROC	*Tradescantia occidentalis*	0–18	–
	woolly plantain	PLPA2	*Plantago patagonica*	0–18	–

	silky prairie clover	DAVI	*Dalea villosa*	0–18	–
	annual buckwheat	ERAN4	*Eriogonum annuum*	0–18	–
	shaggy dwarf morning-glory	EVNU	*Evolvulus nuttallianus*	0–18	–
	phlox heliotrope	HECO5	*Heliotropium convolvulaceum*	0–18	–
	stiff sunflower	HEPAP2	*Helianthus pauciflorus ssp. pauciflorus*	0–18	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–18	–
	bush morning-glory	IPLE	*Ipomoea leptophylla*	0–18	–
	flaxflowered ipomopsis	IPLOL	*Ipomopsis longiflora ssp. longiflora*	0–18	–
	Carolina puccoon	LICA13	*Lithospermum caroliniense*	0–18	–
	dotted blazing star	LIPU	*Liatris punctata*	0–18	–
	lacy tansyaster	MAPIP4	*Machaeranthera pinnatifida ssp. pinnatifida var. pinnatifida*	0–18	–
	tenpetal blazingstar	MEDE2	*Mentzelia decapetala*	0–18	–
	snowball sand verbena	ABFR2	*Abronia fragrans*	0–18	–
	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–18	–
	tarragon	ARDR4	*Artemisia dracunculus*	0–18	–
	groundplum milkvetch	ASCR2	*Astragalus crassicarpus*	0–18	–
	nineanther prairie clover	DAEN	*Dalea enneandra*	0–18	–
Shrub/Vine					
3	**3**			90–269	
	western sandcherry	PRPUB	*Prunus pumila var. besseyi*	90–179	–
	leadplant	AMCA6	*Amorpha canescens*	18–90	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	18–54	–
	prairie rose	ROAR3	*Rosa arkansana*	0–36	–
	soapweed yucca	YUGL	*Yucca glauca*	18–36	–
	sand sagebrush	ARFI2	*Artemisia filifolia*	0–18	–
	spreading buckwheat	EREF	*Eriogonum effusum*	0–18	–
	spinystar	ESVIV	*Escobaria vivipara var. vivipara*	0–18	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	0–18	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–18	–
	skunkbush sumac	RHTR	*Rhus trilobata*	0–18	–

Animal community

WILDLIFE INTERPRETATIONS:

The variety of grasses, forbs, and shrubs on this ecological site in the various plant communities provides habitat for a wide range of wildlife species. Historic large grazers that influenced these plant communities were bison, elk, and pronghorn. Changes over time have resulted in the loss of bison, the reduction in elk numbers, and pronghorn population swings. Domestic grazers now share these habitats with wildlife. The grassland communities of eastern Colorado are home to many bird species. Changes in the composition of the plant community when moving from the reference plant community to other communities on this ecological site may result in dramatic species shifts in the bird community. Because of a lack of permanent water, fish and many amphibians are not expected on this

ecological site. Mule and white-tailed deer may use this ecological site, however the shrub cover is too low to expect more than occasional use. The gray wolf and wild bison used this ecological site in historic times. The wolf is thought to be extirpated from Eastern Colorado. Bison in the area are domesticated.

1.1 Reference Plant Community:
The structural diversity in the plant community found on the reference site is attractive to a number of wildlife species. Common bird species expected on in this plant community include Cassin's sparrow, lark bunting, western meadowlark, and ferruginous and Swainson's hawks. The combination of mid-tall grasses and shrubs provides habitat for lesser prairie chicken in the southeastern parts of this site. Greater prairie chicken use this site in the northern portion of the MLRA. Scaled quail may also use this community in the southern half of the MLRA. White-tailed jackrabbit, badger, mule deer, pronghorn, coyote, plains pocket gopher, spotted ground squirrel, and several species of mice are mammals that commonly use this plant community. Reptiles using this community include prairie rattlesnake, bullsnake, western hognose snake, racer, ornate box turtle, and six-lined racerunner.

1.2 Community: Increased Litter, Excessive Standing Dead Canopy

The same species found in the reference plant community are expected to be found in this community.

2.1 Community:

Due to the loss of species diversity, wildlife use of this community is greatly reduced. Scaled quail may occasionally use these sites when adequate cover is available. Other birds, and occasionally mule deer, may also pass through. Prairie rattlesnake and other reptiles are still found. Swainson's hawk will continue to use this site because as it is easy to spot prey.

3.1 Community:

Wildlife use is very limited. Plant diversity and productivity is greatly reduced or absent.

3.2 Community:

The wildlife found here will be similar to the 3.1 community.

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

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

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

Reference PC - (1600) (0.44)

1.2 PC - (400) (0.11)

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

An on-site visit should be conducted prior to developing a grazing plan.

Hydrological functions

Water is the principal factor limiting forage production on this site. This site is dominated by soils in hydrologic group A. Infiltration and runoff potential for this site ranges from high to moderate. Water transmission through Group A soils is normally greater than 0.30 inches per hour. Runoff is expected to occur only during the most intense storms (refer to NRCS Section 4, National Engineering Handbook (USDA–NRCS, 1972–2012) for runoff quantities and hydrologic curves).

Recreational uses

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

Wood products

No appreciable wood products are present on the site.

Other products

Site Development and Testing Plan

General Data (MLRA and Revision Notes, Hierarchical Classification, Ecological Site Concept, Physiographic, Climate, and Water Features, and Soils Data):

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

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

Updated. All “Required” items complete to Provisional level.
NOTE: Annual Production Table is from the “Previously Approved” ESD 2004. The Species Composition List is also from the 2004 version, with minor edits. These will need review for future updates at Approved level.

Each Alternative State/Community:

Complete to Provisional level

Supporting Information (Site Interpretations, Assoc. & Similar Sites, Inventory Data References, Agency/State Correlation, References):

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

Livestock Interpretations updated to reflect Total Annual Production revisions in each plant community.

Wildlife interpretations, general narrative, and individual plant communities updated to the Provisional level. Hydrology, Recreational Uses, Wood Products, Other Products, Plant Preferences table, and Rangeland Health Reference Sheet carried over from previously “Approved” ESD 2004.

Reference Sheet

The Reference Sheet was previously approved in 2007.
It will be updated at the next “Approved” level.

“Future work, as described in a project plan, to validate the information in this provisional ecological site description is needed. This will include field activities to collect low and medium intensity sampling, soil correlations, and

analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document." (NI 430_306 ESI and ESD, April, 2015)

Other information

Relationship to Other Hierarchical Classifications:

NRCS Classification Hierarchy:
Physiographic Divisions of the United States (Fenneman, 1946): Physiographic DivisionPhysiographic ProvincePhysiographic SectionLand Resource RegionMajor Land Resource Area (MLRA)Land Resource Unit (LRU).
USFS Classification Hierarchy:
National Hierarchical Framework of Ecological Units (Cleland et al, 181-200):
DomainDivisionProvinceSectionSubsectionLandtype Association LandtypeLandtype Phase.

Inventory data references

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

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

Those involved in developing the 2004 site descriptions include: Harvey Sprock, Rangeland Management Specialist, CO-NRCS; Ben Berlinger, Rangeland Management Specialist, CO-NRCS; James Borchert, Soil Scientist, CO-NRCS; Terri Skadeland, Biologist, CO-NRCS.

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Data collection for this ecological site was done in conjunction with the progressive soil surveys within the 67B Central High Plains (Southern Part) of Colorado. It has been mapped and correlated with soils in the following soil surveys: Adams County, Arapahoe County, Baca County, Bent County, Boulder County, Cheyenne County, El Paso County Area, Elbert County, Eastern Part, Kiowa County, Kit Carson County, Larimer County Area, Las Animas County Area, Lincoln County, Logan County, Morgan County, Prowers County, Washington County, Weld County, Northern Part, and Weld County, Southern Part.

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Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	Harvey Sprock, Daniel Nosal
Contact for lead author	Harvey Sprock, Area Rangeland Management Specialist, Greeley, CO
Date	01/11/2005
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None

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2. **Presence of water flow patterns:** Typically none. If present, water patterns are broken, irregular in appearance or discontinuous with numerous debris dams or vegetative barriers.

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3. **Number and height of erosional pedestals or terracettes:** Pedestalled plants caused by wind erosion would be minor in protected areas such as swales. Expect some pedestals on windward side of sharp peaks and narrow ridges where wind scouring would naturally occur.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** 5% or less bare ground, with bare patches ranging from 5-10 inches in diameter. Prolonged drought or wildfire events will cause bare ground to increase upwards to 10-15% with bare patches ranging from 15-20 inches in diameter.

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

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Minor wind scouring may occur on sharp peaks or narrow ridges. Wind erosion/small blowouts may be more obvious with disturbances such as fire or extended drought.

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7. **Amount of litter movement (describe size and distance expected to travel):** Litter should be uniformly distributed with little movement. On steep slopes or knolls, litter may move from a few inches to 1-3 feet depending on intensity of wind/rainfall event.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Stability class rating anticipated to be 2-3 in the interspaces at soil surface.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Average SOM ranges from 1-3%. A-horizon ranges from 0-4 inches. Soils are deep, grayish-brown, weak fine granular or single grain loose structure.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Diverse grass, forb, shrub canopy and root structure reduces raindrop impact and slows overland flow providing increased time for infiltration to occur. Extended drought and/or wildfire may reduce canopy cover and litter amounts resulting in decreased infiltration and increased runoff on slopes of 15-40%.

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

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

    Dominant: warm season tall bunchgrass >

    Sub-dominant: warm season tall rhizomatous > shrubs = cool season bunchgrasses/grasslikes = warm season mid bunchgrass >

    Other: warm season short bunchgrass = leguminous forbs > warm season forbs = cool season forbs

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Typically minimal. Expect slight short/mid bunchgrass and shrub mortality/decadence during and following drought.

14. **Average percent litter cover (%) and depth (in):** Litter cover during and following drought can range from 15-25% and 2-5% following wildfire.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 750 lbs./ac. low precip years, 1600 lbs./ac. average precip years, 2000 lbs./ac. high precip years. After extended drought or the first growing season following wildfire, production may be significantly reduced by 350 – 700 lbs./ac. or more.

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if**

their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site: Invasive plants should not occur in reference plant community. Following fire or extended drought, cheatgrass and Russian thistle may invade assuming a seed source is available.

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