Ecological site FX053A99X022
Loamy Gravel (LoGr)

Last updated: 11/22/2023
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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): 053A–Northern Dark Brown Glaciated Plains

The Northern Dark Brown Glaciated Plains, MLRA 53A, is a large, agriculturally and ecologically significant area. It consists of approximately 6.1 million acres and stretches 140 miles from east to west and 120 miles from north to south, encompassing portions of 8 counties in northeastern Montana and northwestern North Dakota. This region represents part of the southern edge of the Laurentide Ice Sheet during maximum glaciation. It is one of the driest and westernmost areas within the vast network of glacially derived prairie pothole landforms of the Northern Great Plains and falls roughly between the Missouri Coteau to the east and the Brown Glaciated Plains to the west. Elevation ranges from 1,800 feet (550 meters) to 3,300 feet (1,005 meters).

Soils are primarily Mollisols, but Inceptisols and Entisols are also common. Till from continental glaciation is the predominant parent material, but alluvium and bedrock are also common. Till deposits are typically less than 50 feet thick (Soller, 2001). Underlying the till is sedimentary bedrock largely consisting of Cretaceous shale, sandstone, and mudstone (Vuke et al., 2007). The bedrock is commonly exposed on hillslopes, particularly along drainageways. Significant alluvial deposits occur in glacial outwash channels and along major drainages, including portions of the Missouri, Poplar, and Big Muddy Rivers. Large eolian deposits of sand occur in the vicinity of the ancestral Missouri River channel east of Medicine Lake (Fullerton et al., 2004). The northwestern portion of the MLRA contains a large unglaciated area containing paleoterraces and large deposits of sand and gravel known as the Flaxville gravel.

Much of this MLRA was glaciated towards the end of the Wisconsin age, and the maximum glacial extent occurred approximately 20,000 years ago (Fullerton and Colton, 1986; Fullerton et al., 2004). Subsequent erosion from major stream and river systems has created numerous drainageways throughout much of the MLRA. The result is a geologically young landscape that is predominantly a dissected till plain interspersed with alluvial deposits and dominated by soils in the Mollisol and Inceptisol orders. Much of this area is typic ustic, making these soils very productive and generally well suited to production agriculture.

Dryland farming is the predominant land use, and approximately 50 percent of the land area is used for cultivated crops. Winter, spring, and durum varieties of wheat are the major crops, with over 48 million bushels produced annually (USDA-NASS, 2017). Areas of rangeland typically are on steep hillslopes along drainages. The rangeland is mostly native mixed-grass prairie similar to the Stipa-Agropyron, Stipa-Bouteloua-Agropyron, and Stipa-Bouteloua faciations (Coupland, 1950, 1961). Cool-season grasses dominate and include rhizomatous wheatgrasses, needle and thread, western porcupine grass, and green needlegrass. Woody species are generally rare; however, many of the steeper drainages support stands of trees and shrubs, such as green ash and chokecherry. Seasonally ponded, prairie pothole wetlands may occur throughout the MLRA, but the greatest concentrations are in the east and northeast where receding glaciers stagnated and formed disintegration moraines with hummocky topography and numerous areas of poorly drained soils.

Classification relationships

NRCS Soil Geography Hierarchy
• Land Resource Region: Northern Great Plains
• Major Land Resource Area (MLRA): 053A Northern Dark Brown Glaciated Plains

National Hierarchical Framework of Ecological Units (Cleland et al., 1997; McNab et al., 2007)
• Domain: Dry
• Division: Temperate Steppe
• Province: Great Plains-Palouse Dry Steppe Province 331
• Section: Glaciated Northern Grasslands Section 331L
• Subsection: Glaciated Northern Grasslands Subsection 331La
• Landtype association/Landtype phase: N/A

National Vegetation Classification Standard (Federal Geographic Data Committee, 2008)
• Class: Mesomorphic Shrub and Herb Vegetation Class (2)
• Subclass: Temperate and Boreal Grassland and Shrubland Subclass (2.B)
• Formation: Temperate Grassland and Shrubland Formation (2.B.2)
• Division: Central North American and Shrubland Division (2.B.2.Nb)
• Macrogroup: *Hesperostipa comata* - *Pascopyrum smithii* - Festuca hallii Grassland Macrogroup (2.B.2.Nb.2)
o Group: *Hesperostipa comata* - *Bouteloua gracilis* Dry Mixedgrass Prairie Group (2.B.2.Nb.2.b)

EPA Ecoregions
• Level 1: Great Plains (9)
• Level 2: West-Central Semi-Arid Prairies (9.3)
• Level 3: Northwestern Glaciated Plains (42)
• Level 4: Glaciated Dark Brown Prairie (42i)
Glaciated Northern Grasslands (42j)

Ecological site concept

Loamy Gravel is a common ecological site occurring on outwash fans, terraces, and kames that have been overtopped with glacial till. The distinguishing characteristic of this site is that the upper 20 inches of soil is predominantly loamy skeletal, meaning that it contains 35 percent or more coarse fragments, has a texture class finer than loamy fine sand, and contains less than 35 percent clay (Soil Survey Staff, 2014). Soils for this ecological site are typically deep to very deep (more than 40 inches), excessively drained, and derived from gravelly alluvium or glacial outwash. Characteristic vegetation is cool-season rhizomatous grasses and mid-statured, cool-season bunchgrasses.

Associated sites

FX053A99X032	**Loamy (Lo)** The Loamy Dry ecological site is on similar landscapes and slope positions as the Loamy Gravel ecological site. It is adjacent to the Loamy Gravel ecological site but only occurs where slopes are less than 15 percent and coarse fragment content is less than 35 percent.
FX053A99X021	**Sandy Gravel (SyGr)** The Sandy Gravel ecological site is on similar landscapes and slope positions as the Loamy Gravel ecological site. It is adjacent to the Loamy Gravel ecological site, but only occurs where fine-earth textures are loamy fine sand or coarser.
FX053A99X062	**Swale (Se)** The Swale ecological site is downslope from the Loamy Gravel ecological site. It is on similar landscapes but in swales that receive additional moisture.

Similar sites

FX053A99X032	**Loamy (Lo)** This site differs from Loamy Gravel ecological site in that it contains less than 35 percent coarse fragments in the upper 20 inches of soil.

FX053A99X021	**Sandy Gravel (SyGr)** This site differs from Loamy Gravel ecological site in that its soils are sandy skeletal rather than loamy skeletal, meaning that fine-earth textures are loamy fine sand or coarser. Percent clay in the fine-earth fraction is typically less than 18 percent.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Pseudoroegneria spicata*

Legacy ID

R053AY707MT

Physiographic features

This ecological site occurs on paleoterraces, kames, and outwash fans where loamy and gravelly materials have been deposited. Slopes typically range from 0 to 60 percent. This site occurs on all aspects.

Table 2. Representative physiographic features

Landforms	(1) Tableland > Paleoterrace (2) Till plain > Kame (3) Till plain > Outwash fan
Flooding frequency	None
Ponding frequency	None
Elevation	1,800–3,300 ft
Slope	0–60%
Aspect	Aspect is not a significant factor

Climatic features

The Northern Dark Brown Glaciated Plains is a semi-arid region with a temperate continental climate that is characterized by frigid winters and warm to hot summers (Coupland, 1958; Richardson and Hanson, 1977; Heidel et al., 2000). The majority of precipitation occurs as steady, soaking, frontal system rains in late spring to early summer. Summer rainfall comes mainly from convection thunderstorms that typically deliver scattered amounts of rain in intense bursts. These storms may be accompanied by damaging winds and large-diameter hail and result in flash flooding along low-order streams. Approximately 80 percent of the annual precipitation occurs during the growing season. June is the wettest month, followed by July and May (Richardson and Hanson, 1977; Heidel et al., 2000). Average annual precipitation ranges from 11 inches (280 mm) near Richey, Montana, to 15 inches (380 mm) in the Little Muddy drainage near Williston, North Dakota, but precipitation varies greatly from year to year. On average, severe drought and very wet years occur with the same frequency, which is 1 out of 10 years (Coupland, 1958; Heidel et al., 2000). Extreme climatic variations, especially droughts, have the greatest influence on species cover and production (Coupland, 1958, 1961; Biondini et al., 1998). The frost-free period for this ecological site ranges from 90 to 130 days, and the freeze-free period ranges from 115 to 155 days.

Table 3. Representative climatic features

Frost-free period (characteristic range)	90-130 days
Freeze-free period (characteristic range)	115-155 days
Precipitation total (characteristic range)	11-15 in
Frost-free period (average)	110 days

Freeze-free period (average)	135 days
Precipitation total (average)	13 in

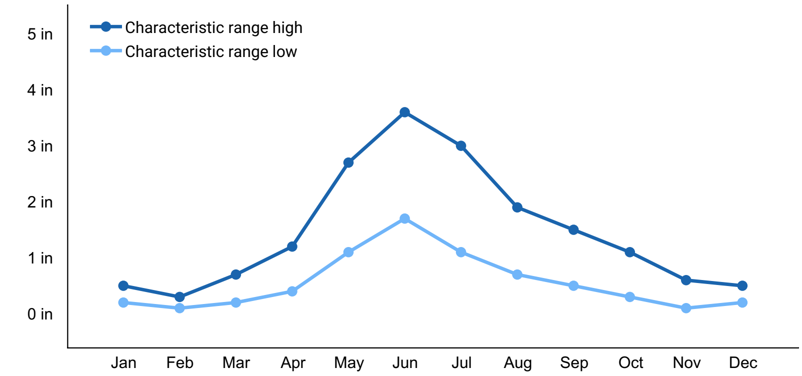


Figure 1. Monthly precipitation range

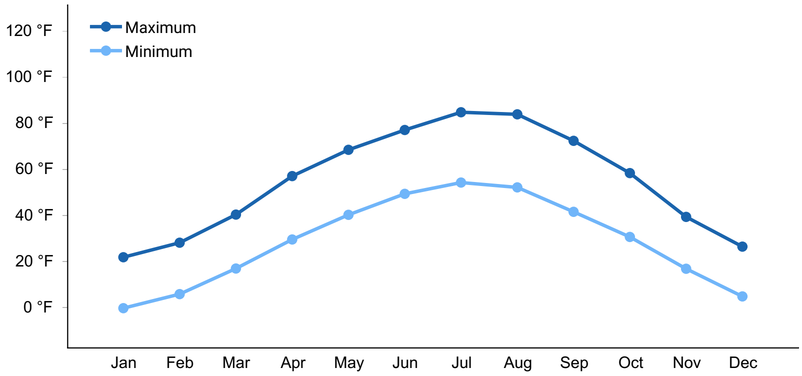


Figure 2. Monthly average minimum and maximum temperature

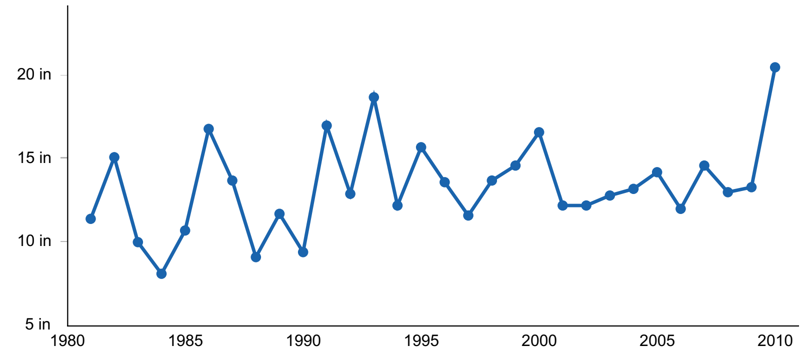


Figure 3. Annual precipitation pattern

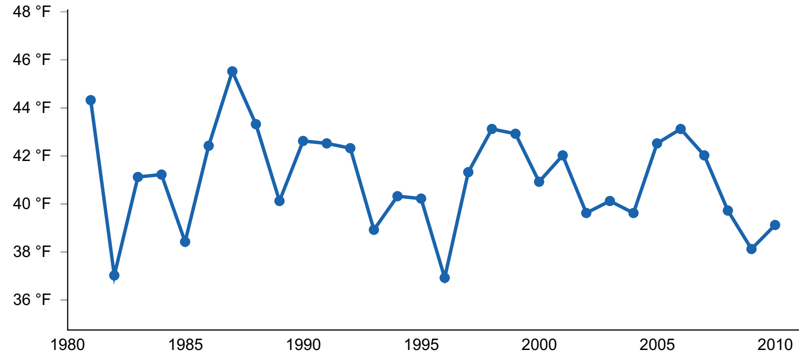


Figure 4. Annual average temperature pattern

Climate stations used

- (1) BREDETTE [USC00241088], Poplar, MT
- (2) CULBERTSON [USC00242122], Culbertson, MT
- (3) OPHEIM 10 N [USC00246236], Opheim, MT
- (4) OPHEIM 12 SSE [USC00246238], Opheim, MT
- (5) PLENTYWOOD [USC00246586], Plentywood, MT
- (6) SCOBEY 4 NW [USC00247425], Scobey, MT
- (7) SIDNEY [USC00247560], Sidney, MT
- (8) VIDA 6 NE [USC00248569], Vida, MT
- (9) WILLISTON SLOULIN INTL AP [USW00094014], Williston, ND

Influencing water features

This is upland ecological site and is not influenced by a water table or run in from adjacent sites. Due to the semi-arid climate in which it occurs, the water budget is normally contained within the soil pedon. Soil moisture is recharged by spring rains, but it but rarely exceeds field capacity in the upper 40 inches before being depleted by evapotranspiration. The high content of coarse fragments results in a very high infiltration rate and this site delivers moisture to downslope sites via subsurface flow. During intense precipitation events, the site may also deliver moisture to downslope sites via surface runoff. Moisture loss through evapotranspiration exceeds precipitation for the majority of the growing season and soil moisture is the primary limiting factor for plant production on this ecological site.

Soil features

Soils for this ecological site are typically deep to very deep (more than 40 inches to bedrock), excessively drained, and derived from gravelly alluvium or glacial outwash. They have a typic ustic moisture regime, which means that the soils are moist in some or all parts for either 180 cumulative days or 90 consecutive days during the growing season but are dry in some or all parts for over 90 cumulative days, and a frigid soil temperature regime (Soil Survey Staff, 2014).

Surface horizon textures typically range from gravelly loam to gravelly clay loam. Some sites may have 2 to 7 inches of loam or silt loam surface horizons over very gravelly subsurface horizons. The underlying horizons contain 35 percent or more coarse fragments and typically have loam, clay loam, or silty clay loam textures. Sometimes, but not always, sandy skeletal layers are present at depths greater than 10 inches. Calcium carbonate equivalent varies from 0 to 15 percent. In the upper 20 inches, electrical conductivity is less than 4 and the sodium absorption ratio is less than 13. Soil pH classes are moderately acid to slightly alkaline in the surface horizon and neutral to strongly alkaline in the subsurface horizons. Content of coarse fragments is 35 percent or more in the upper 20 inches of soil.

Table 4. Representative soil features

Parent material	(1) Alluvium–igneous, metamorphic and sedimentary rock (2) Glaciofluvial deposits–igneous, metamorphic and sedimentary rock
Surface texture	(1) Gravelly loam (2) Gravelly clay loam
Drainage class	Excessively drained
Soil depth	40–72 in
Calcium carbonate equivalent (0-5in)	0–15%
Electrical conductivity (0-20in)	0–3 mmhos/cm
Sodium adsorption ratio (0-20in)	0–12
Subsurface fragment volume <=3" (0-20in)	35–90%
Subsurface fragment volume >3" (0-20in)	35–90%

Ecological dynamics

The information in this ecological site description, including the state-and-transition model (STM), was developed based on historical data, current field data, professional experience, and a review of the scientific literature. As a result, all possible scenarios or plant species may not be included. Key indicator plant species, disturbances, and ecological processes are described to inform land management decisions.

The Loamy Gravel provisional ecological site in MLRA 53A consists of six states: the Historic Reference State (1), the Contemporary Reference State (2), the Shortgrass State (3), the Invaded State (4), the Cropland State (5), and the Post-Cropland State (6). Plant communities associated with this ecological site evolved under the combined influences of climate, grazing, and fire. Extreme climatic variability results in frequent droughts, which have the greatest influence on the relative contribution of species cover and production (Coupland, 1958, 1961; Biondini et al., 1998). Due to the dominance of cool-season graminoids, annual production is highly dependent upon mid- to late-spring precipitation (Heitschmidt and Vermeire, 2005; Anderson, 2006).

The historic ecosystem experienced periodic lightning-caused fires with estimated fire return intervals of 6 to 25 years (Bragg, 1995). Historically, Native Americans also set periodic fires. The majority of lightning-caused fires occurred in July and August, whereas Native Americans typically set fires during spring and fall to correspond with the movement of bison (Higgins, 1986). The precise effects of the historic fire return interval are not definitive, but in general the mixed-grass ecosystem was resilient to fire. Potential effects are generally temporary and may include reduction of litter, fluctuations in production, and changes in species composition (Vermeire et al., 2011, 2014).

Native grazers also shaped these plant communities. American bison (Bison bison) were the dominant historic grazer, but pronghorn (Antilocapra americana), elk (Cervus canadensis), and deer (Odocoileus spp.) were also common. Additionally, small mammals such as prairie dogs (Cynomys spp.) and ground squirrels (Urocitellus spp.) influenced this plant community (Salo et al., 2004). Grasshoppers and periodic outbreaks of Rocky Mountain locusts (Melanoplus spretus) also played an important role in the ecology of these communities (Lockwood, 2004). The mixed-grass ecosystem was resilient to grazing, although localized areas could experience shifts in species composition due to heavy grazing.

Following European settlement, fire was largely eliminated, domestic livestock replaced native ungulates as the primary grazers, and non-native species were introduced to the ecosystem. Aside from drought, livestock grazing is now the principle disturbance on the landscape.

Improper grazing of this site can result in a reduction in the cover of the mid-statured grasses and an increase in shortgrasses such as blue grama (*Bouteloua gracilis*) (Smoliak et al., 1972; Smoliak, 1974). Improper grazing practices include any practices that do not allow sufficient opportunity for plants to physiologically recover from a grazing event or multiple grazing events within a given year and/or that do not provide adequate cover to prevent soil erosion over time. These practices may include, but are not limited to, overstocking, continuous grazing, and/or inadequate seasonal rotation moves over multiple years. Periods of extended drought (approximately 3 years or more) can reduce mid-statured, cool-season grasses and shift the species composition of this community to one dominated by blue grama (Coupland, 1958, 1961). Further degradation of the site due to improper grazing can result in a community dominated by shortgrasses such as blue grama and prairie Junegrass (Koeleria cristata).

Most, if not all, extant examples of this site have some degree of invasion by non-native species. Non-native grasses such as crested wheatgrass (*Agropyron cristatum*), bluegrass (Poa spp.), and brome (Bromus spp.) are the most common invasive species. These species are widespread throughout the Northern Great Plains and can invade relatively undisturbed grasslands (Heidinga and Wilson, 2002; Henderson and Naeth, 2005; Toledo et al., 2014). In most cases native ecological function is relatively intact, but in some cases non-native grasses will displace native species and dominate the ecological functions of the site.

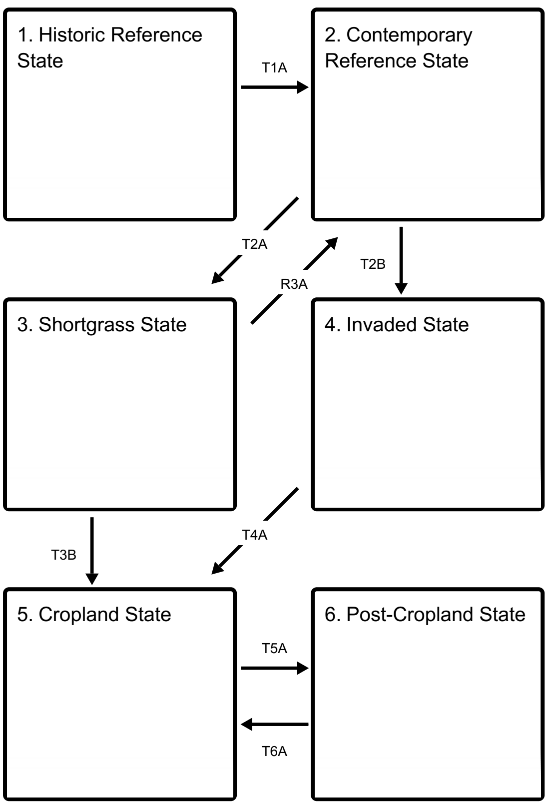
The effects of an altered fire regime are not completely understood at the time of this writing, but evidence suggests that long-term fire suppression can result in accumulations of litter and may contribute to increased abundance of non-native grasses (Murphy and Grant, 2005; Vermeire et al., 2011; Whisenant, 1990). Conversely, fire return intervals of less than 6 years, such as annual burning, can reduce productivity and shift species composition toward warm-season, short-statured grasses (Shay et al., 2001; Smith and McDermid, 2014).

Some of the Loamy Gravel ecological site has been converted to annual cropland. The most common crops are cereal grain crops, such as winter wheat, spring wheat, and barley. When taken out of production, this site is either allowed to revert back to perennial grassland or is seeded back to perennial grass. Such seedings may be comprised of introduced grasses and legumes or a mix of native species. Sites left to undergo natural plant succession after cultivation can, over several decades, support native vegetation similar to the Reference State (1) (Christian and Wilson, 1999) although it may take over 75 years for soil organic matter to return to its pre-disturbed state (Dormaar et al., 1990). Sites seeded with non-native species may persist with this cover type indefinitely (Christian and Wilson, 1999). A mix of native species may also be seeded, however, a return to the Reference State (1) in a reasonable amount of time is unlikely.

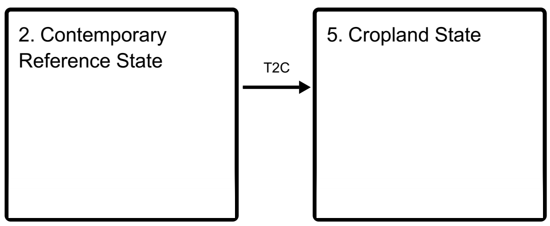
The state-and-transition model (STM) suggests possible pathways that plant communities on this site may follow as a result of a given set of ecological processes and management. The site may also support states not displayed in the STM diagram. Landowners and land managers should seek guidance from local professionals before prescribing a particular management or treatment scenario. Plant community responses vary across this MLRA due to variability in weather, soils, and aspect. The reference community phase may not necessarily be the management goal. The lists of plant species and species composition values are provisional and are not intended to cover the full range of conditions, species, and responses for the site. Species composition by dry weight is provided when available and is considered provisional based on the sources identified in the narratives associated with each community phase.

State and transition model

Ecosystem states



States 2 and 5 (additional transitions)



T1A - Introduction of non-native grass species, such as crested wheatgrass and Kentucky bluegrass.

T2A - Prolonged drought, improper grazing management, or a combination of these factors

T2B - Displacement of native species by non-native invasive species (Crested Wheatgrass, Kentucky bluegrass, noxious weeds, etc.)

T2C - Conversion to cropland

R3A - Range seeding, grazing land mechanical treatment, timely moisture, proper grazing management (management intensive and costly)

T3B - Conversion to cropland

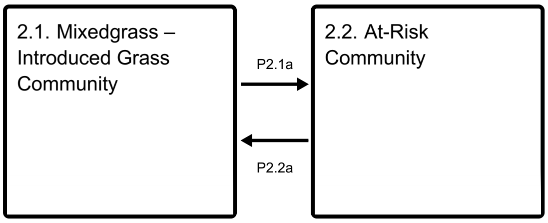
T4A - Conversion to cropland

T5A - Cessation of annual cropping

T6A - Conversion to cropland

State 1 submodel, plant communities

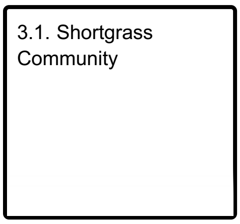
State 2 submodel, plant communities



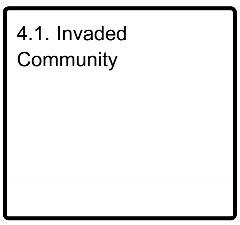
P2.1a - Drought, improper grazing management

P2.2a - Return to normal or above average precipitation, proper grazing management

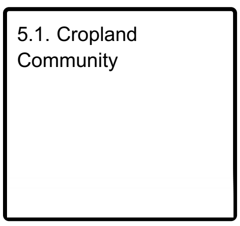
State 3 submodel, plant communities



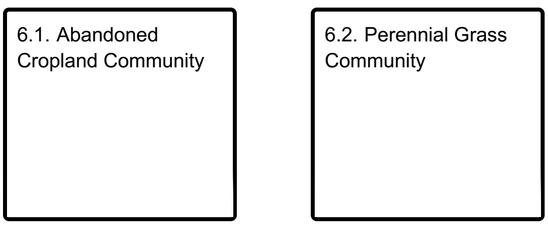
State 4 submodel, plant communities



State 5 submodel, plant communities



State 6 submodel, plant communities



State 1
Historic Reference State

The Historic Reference State (1) contains one community phase characterized by mid-statured bunchgrasses and rhizomatous wheatgrasses. This state is considered extinct and is included here for historical reference purposes. It evolved under the combined influences of climate, grazing, and fire, with climatic variation having the greatest influence on cover and production. In general, this state was resilient to grazing; however, localized areas likely received heavy grazing, which resulted in the species composition shifting to short-statured species. Fire most likely resulted in short-term shifts in species composition to more warm-season grasses such as blue grama and fewer cool-season bunchgrasses.

Community 1.1
Mixedgrass Community

The Mixedgrass Community Phase (1.1) was characterized by mid-statured bunchgrasses and mid-statured rhizomatous wheatgrasses. The plant community was dominantly western wheatgrass (*Pascopyrum smithii*) and needle and thread (*Hesperostipa comata*), but bluebunch wheatgrass (*Pseudoroegneria spicata*) also occurred. Other bunchgrasses such as green needlegrass (*Nassella viridula*) occurred where microsite conditions provided protection from wind and enhanced soil moisture. The mat-forming, warm-season, perennial grass blue grama and prairie Junegrass were the predominant shortgrasses (Coupland, 1950, 1961). Forbs comprised about 10 to 15 percent of the cover and shrubs about 1 to 5 percent.

State 2
Contemporary Reference State

The Contemporary Reference State (2) contains two community phases characterized by mid-statured bunchgrasses and mid-statured rhizomatous wheatgrasses. It evolved under the combined influences of climate, grazing, and fire, with climatic variation having the greatest influence on cover and production. This state differs from the historical reference state in that it is influenced by introduced plant species and has altered fire and grazing regimes. In general, this state is resilient to grazing and fire, although these factors can influence species composition in localized areas. Lesser spikemoss, also known as dense clubmoss (*Selaginella densa*), may occur in some areas; its dynamics on this site are not well understood.

Community 2.1
Mixedgrass – Introduced Grass Community

The Mixedgrass – Introduced Grass Community Phase (2.1) is predominantly native species, but it has some degree of non-native grass establishment. The predominant species are western wheatgrass and needle and thread. Bluebunch wheatgrass also occurs and may be common on some sites. Other bunchgrasses such as green needlegrass are limited to areas where microsite conditions provide protection from wind and enhanced soil moisture. Blue grama and prairie Junegrass are the predominant shortgrasses. Forbs comprised about 10 to 15 percent of the cover and shrubs about 1 to 5 percent. Non-native species such as crested wheatgrass (*Agropyron cristatum*) typically comprise 1 to 3 percent of the plant community.

Community 2.2
At-Risk Community

The At-Risk Community Phase (2.2) occurs when site conditions decline due to drought or improper grazing management. It is characterized by nearly equal proportions of shortgrasses and mid-statured grasses. Mid-statured grasses are in decline and have been substantially reduced in both cover and vigor. Grazing sensitive bunchgrasses such as bluebunch wheatgrass and green needlegrass are rare or absent. Shortgrasses such as blue grama and prairie Junegrass are increasing.

Pathway P2.1a
Community 2.1 to 2.2

Drought, improper grazing management, or a combination of these factors can shift the Mixedgrass – Introduced Grass Community Phase (2.1) to the At-Risk Community Phase (2.2). These factors favor an increase in shortgrasses such as blue grama and a decrease in midgrasses (Coupland, 1961).

Pathway P2.2a
Community 2.2 to 2.1

Normal or above-normal spring precipitation and proper grazing management transition the At-Risk Community (2.2) back to the Mixedgrass – Introduced Grass Community (2.1).

State 3
Shortgrass State

The Shortgrass State (3) consists of one community phase. The dynamics of this state are driven by long-term drought, improper grazing management, or a combination of these factors. Shortgrasses increase with long-term improper grazing at the expense of cool-season midgrasses (Coupland, 1961; Biondini and Manske, 1996). In particular, communities of blue grama can alter soil properties, creating conditions that resist establishment of other grass species (Dormaar and Willms, 1990; Dormaar et al., 1994). Reductions in stocking rates can reduce shortgrass cover and increase the cover of cool-season midgrasses, although this recovery may take decades (Dormaar and Willms, 1990; Dormaar et al., 1994).

Community 3.1
Shortgrass Community

The Shortgrass Community Phase (3.1) occurs when site conditions decline due to long-term drought or improper grazing. Mid-statured grasses such as needle and thread, rhizomatous wheatgrasses, and bluebunch wheatgrass have been largely eliminated. Short-statured species such as blue grama and prairie Junegrass dominate the plant community. The subshrub prairie sagewort may also be common.

State 4
Invaded State

The Invaded State (4) occurs when invasive plant species invade adjacent native grassland communities and displace the native species. Data suggest that native species diversity declines significantly when invasive species exceed 30 percent of the plant community. The non-native perennial grass crested wheatgrass is the greatest concern on this ecological site. Crested wheatgrass has been planted on an estimated 20 million acres in the western U.S. since the 1930s (Holechek, 1981). It is extremely drought tolerant, establishes readily on a variety of soil types, has high seedling vigor, and can dominate the seedbank of invaded grasslands (Rogler and Lorenz, 1983; Henderson and Naeth, 2005). Plant communities dominated by crested wheatgrass have significantly less cover of native grass and forb species (Heidinga and Wilson, 2002). Invasive grass species can invade relatively undisturbed grasslands, and it is not clear what triggers them to displace native species. Proximity to seeded areas is likely a major contributing factor as crested wheatgrass cover decreases with increasing distance from seeded areas (Heidinga and Wilson, 2002). Noxious weeds such as leafy spurge are not widespread in MLRA 53A, but they can be a concern in localized areas. These species are very aggressive perennials. They typically displace native species and dominate ecological function when they invade a site. In some cases, these species can be suppressed through intensive management (herbicide application, biological control, or intensive grazing management). Control efforts are unlikely to eliminate noxious weeds, but their density can be sufficiently suppressed so that species composition and structural complexity are similar to that of the Contemporary Reference State (2). However, cessation of control methods will most likely result in recolonization of the site by the noxious species.

Community 4.1
Invaded Community

Encroachment by introduced grasses, noxious weeds, and other invasive species is common. Reduced plant species diversity, simplified structural complexity, and altered biologic processes result in a state that is substantially departed from both the Reference State (1) and the Contemporary Reference State (2).

State 5
Cropland State

The Cropland State (5) occurs when land is put into cultivation. Major crops in MLRA 53A are small grains such as wheat.

Community 5.1
Cropland Community

Annual, cool-season cereal grains, such as spring wheat, winter wheat, and barley, are the most common crops.

State 6
Post-Cropland State

The Post-Cropland State (6) occurs when cultivated cropland is abandoned and allowed to either revegetate naturally or is seeded back to perennial species for grazing or wildlife use. This state can transition back to the Cropland State (5) if the site is put back into cultivation.

Community 6.1
Abandoned Cropland Community

The Abandoned Cropland Community Phase (6.1) typically occurs when cropland is abandoned with no further management. It may also occur when cropland is abandoned and then seeded to perennial forage species and the reseeding fails. In the absence of active management, the site can revegetate naturally and, over time, potentially return to a perennial grassland community with bunchgrasses and blue grama. Shortly after cropland is abandoned, annual and biennial forbs and annual brome grasses invade the site (Samuel and Hart, 1994). The site is extremely susceptible to erosion due to the absence of perennial species and the coarse soil textures. Eventually, the pioneering annual species are replaced by perennial forbs and pioneering grasses such as blue grama. Depending on the historical management of the site, perennial bunchgrasses such as needle and thread may also return; however, species composition will depend upon the seed bank. Invasion of the site by exotic species, such as crested wheatgrass, will depend upon the site’s proximity to a seed source. Fifty or more years after cultivation, these sites may have species composition similar to phases in the Contemporary Reference State (2). However, soil quality is consistently lower than under conditions prior to cultivation and a shift to the Contemporary Reference State (2) is unlikely within a reasonable time frame (Dormaar and Smoliak, 1985; Christian and Wilson, 1999).

Community 6.2
Perennial Grass Community

The Perennial Grass Community Phase (6.2) occurs when the site is seeded to perennial species for livestock forage or wildlife cover. Seedings typically are comprised of introduced species such as intermediate wheatgrass (*Thinopyrum intermedium*) and alfalfa (*Medicago sativa*), which can persist for several decades. Aggressive species such as crested wheatgrass can form monocultures persisting for at least 60 years (Krzic et al., 2000; Henderson and Naeth, 2005) and can invade adjacent sites if conditions are favorable. A mixture of native species may also be seeded to provide species composition and structural complexity similar to those of the Contemporary Reference State (2). However, soil quality conditions have been substantially altered and will not return to pre-cultivation conditions within a reasonable time frame (Dormaar et al., 1990).

Transition T1A
State 1 to 2

Introduction of non-native grass species occurred in the early 20th century. The naturalization of these species in relatively undisturbed grasslands, coupled with changes in fire and grazing regimes, transitions the Reference State (1) to the Contemporary Reference State (2).

Transition T2A
State 2 to 3

Prolonged drought, improper grazing practices, or a combination of these factors weaken the resilience of the Contemporary Reference State (2) and drive its transition to the Shortgrass State (3). The Contemporary Reference State (2) transitions to the Shortgrass State (3) when mid-statured grasses become rare and contribute little to production. Shortgrasses such as blue grama and prairie Junegrass dominate the plant community.

Transition T2B
State 2 to 4

The Contemporary Reference State (2) transitions to the Invaded State (4) when aggressive perennial grasses or noxious weeds displace native species. The most common concern is crested wheatgrass, which is a widespread invasive species in the Northern Great Plains (Henderson and Naeth, 2005). The precise triggers of this transition are not clear, but data suggest that invasion from adjacent seedings is a major contributing factor (Heidinga and Wilson, 2002). In addition, other rangeland health attributes, such as reproductive capacity of native grasses and soil quality, have been substantially altered.

Transition T2C
State 2 to 5

Tillage or application of herbicide followed by seeding of cultivated crops, such as winter wheat, spring wheat, and barley, transitions the Contemporary Reference State (2) to the Cropland State (5).

Restoration pathway R3A
State 3 to 2

A reduction in livestock grazing pressure alone may not be sufficient to reduce the cover of shortgrasses in the Shortgrass State (3) (Dormaar and Willms, 1990). Blue grama, in particular, can resist displacement by other species (Dormaar and Willms, 1990; Laycock, 1991; Dormaar et al., 1994; Lacey et al., 1995. Intensive management such as reseeding and mechanical treatment may be necessary (Hart et al., 1985), but these practices are labor intensive and costly. Therefore, returning the Shortgrass State (3) to the Contemporary Reference State (2) may require considerable energy and cost and may not be feasible within a reasonable amount of time.

Transition T3B
State 3 to 5

Tillage or application of herbicide followed by seeding of cultivated crops, such as winter wheat, spring wheat, and barley, transitions the Shortgrass State (3) to the Cropland State (5).

Transition T4A
State 4 to 5

Tillage or application of herbicide followed by seeding of cultivated crops, such as winter wheat, spring wheat, and barley, transitions the Invaded State (4) to the Cropland State (5).

Transition T5A
State 5 to 6

The transition from the Cropland State (5) to the Post-Cropland State (6) occurs with the cessation of cultivation. The site may also be seeded to perennial forage species. Such seedings may be comprised of introduced grasses and legumes or a mix of native species.

Transition T6A
State 6 to 5

Tillage or application of herbicide followed by seeding of cultivated crops, such as winter wheat, spring wheat, and barley, transitions the Post-Cropland State (6) to the Cropland State (5).

Additional community tables

Inventory data references

Data for this provisional ecological site was obtained from one medium-intensity plot representing the

Contemporary Reference State (2). This plot was used in conjunction with a review of the scientific literature and professional experience to approximate the plant communities for this state. Information for remaining states was obtained from professional experience and a review of the scientific literature. All community phases are considered provisional based on these plots and the sources identified in this ecological site description.

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Rangeland health reference sheet

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

Author(s)/participant(s)	
Contact for lead author	
Date	04/24/2024
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

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

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

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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):**

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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:

    Sub-dominant:

    Other:

    Additional:

---

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):**

---

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:**
