Ecological site R066XY031NE
Steep Sandy

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General information

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

MLRA notes

Major Land Resource Area (MLRA): 066X–Dakota-Nebraska Eroded Tableland

The Dakota-Nebraska Eroded Tableland (MLRA 66) occurs in north-central Nebraska (56 percent) and south-central South Dakota (44 percent). MLRA 66 is approximately 3.6 million acres and covers all or parts of twelve counties between the two states. The northern border of the MRLA bisects Tripp County, South Dakota, just south of the town of Winner. Valentine is in the northeastern corner of Cherry County, Nebraska and is located on the MLRA's southwestern border. From there, the MLRA stretches southeast to the northwestern corner of Antelope County, Nebraska and the town of O'Neil, Nebraska in Holt County its southeastern border.

The MLRA occupies a smooth fluvial plain primarily consisting of broad intervalley areas with terraces, river breaks, and local badlands along the well-defined major drainages. The slopes range from nearly level tablelands to steep ridges and drainages. The elevation ranges from 1,970 to 2,950 feet. The Keya Paha, Elkhorn, and the Niobrara Rivers flow through the MLRA. The Niobrara is a designated National Scenic River.

Layers of shaly chalk and limestone marine sediments overlaying the Cretaceous Niobrara Formation make up the bulk of the MLRA, though the western and southwestern portions exhibit surface eolian deposits. The floors of the major drainages are underlain by deposits of alluvial sand and gravel. The dominant soil orders in this MLRA are mesic, ustic or aridic Mollisols and Entisols. Loamy and sandy are the primary soil textures in this landscape.

Twenty-seven percent of the land in this MLRA has been broken out of native prairie and farmed, while sixty-six percent of the grasslands remain intact. The remaining acres are divided between forest, urban development, and other uses. Livestock grazing, primarily by cattle, is a major industry. Corn, winter wheat, and grain sorghum are the primary commodity crops but a significant number of acres are planted to forage sorghum and alfalfa for harvest as hay. With limited irrigation available, and annual precipitation averaging from 18 inches in the west to 25 inches in the east, crop production is marginal across most of the MLRA.

The historical matrix vegetation type is mixed-grass prairie. Big bluestem, sand bluestem, prairie sandreed, little bluestem, sideoats grama, and blue grama make up the bulk of the warm-season species. Western wheatgrass, green needlegrass, and needle and thread are the dominant cool-season grasses. Large- and small-patch vegetative communities are found primarily along the riparian zones, on lowland sites, and in closed depressions. Woodlands make up about 3 percent of MLRA 66 and consist primarily of green ash, bur oak, and hackberry. Ponderosa pines can be found on steeper sites in the western portion of the landscape.

Wildlife flourishes in this combination of crop and grassland environments. In a landscape historically occupied by bison herds, white-tailed and mule deer are now the most abundant wild ungulates. Pronghorns also number among the remaining native grazers. A variety of smaller species, including coyote, raccoon, opossum, porcupines, muskrat, beaver, squirrel, prairie dogs, and mink, thrive in the region. Grassland birds, including several upland game birds, are common across the MLRA.

This landscape serves as a backdrop for a disturbance-driven ecosystem, evolving under the influences of

herbivory, fire, and variable climate. Historically, these processes created a heterogeneous mosaic of plant communities and structure heights across the region. Any given site in this landscape burned every six to ten years, with most of the MLRA experiencing a six to eight year fire regime. The fires were caused by lightning strikes and were also set by Native Americans, who used fire for warfare, signaling, and to refresh the native grasses. Indigenous inhabitants understood the value of fire as a tool, and that the highly palatable growth following a fire provided excellent forage for their horses and attracted grazing game animals such as bison and elk.

Land use patterns by post-European settlers have greatly altered the historical fire regime, allowing the expansion of woody species. Fragmentation of the native grasslands by conversion to cropland, transportation corridors, and other developments has contributed to disruption of the natural fire regime of this ecosystem. The most common encroaching woody species is eastern redcedar. While eastern redcedar is native to the landscape, the historic population in MLRA 66 was limited to isolated pockets in rugged river drainageways that were protected from wildfire. Widespread plantings of windbreaks with eastern redcedar as a primary component provide a seed source for the aggressive woody plant which further facilitates woody encroachment. Encroachment of native and introduced shrubs and trees into the native grasslands degrades wildlife habit and causes significant forage loss for domestic livestock. Aggressive fire suppression policies have exacerbated this process to the point that shrub and tree encroachment is a major ecological threat to grasslands throughout most of the MLRA.

Classification relationships

►EPA◄
Level IV Ecoregions of the Conterminous United States
43—Northwestern Great Plains:
43i—Keya Paha Tablelands.

►USDA◄
Land Resource Regions and Major Land Resource Areas (USDA-NRCS, 2006)
Land Resource Region: G—Western Great Plains Range and Irrigated Region:
Major Land Resource Area (MLRA): 66 Dakota-Nebraska Eroded Tableland.

Ecological site concept

The Steep Sandy ecological site is a run-off site located on shoulders, backslopes, foot slopes, toe slopes, and valley sides. Slopes typically range from 15 to 65 percent. Soils are moderately deep to very deep and formed primarily in sandy residuum weathered from sandstone. Soil textures range from sand to fine sandy loam.

These sites are almost entirely intact, with native mixed-grass prairie vegetation prevalent as an understory, and ponderosa pine as an overstory. Some sites also have a deciduous woody component of burr oak, green ash, and hackberry, with a mid-story component of chokecherry, skunkbush sumac, and currant.

Associated sites

R066XY032NE	**Sandy 18-22" P.Z.** The Sandy 18-22 PZ ecological site may occur on uplands adjacent to Steep Sandy ecological sites.

Similar sites

R066XY056NE	**Choppy Sands** The Choppy Sands ecological site occurs on soils with similar soil surface textures but occurs on steep dune landscapes rather than the valleys and canyons of Steep Sandy ecological sites.

Table 1. Dominant plant species

Tree	(1) *Pinus ponderosa*
Shrub	Not specified
Herbaceous	(1) *Andropogon hallii* (2) *Schizachyrium scoparium*

Physiographic features

The Steep Sandy ecological site occurs on back slopes, foot slopes, and toe slopes of valley sides. It is also found on back slopes and foot slopes of deeply dissected sandstone uplands.

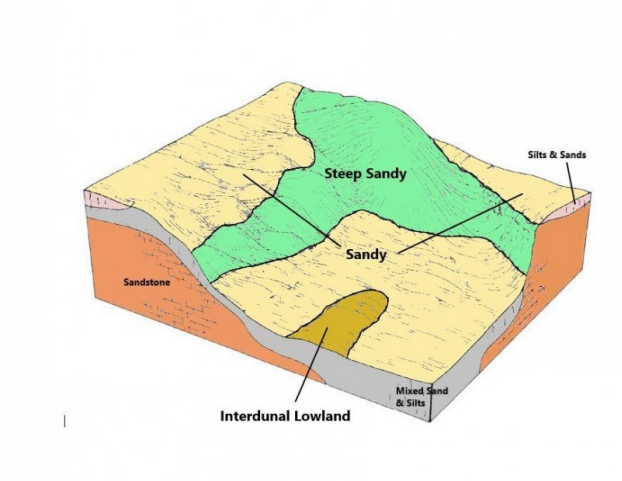


Figure 1. Block diagram for the Steep Sandy site.

Table 2. Representative physiographic features

Landforms	(1) Valley > Valley side (2) Upland > Upland slope
Runoff class	Low to high
Flooding frequency	None
Ponding frequency	None
Elevation	579–914 m
Slope	15–65%
Water table depth	203 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 66 is considered to have a continental climate with cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature may also abound. The climate is the result of this MLRA's location near the geographic center of North America. There are few natural barriers on the northern Great Plains and the winds move freely across the plains and account for rapid changes in temperature.

Annual precipitation ranges from 18 to 25 inches per year. The normal average annual temperature is about 48°F. January is the coldest month with average temperatures ranging from about 19°F (Bonesteel, SD) to about 23°F (Ainsworth, NE). July is the warmest month with temperatures averaging from about 73°F (Harrington, SD) to about 75°F (Gregory, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 54°F. This large annual range attests to the continental nature of the climate this area. Hourly winds average about ten miles per hour annually, ranging from about 11 miles per hour during the spring to about nine miles per hour during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour.

Growth of native cool-season plants begins mid to late March and continues to late June. Native warm-season plants begin growth in early May and continue to late August. Green-up of cool-season plants may occur in September and October when adequate soil moisture is present.

Table 3. Representative climatic features

Frost-free period (characteristic range)	111-120 days
Freeze-free period (characteristic range)	129-139 days
Precipitation total (characteristic range)	457-635 mm
Frost-free period (actual range)	107-124 days
Freeze-free period (actual range)	127-147 days
Precipitation total (actual range)	457-635 mm
Frost-free period (average)	116 days
Freeze-free period (average)	136 days
Precipitation total (average)	559 mm

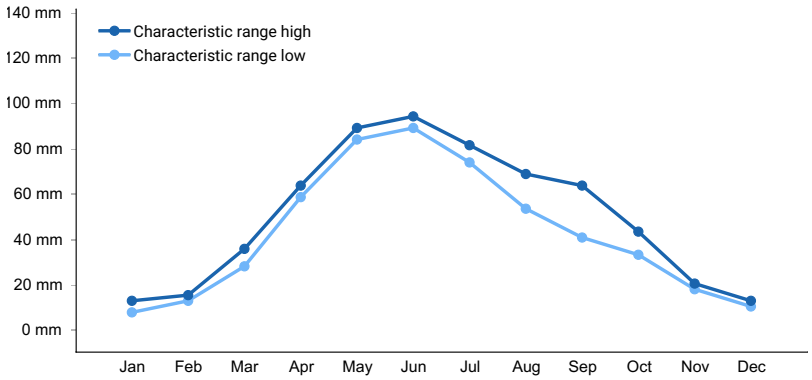


Figure 2. Monthly precipitation range

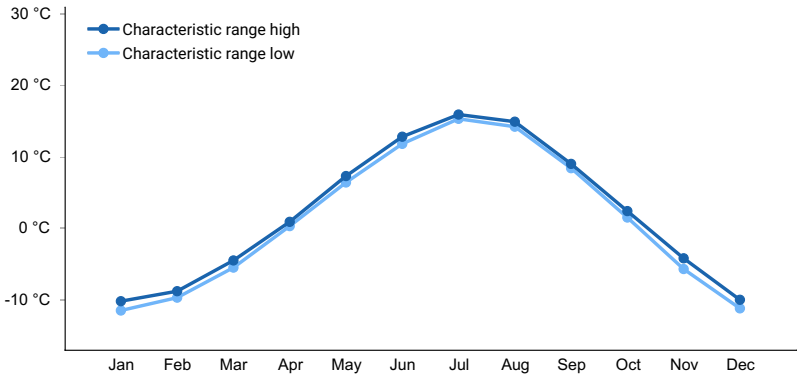


Figure 3. Monthly minimum temperature range

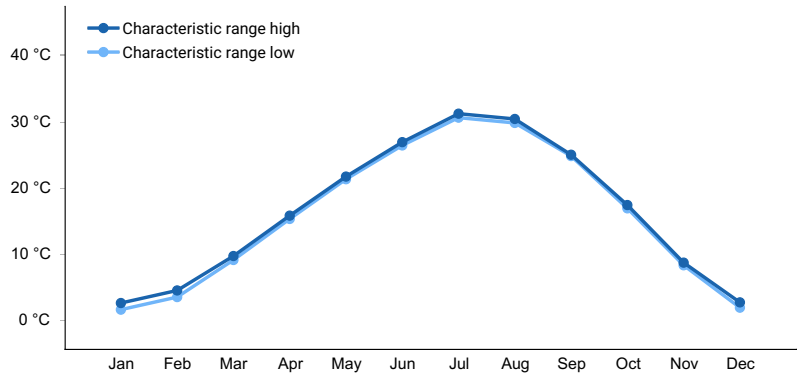


Figure 4. Monthly maximum temperature range

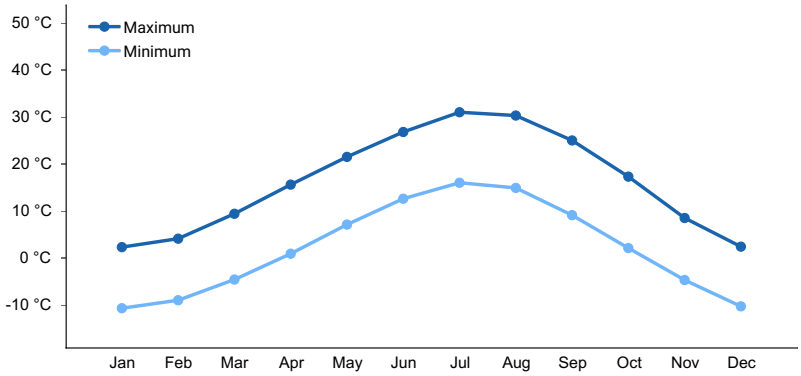


Figure 5. Monthly average minimum and maximum temperature

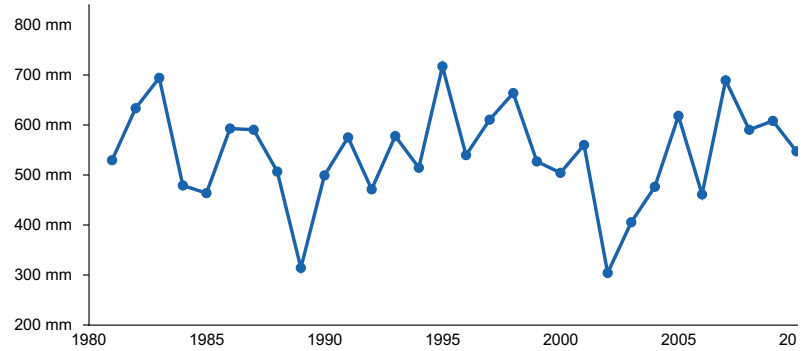


Figure 6. Annual precipitation pattern

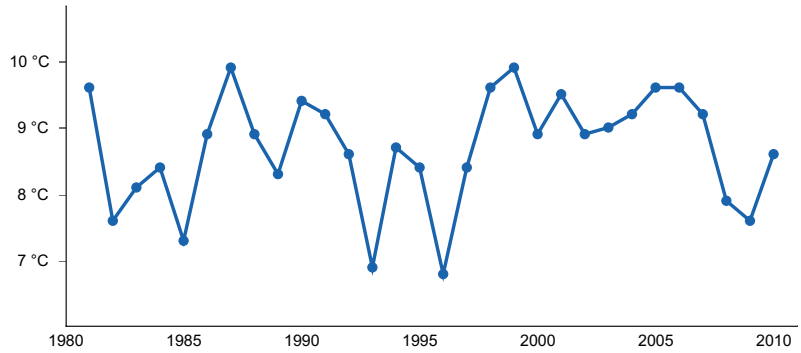


Figure 7. Annual average temperature pattern

Climate stations used

- (1) HARRINGTON [USC00393574], Tuthill, SD
- (2) MISSION 14 S [USC00395638], Mission, SD
- (3) KILGORE 1NE [USC00254432], Kilgore, NE
- (4) VALENTINE MILLER FLD [USW00024032], Valentine, NE
- (5) AINSWORTH [USC00250050], Ainsworth, NE
- (6) SPRINGVIEW [USC00258090], Springview, NE

Influencing water features

The hydrology of the Steep Sandy ecological site functions independently of the water table.

Soil features

The Steep Sandy ecological site occurs on moderately deep and very deep, somewhat excessively to excessively drained soils. These soils typically formed in loamy and sandy residuum weathered from sandstone, but some soils formed from colluvium and eolian sands. Permeability is rapid. Soil surface textures are predominantly loamy fine sand but may be fine sandy loam or sand. Slopes typically range from 15 to 65 percent.

McKelvie, Blula, and Peji are the primary soil series correlated the Steep Sandy ecological site. Additional information can be found in the various soil survey reports. Contact the local USDA Service Center for soil survey reports that include more details specific to your location or visit Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov).

Figure 8. McKelvie Series profile

Table 4. Representative soil features

Parent material	(1) Residuum–sandstone (2) Colluvium (3) Eolian sands
Surface texture	(1) Loamy fine sand (2) Fine sandy loam (3) Sand
Drainage class	Somewhat excessively drained to excessively drained
Permeability class	Rapid
Soil depth	51–203 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	5.08–10.16 cm
Calcium carbonate equivalent (Depth not specified)	0–10%
Electrical conductivity (Depth not specified)	0 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0
Soil reaction (1:1 water) (Depth not specified)	6.1–8.4
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0%

Ecological dynamics

The Steep Sandy ecological site developed under Northern Great Plains climatic conditions, light to severe grazing by bison and other large herbivores, sporadic natural or man-caused wildfire, and other biotic and abiotic factors

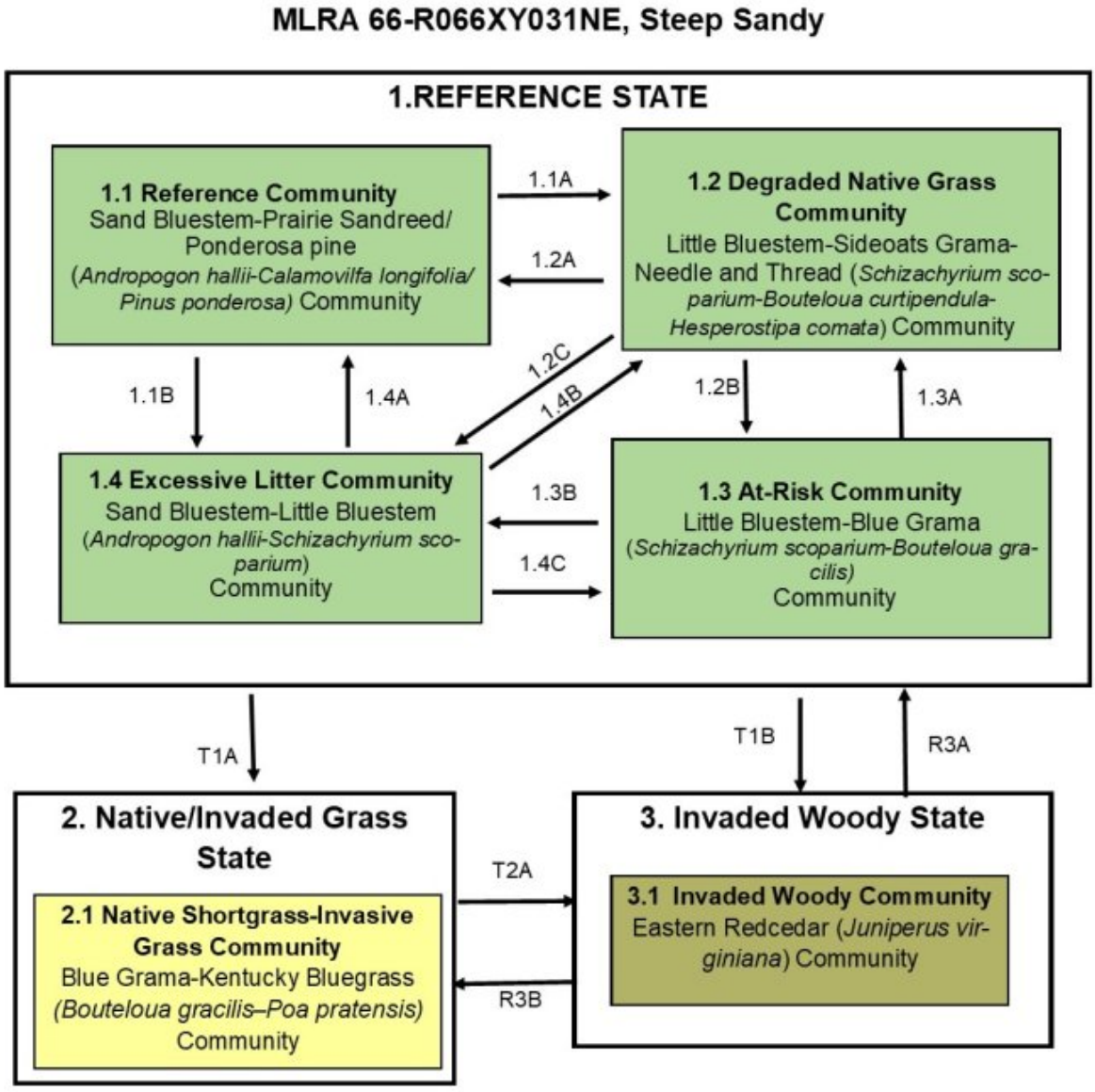
that typically influence soil and site development. This continues to be a disturbance-driven site: by herbivory, fire, and variable climate. Changes occur in the plant communities due to short-term weather variations, impacts of native and exotic plant and animal species, and management actions.

The introduction of domestic livestock by European settlers along with season-long, continuous grazing had a profound impact on the vegetation of the Steep Sandy ecological site. Season-long, continuous grazing causes a repeated removal of the growing point and excessive defoliation of the leaf area of individual warm-season tallgrasses. The resulting reduction in the ability of the plants to harvest sunlight depletes root reserves, subsequently decreasing root mass. The ability of the plants to compete for nutrients is impaired, resulting in decreased vigor and eventual mortality. Species that evade negative grazing impacts through mechanisms such as a growing season adaptation (i.e., cool-season), growing points located near the soil surface, a shorter structure, or reduced palatability will increase. As this site deteriorates, little bluestem, sideoats grama, and prairie sandreed decrease in frequency and production while blue grama, needle and thread, and hairy grama increase.

The State and Transition Model (STM) is depicted below and includes a Reference State (1), a Native/Invaded Grass State (2), and an Invaded Woody State (3). Each state represents the crossing of a major ecological threshold due to the alteration of the functional dynamic properties of the ecosystem. The primary properties observed to determine this change are soil stability, vegetative communities, and the hydrologic cycle. Each state may have one or more plant communities that fluctuate in species composition and abundance within the normal parameters of the state. Within each state, communities may degrade or recover in response to natural and man caused disturbances such as variation in the degree and timing of herbivory, presence or absence of fire, and climatic and local fluctuations in the precipitation regime. The processes that cause the movement between the states and communities are discussed in more detail in the state and community descriptions following the diagram.

Interpretations are primarily based on the Reference Community (1.1). It has been determined by study of rangeland relic areas, areas protected from excessive disturbance, and areas under long-term rotational grazing regimes. Trends in plant community dynamics ranging from heavily grazed to lightly grazed areas, seasonal use pastures, and historical accounts have been used as well. Plant communities, states, transitional pathways, and thresholds have been determined through similar studies and experience.

State and transition model



Transitions and Restorations:

T1A – Heavy grazing with inadequate growing season recovery periods..
T1B – Woody encroachment and no fire or brush management.
T2A – Woody encroachment and no fire or brush management.
R3A – Prescribed burning, wildfire, timber harvest, recurring brush management.
R3B – Prescribed burning, wildfire, timber harvest, recurring brush management.

Community Pathways:

1.1A – Grazing with inadequate recovery periods.
1.1B – Prolonged (>5 years) absence of herbivory and fire.
1.2A – Prescribed grazing with adequate, growing season recovery periods.
1.2B – Grazing with inadequate recovery periods.
1.2C – Prolonged (>5 years) absence of herbivory and fire.
1.3A – Prescribed grazing with adequate, growing season recovery periods.
1.3B – Prolonged (>5 years) absence of herbivory and fire.
1.4A – Prescribed grazing, prescribed burning.
1.4B – Prescribed grazing, prescribed burning.
1.4C – Prescribed grazing, prescribed burning.

Figure 9. State and Transition Model Diagram. MLRA 66, Steep Sandy ecological site.

State 1
Reference State

Figure 10. Steep Sandy Ecological Site, Reference State (1).

The Reference State (1) describes the range of vegetative communities that occur on the Steep Sandy ecological site where the range of natural variability under historic conditions and disturbance regimes is mostly intact. The Reference State developed under the combined influences of climatic conditions, periodic fire activity, grazing by large herbivores, and impacts from small mammals and insects. High perennial grass cover and production allows for increased soil moisture retention, vegetative production and overall soil quality. The Reference State includes four plant community phases which are the Reference Community (1.1), the Degraded Native Grass Community (1.2), the At-Risk Community (1.3), and the Excessive Litter Community (1.4). The Reference Community (1.1) serves as a description of the native plant community that naturally occurs on the site when the natural disturbance regimes are intact or closely mimicked by management practices. The Degraded Native Grass and At-Risk Communities result from management actions that are unfavorable for a healthy Reference Community. The Excessive Litter Community occurs when herbivory and fire are eliminated from the landscape.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- little bluestem (*Schizachyrium scoparium*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass
- blue grama (*Bouteloua gracilis*), grass

Community 1.1
Reference Community

Interpretations are primarily based on the Reference or Sand Bluestem-Prairie Sandreed/Ponderosa Pine (*Andropogon hallii-Calamovilfa longifolia*/*Pinus ponderosa*) Community (1.1). This plant community serves as a description of the native plant community that occurs on the site when the natural disturbance regimes are intact or are closely mimicked by management practices. This phase is dynamic, with fluid relative abundance and spatial boundaries between the dominant structural vegetative groups. These fluctuations are primarily driven by different responses of the species to changes in precipitation timing and abundance, and to fire and grazing events. This site developed with grazing by large herbivores and is well suited for grazing by domestic livestock. This plant community is dominated by warm-season, tall- and midgrasses. Sand bluestem, little bluestem, prairie sandreed, and needle and thread are the dominant grasses. An overstory of trees occurs on the site. Typically, ponderosa pine is the dominant tree species, but bur oak, green ash and hackberry may be present on some sites. The forb component is diverse. Natural fire played a significant role in the succession of this site by limiting the extent of eastern redcedar while maintaining the ponderosa pine and deciduous tree overstory. Wildfires have been actively controlled in recent times, allowing eastern redcedar encroachment. The Reference Community can be found on areas that are managed with prescribed grazing, prescribed burning, and may be found on areas receiving occasional periods of short-term rest. This resilient community is well adapted to the Northern Great Plains climatic conditions. Plant diversity promotes strong tolerance to drought, site and soil stability, a functional hydrologic cycle, and a high degree of biological integrity. These factors create a suitable environment for a healthy and sustainable plant community.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- sand bluestem (*Andropogon hallii*), grass
- little bluestem (*Schizachyrium scoparium*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass

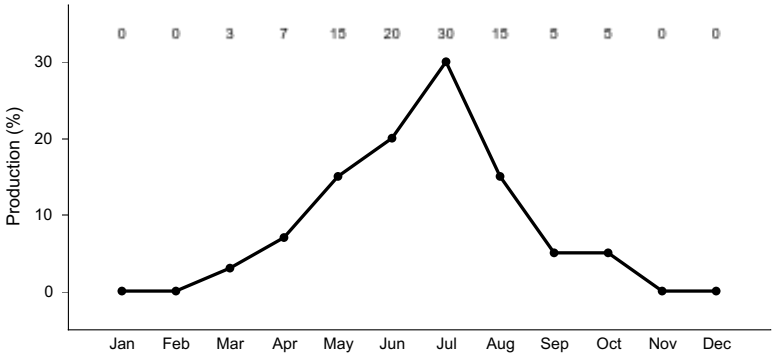


Figure 11. Plant community growth curve (percent production by month). NE6638, Eroded Tableland, warm-season dominant.

Community 1.2
Degraded Native Grass Community

The Degraded Native Grass or Little Bluestem-Sideoats Grama-Needle and Thread (*Schizachyrium scoparium-Bouteloua curtipendula-Hesperostipa comata*) Community (1.2) occurs in response to continuous season-long grazing or rotational grazing with inadequate growing-season recovery periods. Grazing tolerant warm- and cool-season grasses increase. Sand bluestem and prairie sandreed decline, reducing the productivity of the site. Little bluestem, needle and thread, and sideoats and blue grama increase in relative abundance. The composition of the forb component remains diverse. The presence of this community signals a significant loss of production as compared to the Reference Community (1.1). The potential for encroachment by invasive woody species becomes more likely due to the reduction in the amount of deep-rooted species and resulting reduced fuel load to carry fire. While this plant community is less productive and less diverse than the Reference Community, it remains sustainable in regard to site and soil stability, hydrologic function, and biotic integrity.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- little bluestem (*Schizachyrium scoparium*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass
- sideoats grama (*Bouteloua curtipendula*), grass
- blue grama (*Bouteloua gracilis*), grass

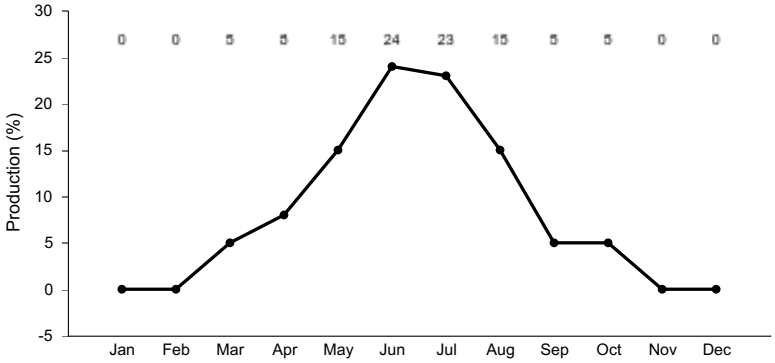


Figure 12. Plant community growth curve (percent production by month). NE6637, Eroded Tableland, warm-season dominant, cool-season subdominant.

Community 1.3
At Risk Community

In the At-Risk or Little Bluestem-Blue Grama (*Schizachyrium scoparium-Bouteloua gracilis*) Community (1.3), the more palatable warm-season tallgrasses have been reduced to a minor component due to continued defoliation during their critical growth periods. Grazing tolerant warm- and cool-season grasses increase significantly. Little bluestem and blue grama are the dominant warm-season grasses, while needle and thread and sedges are the primary native cool-season grasses. Smooth brome, Kentucky bluegrass, and annual bromes may be beginning to invade the plant community. Soil health is affected by reduced efficiency in the nutrient, mineral, and hydrologic cycles as a result of decreases in plant litter and rooting depths. Total annual vegetative production declines significantly. Without a management change, this community is at-risk to transition to the Native/Invaded Grass State (2).

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- little bluestem (*Schizachyrium scoparium*), shrub
- blue grama (*Bouteloua gracilis*), shrub
- needle and thread (*Hesperostipa comata ssp. comata*), shrub
- sedge (*Carex*), other herbaceous

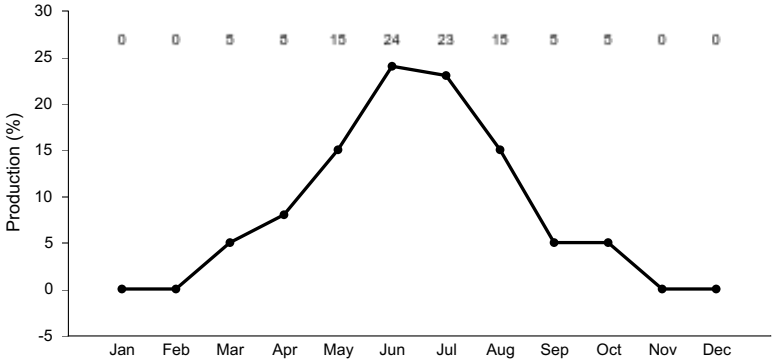


Figure 13. Plant community growth curve (percent production by month). NE6637, Eroded Tableland, warm-season dominant, cool-season subdominant.

Community 1.4
Excessive Litter

The Excessive Litter or Sand Bluestem-Little Bluestem (*Andropogon hallii-Schizachyrium scoparium*) Community (1.4) develops when the natural disturbances of livestock grazing and fire have been removed from the land for a prolonged period of time (more than five years). The litter amount has clearly increased and few or no sedges or understory shortgrasses are present. As the undisturbed duff layer deepens, infiltration of the precipitation is interrupted and evaporation increases significantly, simulating drought-like conditions. Typically, bunchgrasses have developed dead centers and rhizomatous grasses have formed small colonies due to a lack of tiller stimulation. Plant frequency and production have decreased. Pedestalling is usually evident. As compared to the Reference Community (1.1), plant diversity has decreased and native plants tend to occur in individual colonies. This plant community has a high amount of litter covering the soil between widely dispersed mature plants. As the litter layer thickens, the health and vigor of native, warm-season, tall- and midgrasses declines. Soil erosion is low and infiltration and runoff are not significantly different than the Reference Community. This plant community will change rapidly when grazing or fire is returned to the landscape.

Dominant plant species

- sand bluestem (*Andropogon hallii*), grass
- little bluestem (*Schizachyrium scoparium*), grass

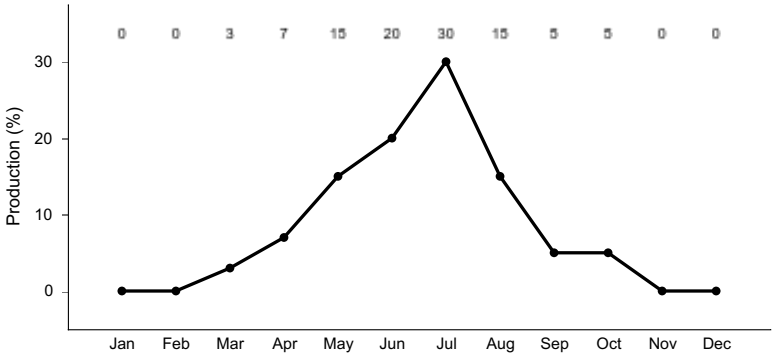


Figure 14. Plant community growth curve (percent production by month). NE6638, Eroded Tableland, warm-season dominant.

Pathway 1.1A
Community 1.1 to 1.2

A shift from the Reference Community (1.1) to the Degraded Native Grass Community (1.2) occurs with continuous season-long grazing or rotational grazing with inadequate growing-season recovery periods.

Pathway 1.1B
Community 1.1 to 1.4

Prolonged interruption (more than five years) of the natural disturbances of herbivory and fire will convert the Reference Community (1.1) to the Excessive Litter Community (1.4).

Pathway 1.2A
Community 1.2 to 1.1

A management strategy that includes prescribed grazing with adequate growing season recovery periods will return the Degraded Native Grass Community (1.2) to the Reference Community (1.1). Appropriately timed prescribed fire may accelerate this recovery.

Pathway 1.2B
Community 1.2 to 1.3

Continued season-long continuous grazing or rotational grazing with inadequate growing-season recovery periods (deferment) will cause the Degraded Native Grass Community (1.2) to move to the At-Risk Community (1.3).

Pathway 1.2C
Community 1.2 to 1.4

Prolonged interruption (more than five years) of the natural disturbances of herbivory and fire will convert the Degraded Native Grass Community (1.2) to the Excessive Litter Community (1.4).

Pathway 1.3A
Community 1.3 to 1.2

A management strategy which includes prescribed grazing with adequate growing-season recovery periods will move the At-Risk Community (1.3) to the Degraded Native Grass Community (1.2). Appropriately timed prescribed fire will accelerate this recovery.

Pathway 1.3B
Community 1.3 to 1.4

Prolonged interruption (more than five years) of the natural disturbances of herbivory and fire will convert the At-Risk Community (1.3) to the Excessive Litter Community (1.4).

Pathway 1.4A
Community 1.4 to 1.1

Reintroduction of the natural processes of herbivory and fire will move the plant community from the Excessive Litter Community (1.4) to the Reference Community (1.1). .

Pathway 1.4B
Community 1.4 to 1.2

Reintroduction of the natural processes of herbivory and fire will move the plant community from the Excessive Litter Community (1.4) to the Degraded Native Grass Community (1.2).

Pathway 1.4C
Community 1.4 to 1.3

Reintroduction of the natural processes of herbivory and fire will move the plant community from the Excessive Litter Community (1.4) to the At-Risk Community (1.3).

State 2
Native/Invaded Grass State

The Native/Invaded Grass State (2) has transitioned from the Reference State (1) and much of the native warm-season tall- and midgrass community has been replaced by native, warm-season shortgrasses and non-native grasses. The loss of warm-season tall- and midgrasses has negatively impacted energy flow and nutrient cycling. The Native/Invaded Grass State includes the Native Shortgrass-Invasive Grass Community (2.1).

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- smooth sumac (*Rhus glabra*), shrub
- blue grama (*Bouteloua gracilis*), grass
- hairy grama (*Bouteloua hirsuta*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

Community 2.1
Native Shortgrass-Invasive Grass Community

The Native Shortgrass-Invasive Grass or Blue Grama-Kentucky Bluegrass (*Bouteloua gracilis-Poa pratensis*) Community (2.1) represents a shift from the Reference State (1) across a threshold to the Native/Invaded Grass State (2). This community develops under long-term heavy grazing with inadequate growing season recovery periods. This may occur with rotational grazing where too little time is allowed for recovery before pastures are re-entered, in large pastures where animals graze individual plants repeatedly, or under continuous season-long grazing during the growing season. Initially, blue grama, hairy grama, needle and thread, and other native cool-season grasses will be the dominant species while warm-season, tall- and midgrasses will either be present as remnants or absent. With continued grazing pressure, Kentucky bluegrass, blue grama, and smooth brome will become the dominant plant species. Annual bromes may be present. Continuous and heavy grazing pressure will maintain this plant community in a sod-bound condition. Forb richness and diversity has decreased significantly. Compared to the Reference Community (1.1), blue grama, hairy grama, and needle and thread have increased, while warm-season tall- and midgrasses have decreased significantly and are present only as remnants. Plant diversity has decreased. Forb richness and diversity has decreased. The high density of short-rooted grasses decreases water infiltration resulting in an impaired hydrologic cycle. This plant community is highly susceptible to an increase in of eastern redcedar and deciduous woody vegetation.

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- blue grama (*Bouteloua gracilis*), grass
- hairy grama (*Bouteloua hirsuta*), grass

- Kentucky bluegrass (*Poa pratensis*), grass
- field brome (*Bromus arvensis*), grass
- cheatgrass (*Bromus tectorum*), grass
- smooth brome (*Bromus inermis*), grass

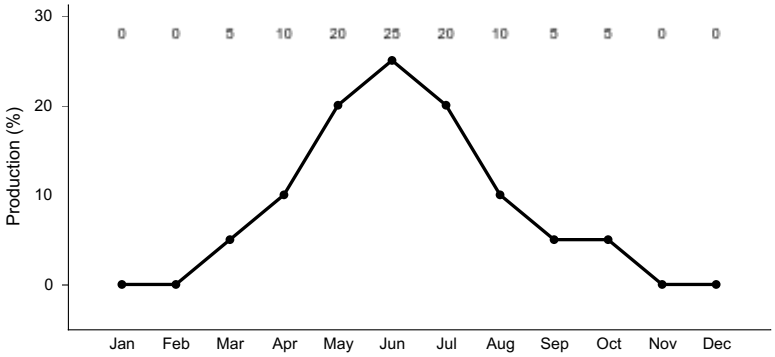


Figure 15. Plant community growth curve (percent production by month). NE6636, Eroded Tableland, cool-season/warm-season codominant.

State 3
Invaded Woody State

The Invaded Woody State (5) is the result of woody encroachment. Once the tree canopy cover reaches 15 percent with an average tree height exceeding five feet, the threshold to the Invaded Woody State has been crossed. Woody species are increasing due to the lack of prescribed fire, brush management, or other woody tree removal. Typical ecological impacts are a loss of native grasses, reduced diversity of functional and structural groups, reduced forage production, and reduced soil quality. Prescribed burning, wildfire, timber harvest and brush management will move the Invaded Woody State toward a grass dominated state. If the Invaded Woody State transitioned from the Native/Invaded Grass State (2) the land cannot return to the Reference State (1) as the native plant community, soils, and hydrologic function had been too severely impacted prior to the woody encroachment to allow the return to the Reference State through woody species removal alone. The Invaded Woody State includes one community, the Invaded Woody Community (4.1).

Dominant plant species

- eastern redcedar (*Juniperus virginiana*), tree
- ponderosa pine (*Pinus ponderosa*), tree
- smooth sumac (*Rhus glabra*), shrub
- Kentucky bluegrass (*Poa pratensis*), grass
- blue grama (*Bouteloua gracilis*), grass
- hairy grama (*Bouteloua hirsuta*), grass

Community 3.1
Invaded Woody Community

The Invaded Woody or Eastern Redcedar (*Juniperus virginiana*) Community (3.1) has at least a 15 percent woody tree cover consisting of trees generally 5 feet or taller. Encroaching trees are primarily eastern redcedar, but native deciduous trees may also have increased on the site due to the suppression of fire. In the absence of fire and brush management, this site is very conducive to eastern redcedar seedling invasion, especially when adjacent to a seed source. Eastern redcedar can eventually dominate the site, resulting in a closed canopy which drastically reduces forage production and has limited value for either livestock grazing or wildlife habitat. Historically, ponderosa pine was a present as a minor component of the plant community. The encroachment of eastern redcedar impairs regeneration of the ponderosa pine overstory and increases the likelihood that a wildfire will significantly reduce the ponderosa pine component. While the tree canopy provides excellent protection from the weather for both livestock and wildlife, decreased forage production reduces the carrying capacity for both domestic livestock and wildlife and significantly reduces habitat for grassland birds. With long-term fire suppression, this plant community will develop extensive ladder fuels which can lead to a removal of most tree species with a wildfire. With properly managed intensive grazing, encroachment of deciduous trees will typically be minimal; however, this will not impact encroachment of coniferous species. The herbaceous component decreases proportionately in relation to the

percent canopy cover, with the reduction being greater under a coniferous overstory. Eastern redcedar control can usually be accomplished with prescribed burning while the trees are six feet tall or less and fine fuel production is greater than 1,500 pounds per acres. Larger red cedars can also be controlled with prescribed burning, but successful application requires the use of specifically designed ignition and holding techniques (https://www.loesscanyonsburning group.com). Resprouting brush must be chemically treated immediately after mechanical removal to achieve effective treatment. The forb component will initially increase following tree removal. To prevent return to a woody dominated community, ongoing brush management such as hand cutting, chemical spot treatments, or periodic prescribed burning is required. This plant community is resistant to change and resilient given normal disturbances. In higher canopy cover situations, the soil erosion will increase in relation the plant community from which this plant community originated. The hydrologic function is also significantly altered under higher canopy cover. Infiltration is reduced and runoff is typically increased because of a lack of herbaceous cover and the rooting structure provided by the herbaceous species. Total annual production during an average year varies significantly, depending on the production level prior to encroachment and the percentage of canopy cover.

Dominant plant species

- eastern redcedar (*Juniperus virginiana*), tree
- ponderosa pine (*Pinus ponderosa*), tree
- Kentucky bluegrass (*Poa pratensis*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass

Transition T1A
State 1 to 2

Heavy grazing with inadequate growing season recovery periods will cause the Reference State (1) to lose a significant proportion of warm-season tall- and midgrass species and cross a threshold to the Native/Invaded Grass State (2). Water infiltration and other hydrologic functions will be reduced due to the root-matting presence of sod-forming grasses. With the decline and loss of deeper-penetrating root systems, soil structure and biological integrity are catastrophically degraded to the point that recovery is unlikely. Once this occurs, it is highly unlikely that grazing management alone will return the community to the Reference State.

Transition T1B
State 1 to 3

Disruption of the natural fire regime and encroachment of invasive exotic and native woody species can cause the Reference State (1) to shift to the Invaded Woody State (3).

Transition T2A
State 2 to 3

Disruption of the natural fire regime and encroachment of invasive exotic and native woody species can cause the Native/Invaded Grass State (2) to shift to the Invaded Woody State (3).

Restoration pathway R3A
State 3 to 1

Prescribed burning, wildfire, harvest, and brush management will move the Invaded Woody State (3) toward the Reference State (1). Using prescribed fire to control the eastern redcedar without negatively impacting the desired pine overstory may be extremely difficult on this site. Mechanical removal followed by low intensity maintenance burns is usually the most effective eastern redcedar control method. The forb component of a site with heavy tree density or canopy cover may initially increase following tree removal through mechanical brush management treatments and prescribed fire. If re-sprouting brush is present, stumps must be chemically treated immediately after mechanical removal. Ongoing brush management such as hand cutting, chemical spot treatments, or periodic prescribed burning is required to prevent a return to the Invaded Woody State. Land that transitioned to the Invaded Woody State (3) from the Native/Invaded Grass State (2) cannot transition to the Reference State (1) through removal of woody species as the native plant community, soils, and hydrologic function have been too severely impacted for that restoration to occur.

Restoration pathway R3B
State 3 to 2

Prescribed burning, wildfire, harvest, and brush management will move the Invaded Woody State (3) toward the Native/Invaded Grass State (2). Using prescribed fire to control the eastern redcedar without negatively impacting the desired pine overstory may be extremely difficult on this site. Mechanical removal followed by low intensity maintenance burns is usually the most effective eastern redcedar control method. The forb component of a site with heavy tree density or canopy cover may initially increase following tree removal through mechanical brush management treatments and prescribed fire. If re-sprouting brush is present, stumps must be chemically treated immediately after mechanical removal. Ongoing brush management such as hand cutting, chemical spot treatments, or periodic prescribed burning is required to prevent a return to the Invaded Woody State. Land that transitioned to the Invaded Woody State (3) from the Native/Invaded Grass State (2) cannot transition to the Reference State (1) through removal of woody species as the native plant community, soils, and hydrologic function have been too severely impacted for that restoration to occur.

Additional community tables

Animal community

Grazing by domestic livestock is one of the major income producing industries in the area. Rangeland in this area may provide yearlong forage. During the dormant period, the forage for livestock will likely be lacking protein to meet livestock requirements and added protein will allow ruminants to better utilize the energy stored in grazed plant materials. A forage quality test (either directly or through fecal sampling) should be used to determine the level of supplementation needed. Stocking rates should be determined after a field visit to document plant composition and production. Carrying capacity estimates should be calculated using this information along with animal preference data, particularly when grazers other than cattle are involved. Under continuous season-long grazing, carrying capacity and stocking rates based upon a harvest efficiency of 25 percent is recommended. More intensive grazing management may result in improved harvest efficiencies and increased carrying capacities may be feasible.

WILDLIFE INTERPRETATIONS:
Major Land Resource Area (MLRA) 66 lies primarily within the Mixed-grass prairie ecosystem. Though European settlers have converted about a quarter of this landscape to farmland, the majority of the prairie is still intact. This area still consists of diverse grassland habitats interspersed with varying densities of depressional wetlands and limited woody riparian corridors. These habitats historically provided critical life cycle components for the grassland birds, prairie dogs, and herds of roaming bison, elk, and pronghorn. Bobcats, wolves, and mountain lions occupied the apex predator niche. Diverse populations of small mammals and insects still provide a bountiful prey base for raptors and omnivores such as coyotes, foxes, raccoons, and opossums. In addition, a wide variety of reptiles and amphibians thrive in this landscape.

The Mixed-Grass Prairie was a disturbance-driven ecosystem with fire, herbivory, and climate functioning as the primary disturbances. Following European settlement, elimination of fire, overgrazing, and some habitat fragmentation significantly altered the appearance and functionality of the entire ecosystem. Bison and prairie dogs were historically keystone species, but free-roaming bison herds have been extirpated in this region. The loss of bison and fire as ecological drivers greatly influenced the character of the remaining native grasslands and the habitats that they provide. Fragmentation has reduced habitat quality for numerous area-sensitive species, as highlighted by the decline of the greater prairie chicken.

Historically, an ecological mosaic of the sites provided habitat for species requiring unfragmented grasslands. Most of these important habitat features and components are intact, providing upland nesting habitat for grassland birds and game birds; nesting and escape cover for waterfowl; forbs and insects for brood-rearing habitat; and a forage source for small and large herbivores.

Disruption of the natural fire regime and lack of appropriate grazing management are the greatest threats to the ecosystem dynamics today. Tree and shrub encroachment from lack of fire creates habitat that favors generalist species such as American robin and mourning dove, and provides perches for raptors, increasing the predation mortality on native bird populations. Introduced species such as smooth bromegrass, Kentucky bluegrass, nodding plumeless thistle (musk thistle), and Canada thistle further degrade the biological integrity of many areas of the prairie.

Hydrological functions

Water is the principal factor limiting forage production on this site. For the interpretive plant community, rills and gullies should not typically be present. Water flow patterns should be barely distinguishable if at all present. Pedestals are only slightly present in association with bunchgrasses such as little bluestem. Litter typically falls in place, and signs of movement are not common. Chemical and physical crusts are rare to non-existent. Cryptogamic crusts are present but only cover 1-2% of the soil surface. Overall, this site has the appearance of being very stable and productive.

Recreational uses

This site provides hunting opportunities for a number of game species. The wide variety of plants which bloom from spring until fall as well as the panoramic views have an aesthetic value that appeals to visitors.

Wood products

Limited timber harvest, posts and poles, and fuelwood are all viable wood products on this site.

Other information

Field Offices (Counties)
Nebraska:
Ainsworth, (Brown, Keya Paha, Rock)
Bloomfield, (Knox)
Neligh, (Antelope)
O'Neill, (Holt)
Spencer, (Boyd)
Valentine, (Cherry)

South Dakota:
Burke, (Gregory)
Martin, (Bennett, Shannon)
Winner (Tripp)
White River, (Mellette, Todd)

Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from trained range personnel were also used. Those involved in developing this site include Wayne Bachman, Soil Scientist, NRCS; Stan Boltz, Range Management Specialist, NRCS; Anna Ferguson, Soil Conservationist, NRCS; Roger Hammer, Soil Scientist, NRCS; Dana Larsen, Range Management Specialist, NRCS; Dave Schmidt, Rangeland Management Specialist, NRCS; Kim Stine, Rangeland Management Specialist, NRCS.

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Approval

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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.

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Date	11/18/2024
Approved by	Suzanne Mayne-Kinney
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Typically, none. A slight presence of rills may exist on steeper slopes (greater than 30 percent). When they do occur, rills are shallow (less than 6 inches deep) and narrow (less than 3 inches wide). As slopes increase, rills will be more frequent, deeper, and wider.

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2. **Presence of water flow patterns:** Typically, none. Water flow patterns are not expected on slopes of 30 percent or less. They may occur on steeper slopes. Where they do occur, they are rare, narrow (less than 6 inches wide), short (less than 12 inches long) and disconnected, disrupted by perennial vegetation.

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3. **Number and height of erosional pedestals or terracettes:** Typically, none. Occasionally, bunch grasses may be slightly pedestalled (0.5 inch/1.25 cm) with no exposed roots. Multi-year drought or wildfire can contribute to increased incidences of pedestalled plants.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground is typically 15 percent or less. Bare ground patches are not connected and are less than 12 inches (30 cm) across, unless associated with disturbance such as burrowing animals. Multi-year drought and/or wildfire can increase bare ground to 25 percent for up to two years following the disturbance. Cross-sectional viewing of this site appears to have more bare ground than vertical viewing due to exposed steep slopes. Nearly vertical slopes should not be included in the evaluation as those areas are not part of the steep sandy site but are considered a non-site.

   Bare ground is exposed mineral soil that is not covered by vegetation (basal and/or foliar canopy), litter, standing dead vegetation, gravel/rock, and visible biological curst (e.g., lichen, mosses, algae).

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5. **Number of gullies and erosion associated with gullies:** Gullies may be present, typically in association with drainageways and on steeper slopes. Gullies may develop after intense rainfall events and will re-vegetate rapidly.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Typically, none. Occasional areas associated with concentrated animal activity (livestock trailing and burrowing animals) may exhibit wind scoured areas with accompanying deposition. These areas are typically less than 10 feet (3 meters) across and comprise less than 1 percent of the site.

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7. **Amount of litter movement (describe size and distance expected to travel):** Fine litter movement of 1 to 3 feet (0.3 to 1 meter) is possible during intense rains. Coarse litter may move but will move shorter distances than fine litter.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability ratings should typically be 4 to 6.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** A-horizon should be 2 to 9 inches (5 to 23 cm) thick. Soil colors are dark gray, grayish brown, or dark grayish brown (values of 4 or 5) when dry and very dark grayish brown, very dark gray or dark grayish brown (values of 3 or 4) when moist. Structure

is typically weak fine granular to weak very fine granular.

The primary soil series correlated to the Steep Sandy ecological site are McKelvie, Peji, and Blula.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** The functional/structural groups provide a combination of rooting depths and structure which positively influences infiltration. Combination of shallow and deep rooted species (mid & tall rhizomatous and tufted perennial cool season grasses) with fine and coarse roots positively influences infiltration. The presence of trees in excess of that in the Reference State (1) may adversely impact infiltration.

    The expected composition of the plant community is 75 to 90 percent perennial grasses and grass-likes, 5 to 10 percent forbs, 0 to 5 percent shrubs, and 5 to 10 percent coniferous trees. The perennial grass and grass-like component is made up of C4, tallgrasses; C4, midgrasses; C4, shortgrasses; C3, bunchgrasses; and grass-likes.

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11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None. A compaction layer should not be present,

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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: Phase 1.1
    1. Native, perennial, C4, tallgrass, (2 species minimum): prairie sandreed, sand bluestem, switchgrass.
    2. Native, perennial, C4, midgrass, (2 species minimum): little bluestem, sideoats grama, sand dropseed

    Phase 1.2
    1. Native, perennial, C4, midgrass, (2 species minimum): little bluestem, sideoats grama, sand dropseed.
    2. Native, perennial, C3, bunchgrasses (3 species minimum): needle and thread, porcupinegrass, prairie Junegrass, Scribner’s rosettegrass.

    Phase 1.3
    1. Native, perennial, C4 shortgrass (1 species minimum): blue grama, hairy grama.
    2. Native, perennial, C4, midgrass, (2 species minimum): little bluestem, sideoats grama, sand dropseed.

    Sub-dominant: Phase 1.1
    1. Native, perennial, C3, bunchgrasses (3 species minimum): needle and thread, porcupinegrass, prairie Junegrass, Scribner’s rosettegrass.
    2. Native, perennial, C4 shortgrass (1 species minimum): blue grama, hairy grama.

    Phase 1.2
    1. Native, perennial, C4, tallgrass, (2 species minimum): prairie sandreed, sand bluestem, switchgrass
    2. Native, perennial, C4 shortgrass (1 species minimum): blue grama, hairy grama.

    Phase 1.3
    1. Native, perennial, C3, bunchgrasses (3 species minimum): needle and thread, porcupinegrass, prairie Junegrass, Scribner’s rosettegrass.
    3. Grass-like (1 species minimum): threadleaf sedge, other sedges.

    Other: Minor - Phase 1.1
    1. Native forb: forbs vary from location to location.

2. Grass-likes: sedges.
3. Coniferous trees: ponderosa pine.
4. Shrubs: shrubs vary from location to location.

Minor - Phase 1.2
1. Grass-like: sedges.
2. Forbs: forbs present vary from location to location.
3. Coniferous trees: ponderosa pine.
4. Shrubs: shrubs vary from location to location

Minor - Phase 1.3
1. Coniferous trees: ponderosa pine.
2. Shrubs: shrubs present vary from location to location.
3. Forbs: forbs present vary from location to location.
4. Non-native C3 grass: Kentucky bluegrass, field brome, smooth brome, cheatgrass.
5. Native, perennial, C4, tallgrass, (2 species minimum): prairie sandreed, sand bluestem, switchgrass.

Additional: The Reference Community (1.1) consists of eight F/S groups. These groups are, in order of relative abundance, native, perennial, C4 tallgrass; native, perennial, C4 midgrass; native, perennial, C3 bunchgrass; perennial, C4 shortgrass; native forb = grass-like = coniferous tree; shrub.
The Degraded Native Community (1.2) consists of eight F/S groups. These groups in order of relative abundance are native, perennial, C4 midgrass; native, perennial, C3 bunchgrass = perennial, C4 shortgrass; native, perennial, C4 tallgrass; native forb = grass-like = coniferous tree; shrub.

The At Risk Community (1.3) also consists of nine groups which are native, perennial, C4, shortgrass = native, perennial, C4 midgrass; native, perennial, C3 bunchgrass; grass-like; coniferous tree; forb = shrub = non-native C3 grass; native, perennial, C4 tallgrass.

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Bunch grasses have strong, healthy centers with few (less than 3 percent) dead centers. Shrubs may show some dead branches (less than 5 percent) as plants age.

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14. **Average percent litter cover (%) and depth (in):** Plant litter cover is evenly distributed throughout the site and is expected to be 50 to 80 percent and at a depth of 0.25 to 0.50 inch (0.65 to 1.3 cm). Litter cover during and following multi-year drought can range from 30 to 40 percent.

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** The representative value (RV) for annual production is 2,200 pounds per acre on an air dry weight basis. Low and High production years should yield 1,800 and 2,600 pounds per acre respectively.

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** No non-native invasive species are present. Annual bromes (cheatgrass and Japanese/field), eastern redcedar, and Kentucky bluegrass are known invasives that have the potential to become dominant or co-

dominant on this site. Consult the state noxious weed and state watch lists for potential invasive species. Note: species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants.

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17. **Perennial plant reproductive capability:** All perennial species exhibit high vigor relative to recent weather conditions. Perennial grasses should have vigorous rhizomes or tillers; vegetative and reproductive structures are not stunted. All perennial species should be capable of reproducing annually.
