USDA Natural Resources Conservation Service

Ecological site R066XY053NE
Interdunal Lowland

Last updated: 2/06/2025
Accessed: 05/10/2025

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 12 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 Interdunal Lowland ecological site occurs in sandhill landscapes in low-lying swales on interdune landforms. It does not receive a significant amount additional moisture from run off or overflow, but typically has a high water table at approximately 36 inches. Slopes range from 1 to 3 percent. Soils are very deep and formed in eolian sand. Soil surface textures are fine sand to loamy fine sand, while subsoil textures are fine sand. The surface horizon is 6 to 15 inches thick.

The vegetation in the Reference State (1.0) consists of a warm- and cool-season grasses and grass-likes. Sand bluestem, little bluestem, prairie sandreed, switchgrass, and blue grama are dominant. Cool-season grasses and grass-like species including needle and thread, and various sedges. Forbs are common and diverse; shrubs can include leadplant and rose.

Associated sites

R066XY032NE	**Sandy 18-22" P.Z.** The Sandy 18-22” PZ ecological site often occurs adjacent to the Interdunal Lowland ecological site but is located on a higher landscape position.
R066XY033NE	**Sands 18-22" P.Z.** The Sands 18-22” PZ ecological site often occurs adjacent to the Interdunal Lowland ecological site but is located on a higher landscape position.

Similar sites

R066XY051NE	**Sandy Lowland** The Sandy Lowland ecological site also receives additional moisture from run off or overflow and has similar soil surface textures to Interdunal Lowland ecological sites. Interdunal Lowland typically has a seasonal high water table at approximately 40 inches while the Sandy Lowland ecological site does not.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Andropogon hallii* (2) *Calamovilfa longifolia*

Physiographic features

The Interdunal Lowland site occurs on swales and interdunes of sandhills landscapes in MLRA 66. The site occupies a run-on landscape position with slopes typically ranging from zero to three percent.

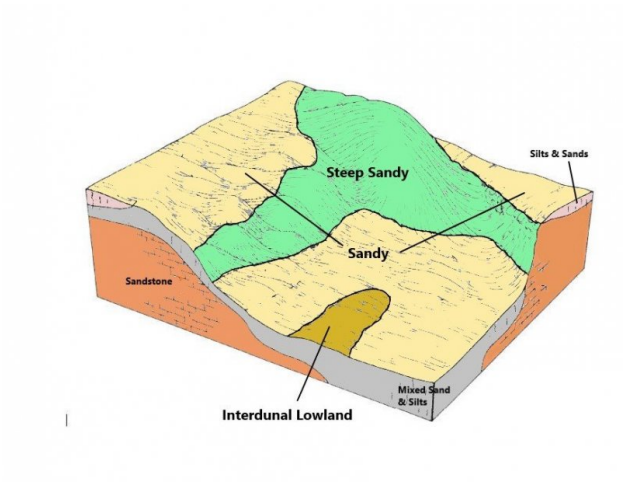


Figure 1. Block diagram of Interdunal Lowland site.

Table 2. Representative physiographic features

Landforms	(1) Sandhills > Interdune (2) Hummock
Runoff class	Negligible to very low
Flooding frequency	None
Ponding frequency	None
Elevation	1–3 ft
Slope	0–3%
Water table depth	36–60 in
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 the location of MLRA 66 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)	112-126 days
Freeze-free period (characteristic range)	129-146 days
Precipitation total (characteristic range)	18-25 in
Frost-free period (actual range)	97-129 days
Freeze-free period (actual range)	122-149 days
Precipitation total (actual range)	18-25 in
Frost-free period (average)	118 days
Freeze-free period (average)	137 days
Precipitation total (average)	24 in

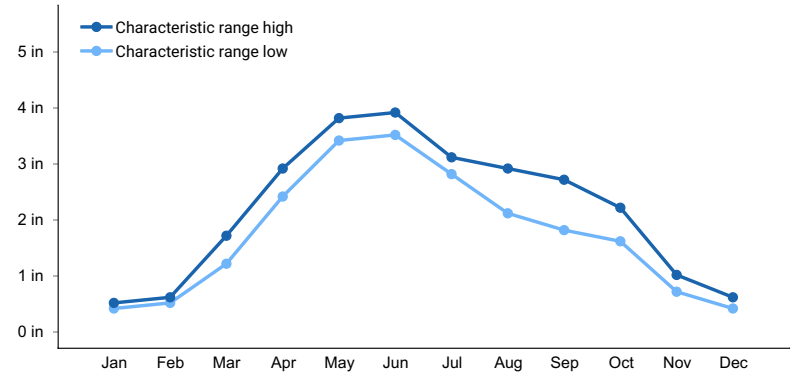


Figure 2. Monthly precipitation range

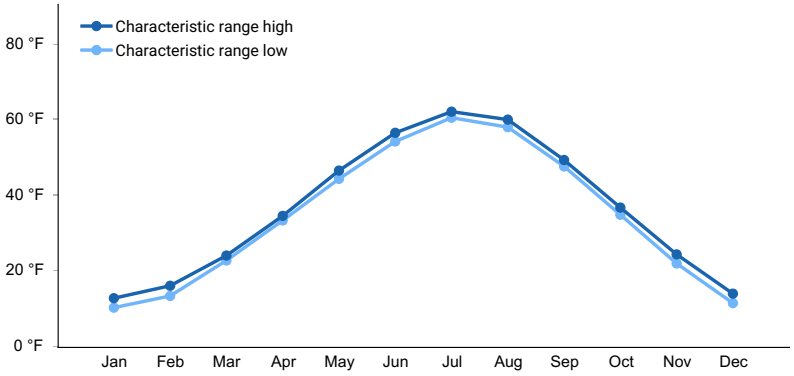


Figure 3. Monthly minimum temperature range

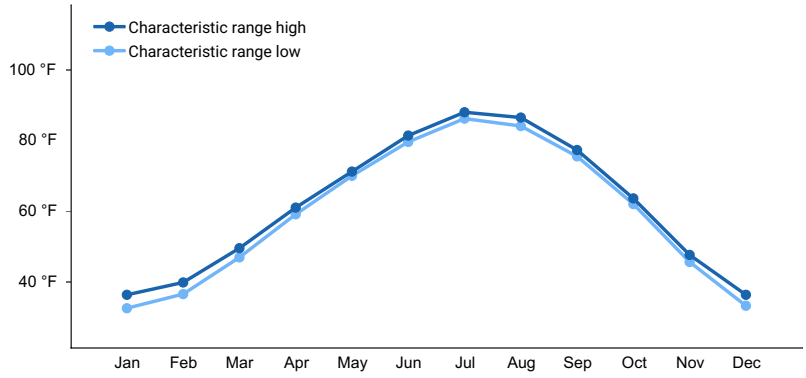


Figure 4. Monthly maximum temperature range

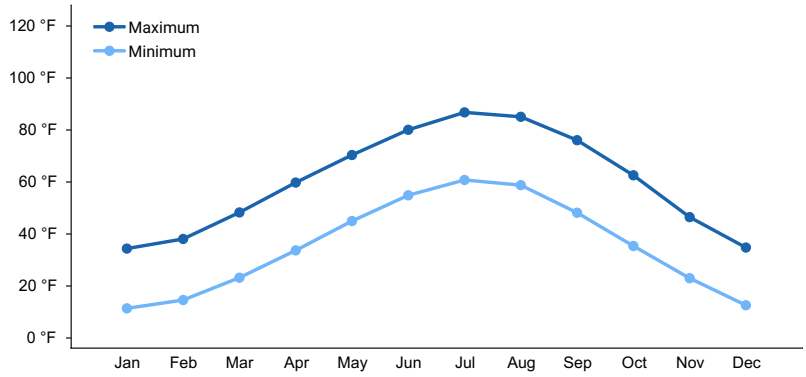


Figure 5. Monthly average minimum and maximum temperature

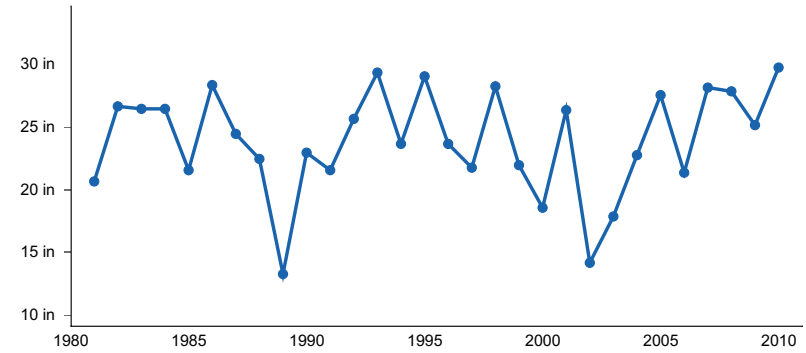


Figure 6. Annual precipitation pattern

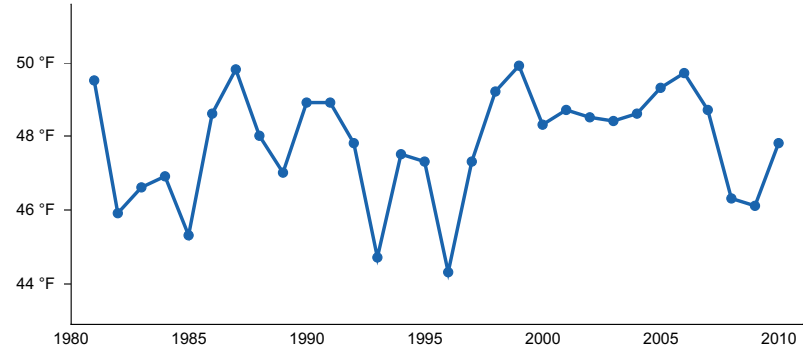


Figure 7. Annual average temperature pattern

Climate stations used

- (1) MARTIN 5 E [USC00395285], Martin, SD
- (2) HARRINGTON [USC00393574], Tuthill, SD
- (3) VALENTINE MILLER FLD [USW00024032], Valentine, NE

- (4) SPRINGVIEW [USC00258090], Springview, NE
- (5) AINSWORTH [USC00250050], Ainsworth, NE
- (6) NEWPORT [USC00255925], Newport, NE
- (7) BUTTE [USC00251365], Butte, NE
- (8) ATKINSON 3SW [USC00250420], Atkinson, NE
- (9) O NEILL [USC00256290], Oneill, NE
- (10) EWING [USC00252805], Ewing, NE
- (11) KILGORE 1NE [USC00254432], Kilgore, NE
- (12) LYNCH [USC00255040], Lynch, NE

Influencing water features

The surface hydrology functions independently of the water table, but the deeper-rooted vegetation species occupying the site have periodic access to additional moisture from the of the water table which is at a depth of approximately 36 inches during some portion of the growing season.

Soil features

The soils associated with the Interdunal Lowland ecological site are very deep, moderately well drained soils formed in eolian sands on interdunes in sandhills landscapes. Slopes range from 1 to 3 percent. Soil surface textures are usually fine sand but may be loamy fine sand while subsoils are a fine sand textured with aquic conditions below 48 inches. The surface layer is typically six to ten inches thick but may be up to fifteen inches. There are typically no carbonates, with only 1 to 10 percent clay in the particle-size control section. The saturated hydraulic conductivity is very high, and runoff is negligible.

Ipage is the primary soil series correlated to this 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 detail specific to your location or visit Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov).

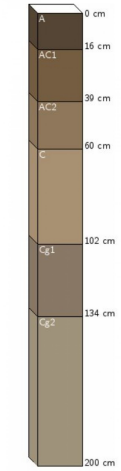


Figure 8. Ipage Series Profile

Table 4. Representative soil features

Parent material	(1) Eolian sands
Surface texture	(1) Fine sand (2) Loamy fine sand
Drainage class	Moderately well drained
Permeability class	Rapid
Soil depth	60 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%

Available water capacity (Depth not specified)	1.9–4.1 in
Calcium carbonate equivalent (Depth not specified)	0%
Electrical conductivity (Depth not specified)	0–2 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0
Soil reaction (1:1 water) (Depth not specified)	5.6–7.3
Subsurface fragment volume <=3" (Depth not specified)	0%
Subsurface fragment volume >3" (Depth not specified)	0–2%

Ecological dynamics

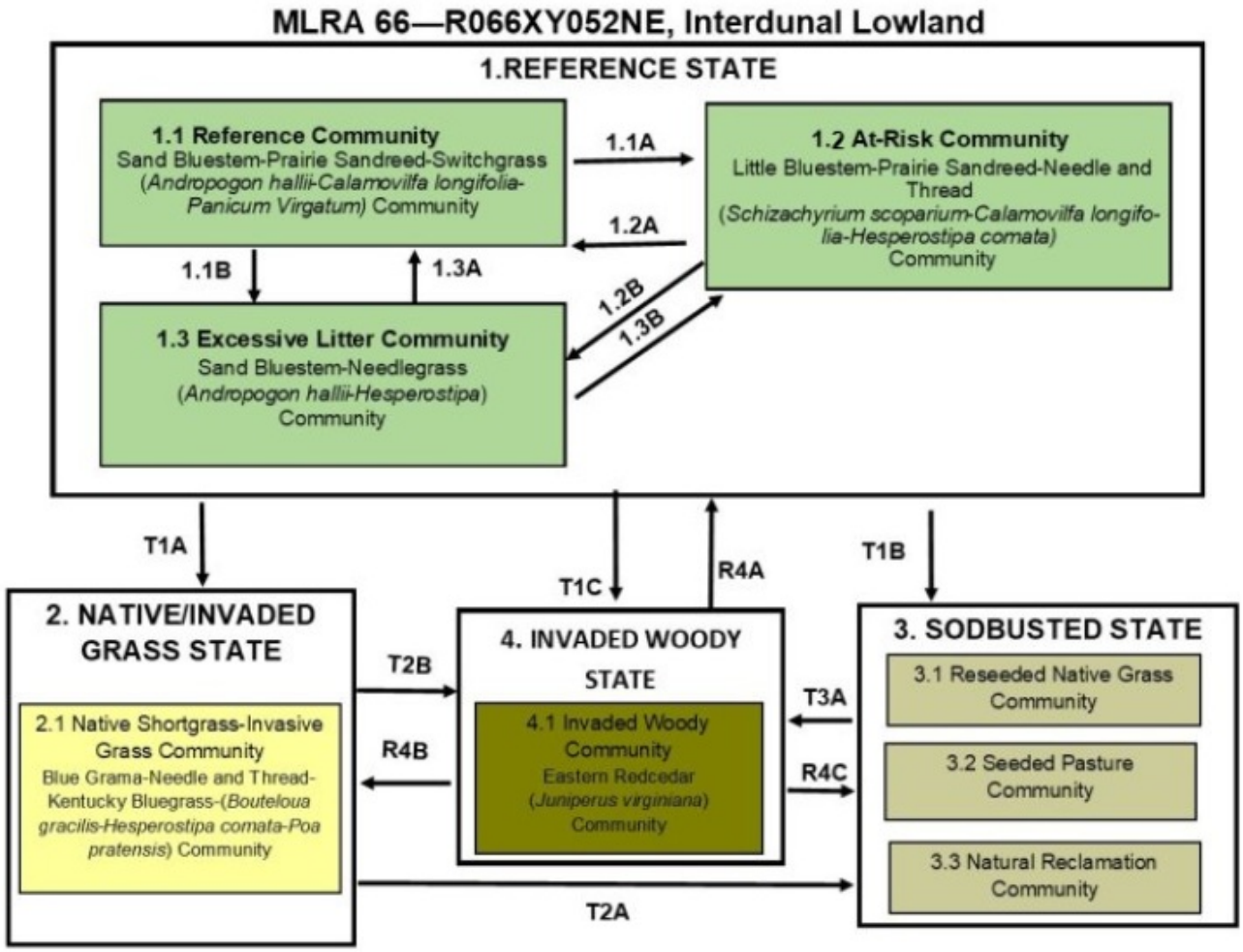
Interdunal Lowland ecological sites developed under Northern Great Plains climatic conditions, light to severe grazing by bison and other large herbivores, sporadic natural or human-caused wildfire, and other biotic and abiotic factors that typically influence soil and site development. This continues to be a disturbance driven site with herbivory, fire, and variable climate being the primary disturbances. Changes occur in the plant communities due to short-term weather variations, impacts of native and/or 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 Interdunal Lowland 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, sand bluestem, little bluestem and prairie sandreed will decrease in frequency and production while blue grama and needle and thread increase.

The State-and-Transition Model (STM) is depicted below and includes a Reference State (1), a Native/Invaded Grass State (2), a Sodbusted State (3), and an Invaded Woody State (4). Each state represents the crossing of a major ecological threshold due to alteration of the functional dynamic properties of the ecosystem. The main properties observed to determine this change are the soil and vegetative communities and the hydrologic cycle. Each state may have one or more vegetative 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: Long-term (> 10 years) heavy grazing, or haying, with inadequate growing season recovery periods.
T1B: Tillage to facilitate production agriculture.
T1C: Woody encroachment with no fire or brush management.
T2A: Tillage to facilitate production agriculture.
T2B: Woody encroachment with no fire or brush management.
T3A: Woody encroachment with no fire or brush management.
R4A: Prescribed burning, wildfire, mechanical harvest, brush management.
R4B: Prescribed burning, wildfire, mechanical harvest, brush management.
R4C: Prescribed burning, wildfire, mechanical harvest, brush management.

Community Pathways:

1.1A: Continuous, season long grazing, rotational grazing with inadequate recovery periods, repetitive haying.
1.1B: Prolonged (> 5 years) absence of herbivory and fire.
1.2A: Prescribed grazing with adequate, growing season recovery periods.
1.2B: Prolonged (> 5 years) absence of herbivory and fire.
1.3A: Prescribed grazing, prescribed burning.
1.3B: Prescribed grazing, prescribed burning.

State 1
Reference State

The Reference State (1) describes the range of vegetative communities that occur on the Interdunal Lowland 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 three plant community phases which are the Reference Community (1.1), the At-Risk Community (1.2), and the Excessive Litter Community (1.3). The Reference Community 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 At-Risk Community results from management decisions 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

- sand bluestem (*Andropogon hallii*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass
- switchgrass (*Panicum virgatum*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass
- little bluestem (*Schizachyrium scoparium*), grass

Community 1.1
Reference Community

Interpretations are primarily based on the Reference Community or Sand Bluestem-Prairie Sandreed-Switchgrass (*Andropogon hallii-Calamovilfa longifolia-Panicum virgatum*) 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. Deep-rooted native warm-season grasses are able to periodically utilize subsurface moisture, giving them a competitive advantage in the community. Warm-season, tall- and midgrasses dominate this plant community. Sand bluestem, little bluestem, prairie sandreed, switchgrass, and blue grama are the dominant species. Cool-season grasses and grass-like species including needle and thread and various sedges are also present. The forb community is diverse. Leadplant and rose are common shrubs. The potential vegetation is about 80 to 90 percent grasses, 5 to 10 percent forbs and 5 to 10 percent shrubs. Natural fire played a significant role in the succession of this site by preventing the establishment of eastern redcedar. Wildfires have been actively controlled in recent times, allowing eastern redcedar encroachment. This plant community can be found on areas that are managed with prescribed grazing and prescribed burning. It may be found on areas receiving occasional periods of short-term rest. Management strategies to sustain this community include proper stocking rates, adequate growing season recovery times, monitoring key forage species, and prescribed fire every 6 to 8 years (R. P. Guyette and others, 2012). 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

- sand bluestem (*Andropogon hallii*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass
- switchgrass (*Panicum virgatum*), grass

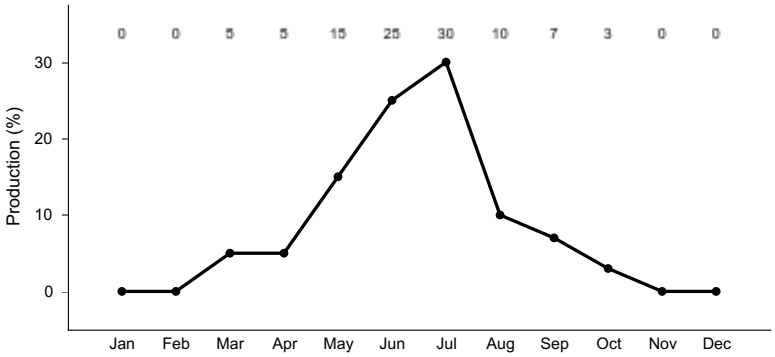


Figure 9. Plant community growth curve (percent production by month). NE6534, NE/SD Sandhills, Native Grasslands. Warm-season dominant, cool-season subdominant, mid- and tallgrasses.

Community 1.2
At-Risk Community

The At-Risk or Little Bluestem-Prairie Sandreed-Needle and Thread (*Schizachyrium scoparium-Calamovilfa*

longifolia-Hesperostipa comata) Community (1.2) is marked by a significant loss of production. This community develops with continuous season-long grazing or rotational grazing with inadequate recovery periods. Cool-season and warm-season shortgrasses have increased as compared to the Reference Community (1.1). Most of the palatable plants from the Reference Community are present but occur in reduced amounts. The composition of the forb component remains diverse. The potential for encroachment by invasive woody species becomes more likely due to fewer deep-rooted species and a reduced fuel load to carry fire. The dominant grasses are prairie sandreed and little bluestem. Grasses of secondary importance include blue and hairy grama, needle and thread, sand dropseed, and western wheatgrass. Forbs commonly found in this plant community include white sagebrush, heath aster, goldenrod, hoary verbena, and cuman ragweed. Indiangrass is greatly reduced and may be present only as a remnant while sand bluestem is significantly reduced. Forbs and cool-season grasses are a higher percentage of the community as compared to the Reference Community. The potential vegetation is about 75 to 85 percent grasses or grass-like plants, 10 to 15 percent forbs, and 5 to 10 percent woody shrubs. As this site deteriorates, more grazing-tolerant species such as prairie sandreed, little bluestem, sand dropseed, and blue grama initially increase, while sand bluestem and switchgrass decrease in frequency and production. The reduction in warm-season tallgrasses not only reduces the annual production but also the ability to increase production in favorable years. The soil surface remains intact and this plant community is considered stable. While this plant community is less productive and less diverse than the Reference Plant Community, it remains sustainable in regard to site and soil stability, hydrologic function, and biotic integrity. Unless the management strategy is changed, prairie sandreed and little bluestem populations will become a smaller portion of the plant community, while warm-season shortgrasses and cool-season grasses will increase causing the community to cross the threshold to the Native/Invaded Grass State (2). The resiliency of this plant community is moderate depending upon the intensity and duration of disturbance. Infiltration and runoff are generally not affected due to the nature of the soil.

Dominant plant species

- little bluestem (*Schizachyrium scoparium*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass

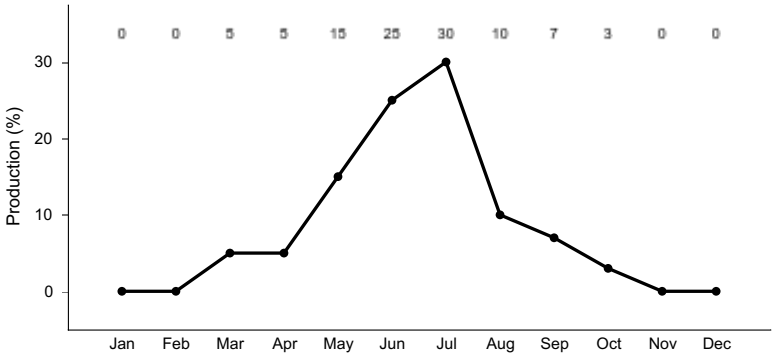


Figure 10. Plant community growth curve (percent production by month). NE6534, NE/SD Sandhills, Native Grasslands. Warm-season dominant, cool-season subdominant, mid- and tallgrasses.

Community 1.3
Excessive Litter Community

The Excessive Litter or Sand Bluestem-Needlegrass (*Andropogon hallii*-Hesperostipa) Community (1.3) 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). Periodic fire may extend the amount of time it will take to reach this community. 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
- needle and thread (*Hesperostipa comata ssp. comata*), grass
- porcupinegrass (*Hesperostipa spartea*), grass

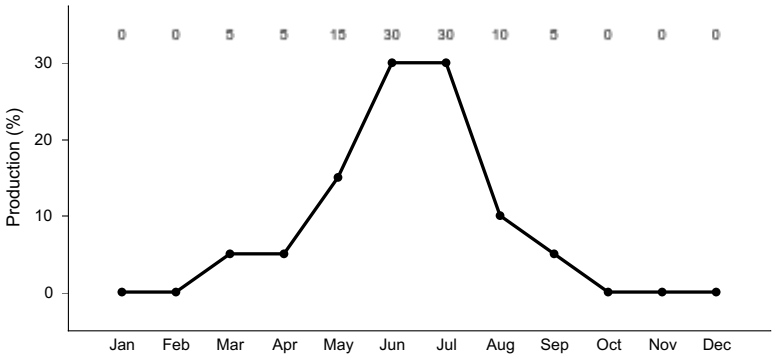


Figure 11. Plant community growth curve (percent production by month). NE9002, Sandhills, Native Grassland, Non-Use. Nebraska/South Dakota - Warm-season dominant, cool-season subdominant, mixed-tallgrass.

Pathway 1.1A
Community 1.1 to 1.2

A shift from the Reference Community (1.1) to the At-Risk Community (1.2) occurs with continuous, season-long grazing or rotational grazing with inadequate growing-season recovery periods. Repetitive haying without allowing adequate recovery periods during the growing season will also cause this shift.

Pathway 1.1B
Community 1.1 to 1.3

Prolonged (more than 5 years) interruption of the natural disturbances of herbivory and fire will move the Reference Community (1.1) to the Excessive Litter Community (1.3).

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing with appropriate stocking rates and adequate growing season recovery periods will return the At-Risk Community (1.2) to the Reference Community (1.1). Prescribed fire will accelerate this process. Allowing adequate recovery time during the growing season when the land is hayed will also facilitate return to the Reference Community.

Pathway 1.2 B
Community 1.2 to 1.3

Prolonged (more than 5 years) interruption of the natural disturbances of herbivory and fire will move the At-Risk Community (1.2) to the Excessive Litter Community (1.3).

Pathway 1.3A
Community 1.3 to 1.1

Reintroduction of the natural processes of herbivory and fire will return the Excessive Litter Community (1.3) to the Reference Community (1.1).

Pathway 1.3B
Community 1.3 to 1.2

Reintroduction of the natural processes of herbivory and fire will return the Excessive Litter Community (1.3) to the

At-Risk Community (1.2).

State 2
Native/Invaded Grass State

The Native/Invaded Grass State (2) has been degraded from the Reference State (1) and much of the native, warm-season, tall- and midgrass components have been replaced by native, warm-season shortgrasses and non-native, cool-season grasses. The loss of warm-season, tall- and midgrasses has negatively impacted energy flow and nutrient cycling. Water infiltration is reduced due to the shallow root system and rapid runoff characteristics of the shortgrass dominated communities. The Native/Invaded Grass State includes the Shortgrass Sod Community (2.1).

Dominant plant species

- Kentucky bluegrass (*Poa pratensis*), grass
- blue grama (*Bouteloua gracilis*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass

Community 2.1
Shortgrass Sod Community

The Shortgrass Sod or Blue Grama-Kentucky Bluegrass (*Bouteloua gracilis-Poa pratensis*) Community (2.1) occurs when a threshold is crossed from the Reference State (1). Most of the warm-season tall- and midgrasses and cool-season bunchgrasses have been removed from the plant community. Plant diversity is low. Small, isolated plants may exist in a prostrate form to avoid defoliation. With the decline and loss of deeper-penetrating root systems, a compacted layer may form in the soil profile below the shallower replacement root systems. This plant community typically develops with heavy livestock grazing, usually season long, or with annual haying followed by fall grazing. It can also develop with long-term (greater than ten years) exclusion of grazing and fire and under this management, Kentucky bluegrass will be the dominant species. Dominant grasses include needle and thread, blue or hairy grama, and sand dropseed. Kentucky bluegrass may have a significant presence in the plant community. Other grasses or grass-likes include prairie Junegrass, Scribner's rosette grass, western wheatgrass, and sedges. Common forbs include cuman ragweed, hoary verbena, white sagebrush, and heath aster. Pricklypear and rose are the dominant shrubs. Annual haying delays the increase of rose but increases the cactus component. The potential vegetation is about 80 to 90 percent grass or grass-like plants, 5 to 10 percent forbs, and 5 to 10 percent shrubs. This plant community is fairly resistant to change. Species richness and plant diversity has decreased significantly as compared to the Reference Community (1.1), resulting in a community that is not resilient when disturbed. Plant litter is low, but due to the presence of heavy sod, soil erosion is also low. Water infiltration and runoff are moderate due to soil texture and hydrologic function is negatively affected.

Dominant plant species

- rose (*Rosa*), shrub
- pricklypear (*Opuntia*), shrub
- blue grama (*Bouteloua gracilis*), grass
- needle and thread (*Hesperostipa comata ssp. comata*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- Cuman ragweed (*Ambrosia psilostachya*), other herbaceous
- white sagebrush (*Artemisia ludoviciana*), other herbaceous
- white heath aster (*Symphyotrichum ericoides*), other herbaceous
- hoary verbena (*Verbena stricta*), other herbaceous

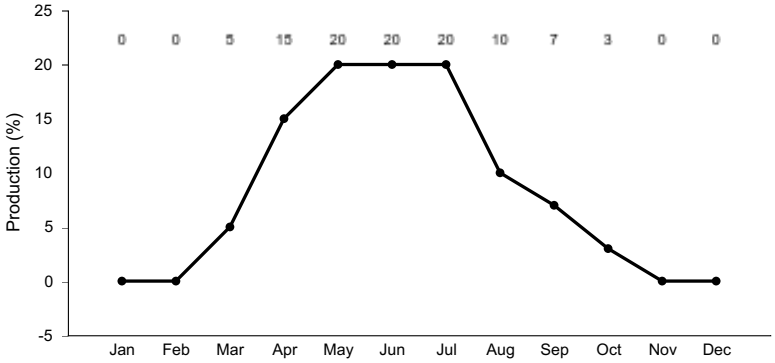


Figure 12. Plant community growth curve (percent production by month). NE6539, NE/SD Sandhills, Native Grass, Disturbed. Warm-season and cool-season co-dominant, short-, mid-, and tallgrasses.

State 3
Sodbusted State

The threshold to the Sodbusted State (3) is crossed as a result of mechanical disturbance to facilitate production agriculture. If farming operations are suspended, the site can seeded to native grasses and forms resulting in the Reseeded Native Grass Community (3.1), be seeded to a tame pasture forage mixture resulting in the Seeded Pasture Community (3.2), or be abandoned with no seeding which will result in the Natural Reclamation Community (3.3). Permanent alterations of the soil, plant community, and hydrologic cycle make restoration to the Reference State (1) extremely difficult, if not impossible.

Dominant plant species

- sand bluestem (*Andropogon hallii*), grass
- prairie sandreed (*Calamovilfa longifolia*), grass
- smooth brome (*Bromus inermis*), grass
- crested wheatgrass (*Agropyron cristatum*), grass
- orchardgrass (*Dactylis glomerata*), grass
- timothy (*Phleum pratense*), grass
- tall fescue (*Schedonorus arundinaceus*), grass

Community 3.1
Reseeded Native Grass Community

The Reseeded Native Grass Community (3.1) does not contain native remnants, and varies considerably depending upon the seed mixture, the degree of soil erosion, the age of the stand, fertility management, and past grazing management. Native range and grasslands seeded to native species are ecologically different and should be managed separately. Factors such as functional group, species, stand density, and improved varieties all impact the production level and palatability of the seedings. Species diversity is often limited, and when grazed in conjunction with native rangelands, uneven forage utilization may occur. Total annual production during an average year varies significantly depending upon precipitation, management, and grass species seeded. Prescribed grazing including appropriate utilization levels, adequate growing-season recovery periods, and timing of grazing that favor the productivity, health, and vigor of the seeded species is required to maintain this community. Periodic prescribed burning and brush management may also be needed.

Community 3.2
Seeded Pasture Community

The Seeded Pasture Community (3.2) does not contain native remnants and varies considerably depending upon the extent of soil erosion, the species seeded, the quality of the stand that was established, the age of the stand, and management of the stand since establishment. There are several factors that make seeded tame pasture a different grazing resource than native rangeland and land seeded to a native grass mixture. Factors such as species selected, stand density, improved varieties, and harvest efficiency all impact production levels and palatability. Species diversity on seeded tame pasture is often limited to a few species. When seeded pasture and

native rangelands or seeded pasture and seeded rangeland are in the same grazing unit, uneven forage utilization will occur. Improve forage utilization and stand longevity by managing this community separately from native rangelands or land seeded to native grass species. Total annual production during an average year varies significantly depending on the level of management and species seeded. Improved varieties of warm-season or cool-season grasses are recommended for optimum forage production. Fertilization, weed management, and prescribed grazing including appropriate utilization levels, adequate growing-season recovery periods, and timing of grazing that favor the productivity, health, and vigor of the seeded species are required to maintain this community. Periodic prescribed burning and brush management may also be needed.

Community 3.3
Natural Reclamation Community

The Natural Reclamation Community (3.3) consists of annual and perennial weeds and less desirable grasses. These sites have been farmed and abandoned without being reseeded. Soil organic matter and carbon reserves are reduced, soil structure is changed, and a plowpan or compacted layer can form, which decreases water infiltration. Residual synthetic chemicals may remain from farming operations. In early successional stages, this community is not stable. The hazard of erosion is a resource concern. Total annual production during an average year varies significantly depending on the succession stage of the plant community and any management applied to the system.

State 4
Invaded Woody State

The Invaded Woody State (4) is the result of woody encroachment. Once the tree canopy cover reaches 15 percent with an average tree height exceeding five feet, the threshold is crossed. Woody species are encroaching due to lack of prescribed fire and other brush management practices. Typical ecological impacts are a loss of native grasses, degraded forage productivity, and reduced soil quality. Prescribed burning, wildfire, timber harvest and brush management will move this state toward a grass dominated state. If the Invaded Woody State transitioned from the Native/Invaded Grass State (2) or the Sodbusted State (3), the land cannot transition 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 restoration to the Reference State. This Woody Invaded State includes one community, the Invaded Woody Community (4.1)

Dominant plant species

- eastern redcedar (*Juniperus virginiana*), tree

Community 4.1
Invaded Woody Community

The Invaded Woody Community or Eastern Redcedar (*Juniperus virginiana*) Community (4.1) has at least 15 percent canopy cover consisting of trees generally 5 feet or taller. Encroaching trees are primarily eastern redcedar. Additional woody cover from deciduous trees and shrubs may be present. In the absence of fire and brush management, this ecological site is very susceptible to eastern redcedar seedling invasion, especially when adjacent to a seed source. Eastern redcedar can eventually dominate the site resulting in a closed canopy monoculture which drastically reduces forage production and which has limited value for either livestock grazing or wildlife habitat. 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
- blue grama (*Bouteloua gracilis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass

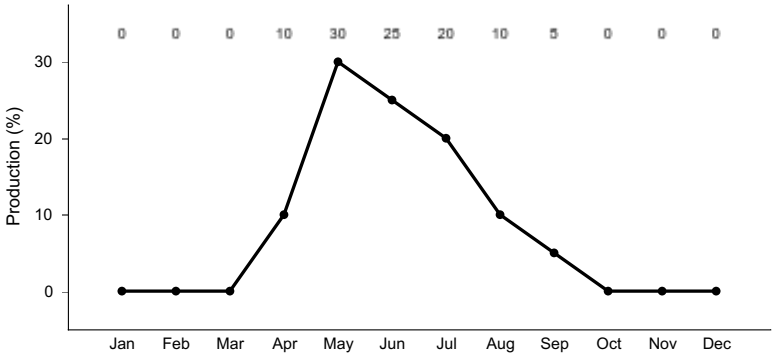


Figure 13. Plant community growth curve (percent production by month). NE6542, NE/SD Sandhills, Eastern Redcedar Encroachment. Closed or nearly closed canopy of eastern redcedar.

Transition T1A
State 1 to 2

Heavy, season-long, long-term (more than ten years) grazing or heavy rotational grazing with inadequate 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). This transition will also occur with repetitive haying with inadequate recovery periods. 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

The Reference State (1) is significantly altered by tillage to facilitate production agriculture. The disruption to the plant community, the soil, and the hydrology of the system make restoration to a true reference state unlikely.

Transition T1C
State 1 to 4

Disruption of the natural fire regime and the encroachment of invasive exotic and native woody species can cause the Reference State (1) to shift to the Invaded Woody State (4).

Transition T2A
State 2 to 3

The Native/Invaded Grass State (2) is significantly altered by tillage to facilitate production agriculture. The disruption to the plant community, the soil and the hydrology of the system make restoration unlikely.

Transition T2B
State 2 to 4

Disruption of the natural fire regime and the encroachment of invasive exotic and native woody species can cause the Native/Invaded Grass State (2) to shift to the Invaded Woody State (4).

Transition T3A
State 3 to 4

Disruption of the natural fire regime and the encroachment of invasive exotic and native woody species can cause the Sodbusted State (3) to shift to the Invaded Woody State (4).

Restoration pathway R4A
State 4 to 1

Prescribed burning, wildfire, harvest, and brush management will move the Invaded Woody State (4) toward the Reference State (1). The forb component may initially increase following tree 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. The heavier the existing canopy cover, the greater the energy input required to return to the Reference State by management practices. The amount of time required for this restoration to occur depends on the severity and duration of the encroachment. Land that transitioned to the Woody Invaded State from the Native/Invaded Grass State (2) or the Sodbusted State (3), cannot transition to the Reference State 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 R4B
State 4 to 2

Prescribed burning, wildfire, harvest, and brush management will move the Invaded Woody State (4) toward the Native/Invaded Grass State (2). The forb component may initially increase following tree 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. The heavier the existing canopy cover, the greater the energy input required to return to the Reference State by management practices. The amount of time required for this restoration to occur depends on the severity and duration of the encroachment. Land that transitioned to the Woody Invaded State from the Native/Invaded Grass State or the Sodbusted State (3), 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 R4C
State 4 to 3

Prescribed burning, wildfire, harvest, and brush management will move the Invaded Woody State (4) toward the Sodbusted State (3). The forb component may initially increase following tree 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. The heavier the existing canopy cover, the greater the energy input required to return to the Reference State by management practices. The amount of time required for this restoration to occur depends on the severity and duration of the encroachment. Land that transitioned to the Woody Invaded State from the Native/Invaded Grass State (2) or the Sodbusted State (3), 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

LIVESTOCK – GRAZING INTERPRETATIONS:
Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide year-long forage for cattle, sheep, or horses. During the dormant period, the protein levels of the forage may be lower than the minimum needed to meet livestock (primarily cattle and sheep) requirements. 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

The Interdunal Lowland is a run-on site, with moderately well drained soils. The depth to the water table allows the deeper- rooted native grasses seasonal access to additional water.

The high infiltration rate of these sands results in few rills and gullies or water flow patterns. Pedestals are only slightly present in association with bunchgrasses such as needle and thread. Litter typically falls in place. Chemical and physical crusts are rare to non-existent. Cryptogamic crusts are present but only cover 1-2 percent of the soil surface. This crusting is not significant for hydrologic considerations. Overall, this site has the appearance of being stable and productive.

Recreational uses

This site provides hunting opportunities for upland game species. The wide variety of plants which 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

Seed harvest of native plant species can provide additional income 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; and Kim Stine, Rangeland Management Specialist, NRCS.

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Approval

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Acknowledgments

Many thanks to the members of the soils, local practitioners and technical teams, as well as the editor.

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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:** None. Rills are not expected on this site.

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2. **Presence of water flow patterns:** None. Water flow patterns are not expected on this site.

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3. **Number and height of erosional pedestals or terracettes:** None. Pedestals and terracettes are not expected on this site.

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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 10 percent or less with patches of 2 to 3 inches (5 to 7.5 cm) in diameter.

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

5. **Number of gullies and erosion associated with gullies:** None. Gullies are not expected on this site.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None. Wind-scoured areas and depositional areas are not expected on this site.

7. **Amount of litter movement (describe size and distance expected to travel):** Litter should fall in place. Slight amount of movement of fine litter (less than 12 inches or 30 cm) from water is possible, but not normal. Litter movement from wind is not expected.

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 5 to 6, normally 6. Surface organic matter adheres to the soil surface. Soil surface fragments will typically retain structure indefinitely when dipped in distilled water.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** The A-horizon should be 5 to 20 inches (13 to 51 cm) thick. Soil is grayish brown to light brownish gray, (values of 4 to 6) when dry and very dark gray, to dark grayish brown (values of 3 to 4) when moist. Structure is weak very fine granular to single grain.

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. Invasion of introduced cool-season grasses such as annual bromes, Kentucky bluegrass, and smooth brome may have an adverse impact on infiltration and runoff. Woody encroachment may also negatively influence infiltration.

    The expected composition of the plant community is 80 to 90 percent perennial grasses and grass-likes, 5 to 10 percent forbs, and 0 to 5percent shrubs. The perennial grass and grass-like component is made up of C4, tallgrasses; C4, midgrasses, C3, bunchgrasses; C4, shortgrasses; C3, rhizomatous grasses; and grass-likes.

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,

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, (3 species minimum): sand bluestem, prairie sandreed, Indiangrass, switchgrass.
    2. Native, perennial, C4 midgrass (1 species minimum): little bluestem, sand lovegrass, sand dropseed, purple lovegrass.

    Phase 1.2

1. Native, perennial, C4 midgrass (2 species minimum): little bluestem, sand lovegrass, sand dropseed, purple lovegrass.
2. Native, perennial, C4 midgrass, 230-690 #/ac (2 species minimum): sand bluestem, prairie sandreed, Indiangrass, switchgrass.

Phase 1.3
1. Native, perennial, C4 tallgrass, (3 species minimum): sand bluestem, prairie sandreed, Indiangrass, switchgrass.
2. Native, perennial, C3 bunchgrass, (1 species minimum): needle and thread, prairie Junegrass, Scribner's rosettegrass.

Sub-dominant: Phase 1.1
1. Native, perennial, C3 bunchgrass, (1 species minimum): needle and thread, prairie Junegrass, Scribner's rosettegrass.

Phase 1.2
1. Native, perennial, C3 bunchgrass: (2 species minimum): needle and thread, prairie Junegrass, Scribner's rosettegrass, porcupinegrass

Phase 1.3
1. Native, perennial, C4 midgrass (1 species minimum): little bluestem, sand lovegrass, sand dropseed, purple lovegrass

Other: Minor - Phase 1.1
1. Native, perennial, C4 shortgrass: blue grama, hairy grama, thin paspalum.
2. Native forbs: forbs present vary from location to location.
3. Grass-like: sedges.
4. Native, perennial, C3 rhizomatous grass: western wheatgrass.
5. Shrub: leadplant, rose and other shrubs that vary from location to location.

Minor -Phase 1.2
1. Native, perennial, C4 shortgrass: blue grama, hairy grama, thin paspalum.
2. Native forbs: forbs present vary from location to location.
3. Grass-like: sedges
4. Native, perennial, C3 rhizomatous grass: western wheatgrass.
5. Shrub: leadplant, rose, pricklypear and other shrubs that vary from location to location.

Minor -Phase 1.3
1. Non-native, C3 grass: cheatgrass, Kentucky bluegrass.
2. Native, perennial, C4 shortgrass: blue grama, hairy grama, thin paspalum.
3. Native, perennial, C3 rhizomatous grass: western wheatgrass.
4. Forb: forbs present vary from location to location.
5. Grass-like: sedges.
6.. Shrub: prickly pear, rose and other shrubs that vary from location to location.

Trace -Phase 1.2
1. Non-native, C3 grass: cheatgrass, Kentucky bluegrass.

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; native, perennial, C4 shortgrass = native forb; grass-like = shrub = native, C3 rhizomatous grass.

The At Risk Community (1.2) consists of nine F/S groups which are in order of relative abundance native, perennial, C4 tallgrass; native, perennial, C4 midgrass; native perennial, C3 bunchgrass = native, perennial, C4 shortgrass; native forbs; shrubs; grass-like; native, perennial, C3 rhizomatous grass = native, perennial, non-native C3 grass.

The Excessive Litter Community (1.3) consists of nine F/S groups which include native, perennial, C4 tallgrass; native, perennial, C3 bunchgrass; native, perennial, C4 midgrass; non-native, C3 grass; native, perennial, C4 shortgrass; native perennial, C3 rhizomatous grass; forb; grass-like; and shrub.

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

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

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

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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:**

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17. **Perennial plant reproductive capability:**
