USDA Natural Resources
Conservation Service

Ecological site R062XC011SD
Clayey - South

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Accessed: 05/20/2025

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): 062X–Black Hills

The Black Hills (MLRA 62) is a unique, low lying mountain range situated in the midst of a mixed short and mid-grass prairie. It is a true Island in the Plains, as it has geophysical and biological attributes that are unlike the surrounding area. The Black Hills have strong floristic ties to four of the North American biomes: Cordilleran (Rocky Mountain) Forest, Northern Coniferous Forest, Eastern Deciduous Forest, and Grasslands.

MLRA 62 is approximately 3,040 square miles in size; 74 percent is located in South Dakota, and 26 percent is in Wyoming. The towns of Lead, Deadwood, Hill City, and Custer, South Dakota, are in this area. U.S. Highways 16 and 385 cross the MLRA. The Black Hills National Forest, Custer State Park, Mt. Rushmore National Monument, Wind Cave National Park, and Jewel Cave National Monument are located in this MLRA.

This area forms the core of the Black Hills and the Bear Lodge Mountains where the elevation ranges between 3,600 to 6,565 feet, however, Black Elk Peak (Harney Peak) rises to 7,242 feet. Slopes range from moderately sloping on some of the high plateaus to very steeply sloping along drainageways and on peaks and ridges. Narrow valleys generally are gently sloping to strongly sloping.

The Black Hills uplift is the product of the Laramide mountain-building episodes that produced most of the ranges in the Rocky Mountains. Uplift began near the end of the Cretaceous period, 65 million years ago and ended by 35 million years ago (Froiland 1990). The core of the Black Hills is a plutonic mass of granite with steeply dipping metamorphic rocks, primarily slate and schist, directly surrounding the granite core. A plateau of Mississippian limestone surrounds the igneous and metamorphic rock core. The

Madison limestone is broken around the outer edges of the uplifted area. The Permian Minnekahta limestone forms the outermost boundary of the area. Many other tilted sandstone, shale, and limestone units are exposed like a bathtub ring inside the steeply dipping Madison limestone.

The dominant soil orders in this MLRA are Alfisols (forest soils) and Mollisols (grassland soils). The soils in the area have a frigid or cryic soil temperature regime, a udic or ustic soil moisture regime, and mixed, micaceous, or smectitic mineralogy. They are shallow to very deep, generally well drained, and loamy in texture.

The Black Hills MLRA supports open to dense forest vegetation. Ponderosa pine is the dominant species across the Black Hills. White spruce grows at the higher elevations and along the major drainageways. Bur oak is found intermixed with pine in the northern and eastern fringes of the Black Hills, and Rocky Mountain Juniper is more common in the southern portion of the Black Hills. Aspen and paper birch are minor components found throughout the Black Hills. Prairie dropseed, roughleaf ricegrass, green needlegrass, poverty oatgrass, Richardson's needlegrass, slender wheatgrass, and Canada wildrye are the most common native grasses under open forest stands. The most common native shrubs are bearberry, common juniper, grouse whortleberry, poison ivy, and Saskatoon serviceberry.

MLRA 62 land ownership is approximately 47 percent private and 53 percent federal. Rangeland and forestland are split almost equally between private and federal ownership (47 percent each). Minor areas of land are privately owned cropland and urban development. The forestland in this area is used mainly for timber production, recreation, and grazing.

The major resource concerns are soil erosion and surface compaction caused by logging, mining, wildfires, grazing, and urban expansion. The quality of ground and surface water is another concern, especially in the northern part of the Black Hills. The primary cause is contamination from mine waste and septic systems in areas of rural development and urban expansion (USDA-NRCS, 2006: Ag Handbook 296).

LRU notes

For development of ecological sites, MLRA 62 is divided into three LRU's or physiographic zones (A, B, C, and Y). Each LRU has a set of ecological sites that represents these zones.

The LRU is identified in the Ecological Site ID: R062XY000SD; "062X" identifies the MLRA, the next letter "Y" identifies the LRU. Note: The organization of Ecological Site ID's will likely change in the future.

The North, LRU-A includes the northern Black Hills and Bear Lodge Mountains. It receives between 22 and 30 inches of annual precipitation and has a frigid soil temperature regime.

The High Central, LRU-B includes the high elevation central core of the Black Hills, which receives between 25 to 35 inches of annual precipitation and has a cryic soil temperature regime.

The South, LRU-C includes the southern portion of the Black Hills and receives between 17 to 21 inches of annual precipitation and has a frigid soil temperature regime.

One additional grouping of ecological sites that are common to the entire MLRA are designated with a “Y” in the ecological site ID.

Classification relationships

USDA Land Resource Region G—Western Great Plains Range and Irrigated Region:
Major Land Resource Area (MLRA) 62—Black Hills

US Environmental Protection Agency (EPA) Level IV Ecoregions of the Conterminous United States:
Black Hills Plateau—17b
Black Hills Core Highlands—17c

USDA Forest Service Ecological Subregions: Sections and Subsections of Conterminous United States:
Black Hills Coniferous Forest Province—M334:
Black Hills Section—334A
Black Hills Limestone Plateau-Core Highlands Subsection—M334Ab

Ecological site concept

The Clayey - South ecological site occurs throughout the southern portion of MLRA 62. It is located on upland landscapes and does not receive additional moisture from runoff or overflow. The typical slopes range is from 2 to 30 percent. Soils are moderately deep to very deep, (greater than 20 inches) with surface textures ranging from silty clay loam to clay loam, and 4 to 10 inches deep. Subsurface textures range from clay loam to cobbly silty clay loam.

The vegetation in the Reference State (1.0) consists of a mix of cool- and warm-season grasses, however, mid-statured cool-season rhizomatous wheatgrass and needlegrasses will be the dominant groups. Forbs are common and diverse. Shrubs will include rose, snowberry, and fringed sagewort. Ponderosa pine and Rocky Mountain juniper may be found scattered across the site. The Clayey - South site is susceptible to invasion of non-native, cool-season grasses.

Associated sites

R062XY012SD	**Thin Upland** The Thin Upland ecological site is found on steeper slopes adjacent to or up slope of the Clayey - South ecological site.
R062XC010SD	**Loamy - South** The Loamy - South ecological site is found on similar landscape position adjacent to the Clayey - South ecological site.

Similar sites

R062XC010SD	**Loamy - South** The Loamy - South ecological site will have less green needlegrass, more needle and thread, and more big bluestem than the Clayey - South ecological site.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Pascopyrum smithii* (2) *Nassella viridula*

Physiographic features

The Clayey - South ecological site occurs on rolling to sloping backslopes and footslopes in the Black Hills.

Table 2. Representative physiographic features

Landforms	(1) Ridge (2) Hillslope
Runoff class	Medium to very high
Flooding frequency	None
Ponding frequency	None
Elevation	1,158–1,890 m
Slope	2–30%
Water table depth	203 cm
Aspect	Aspect is not a significant factor

Climatic features

MLRA 62 is in a microclimate caused by the influence of increased elevation which leads

to increased precipitation, moderate air temperature, and lower wind velocities as compared to the surrounding Great Plains. In general, the Black Hills climate is a continental type, cold in the winter and hot in the summer.

Annual precipitation in MLRA 62 typically increases with elevation and decreases from west to east and from north to south. The average annual precipitation range for MLRA 62 is 18 to 35 inches. Most of the rainfall occurs as frontal storms early in the growing season, in May and June. Some high-intensity, convective thunderstorms occur in July and August. Precipitation in the winter occurs mostly as snow. Twenty to forty percent of the annual precipitation falls as snow. The annual average snowfall ranges from 23 inches at the lower elevations in the south, to 54 inches in the higher elevations of the central core of the Black Hills.

The average annual temperature ranges from 36°F to 48°F. January is the coldest month, with an average temperature of 22°F in the higher elevation of the central core, and 25°F in the southern part of MLRA 62. July is the warmest month, with an average daily temperature of 67°F in the central core, and 73°F in the southern part of this MLRA. The frost-free period ranges from 129 to 168 days. It is shortest at higher elevations and in the northwestern part of the MLRA. Hourly winds are estimated to average about 11 miles per hour (mph) annually.

Growth of cool-season plants begins in April, slowing or ceasing growth by mid-August. Warm-season plants begin growth in May and continue to mid-September. Regrowth of cool-season plants may occur in September and October, depending upon soil moisture availability.

The average annual precipitation range for LRU-C (Southern Black Hills) is 18 to 21 inches.

Table 3. Representative climatic features

Frost-free period (characteristic range)	99-108 days
Freeze-free period (characteristic range)	117-129 days
Precipitation total (characteristic range)	483-508 mm
Frost-free period (actual range)	95-109 days
Freeze-free period (actual range)	114-130 days
Precipitation total (actual range)	457-533 mm
Frost-free period (average)	103 days
Freeze-free period (average)	123 days
Precipitation total (average)	508 mm

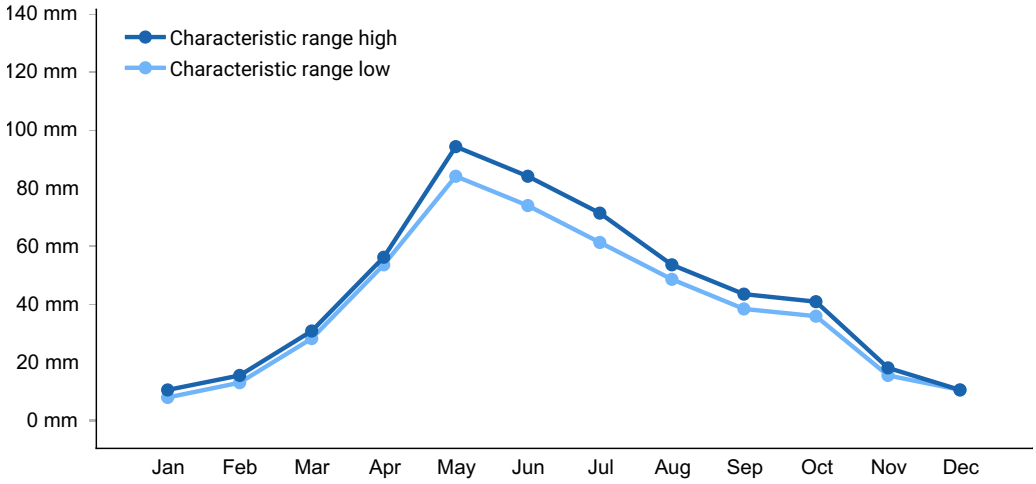


Figure 1. Monthly precipitation range

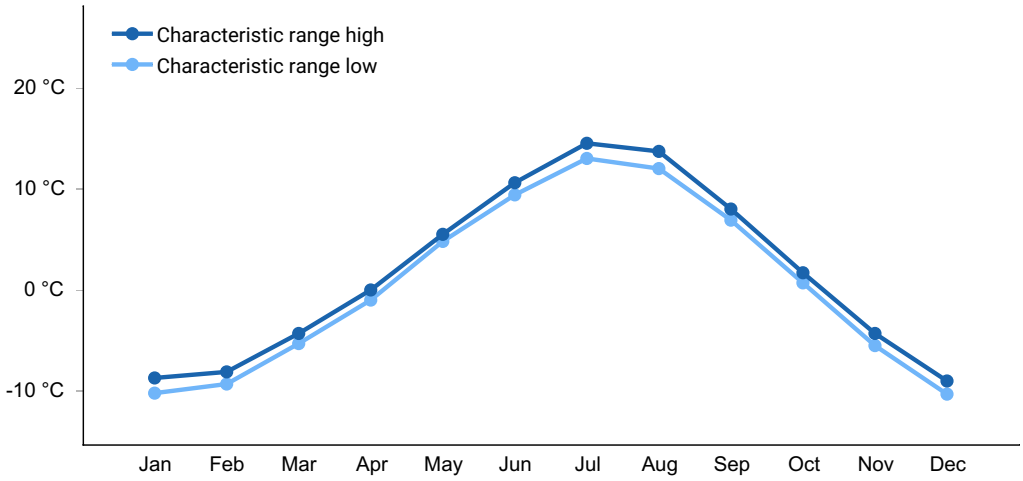


Figure 2. Monthly minimum temperature range

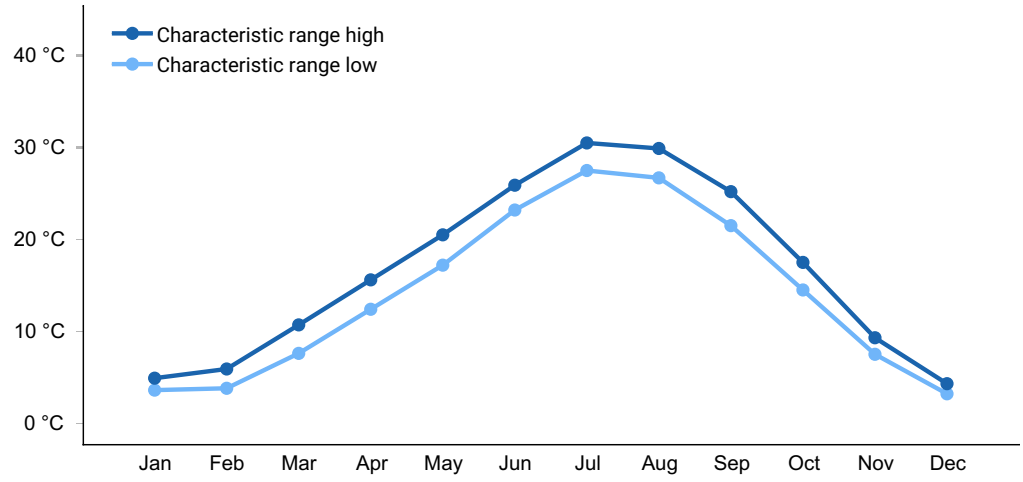


Figure 3. Monthly maximum temperature range

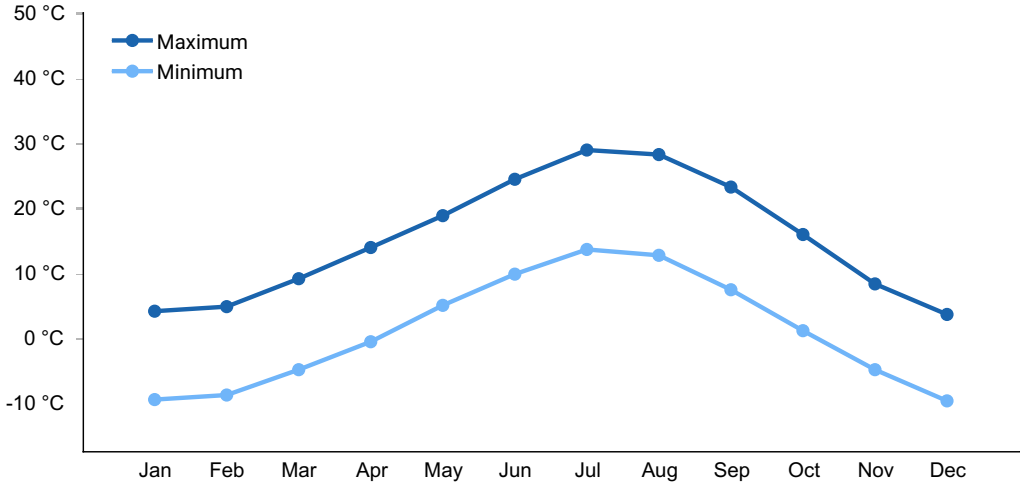


Figure 4. Monthly average minimum and maximum temperature

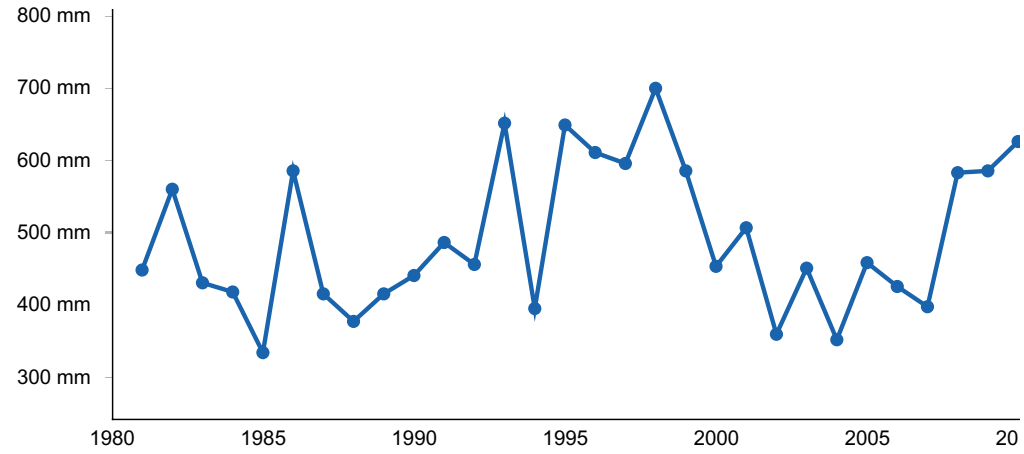


Figure 5. Annual precipitation pattern

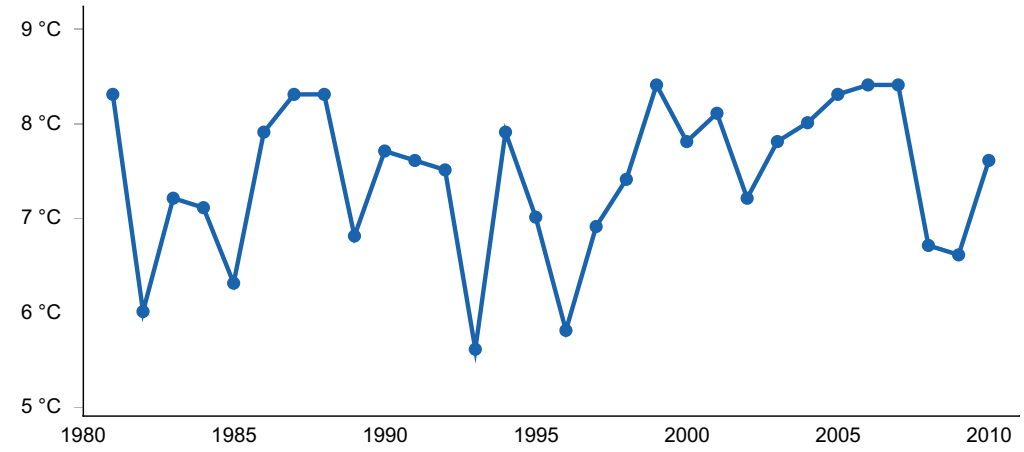


Figure 6. Annual average temperature pattern

Climate stations used

- (1) HOT SPRINGS [USC00394007], Hot Springs, SD
- (2) WIND CAVE [USC00399347], Buffalo Gap, SD
- (3) MT RUSHMORE NATL MEM [USC00395870], Keystone, SD
- (4) JOHNSON SIDING [USC00394343], Rapid City, SD

Influencing water features

No riparian areas or wetland features are directly associated with the Clayey - South ecological site.

Soil features

Soils common to the Clayey - South ecological site are moderately deep to very deep and well drained. The surface layer ranges from 4 to 10 inches in thickness. Surface textures are moderately fine to fine, ranging from clay loam to silty clay loam. The soils are typically calcareous, although depth to carbonates varies and is generally not a factor in plant community dynamics. Some of the soils have a layer of soft bedrock between 20 and 40 inches that is restrictive to water movement and root penetration. Representative soils of this ecological site have a frigid temperature regime.

Major soils correlated to the Clayey - South ecological site include, Metre, cool and Norrest, cool. Metre and Norrest soils have cooler soil temperatures than is typical for the series and are considered taxadjuncts.

These soils are mainly susceptible to water erosion. The hazard of water erosion increases as slope increases. Loss of 50 percent or more of the surface layer of the soils on this site can result in a shift in species composition and/or production. Rills and gullies tend to form under prolonged exposure of the surface of the soil. On steeper slopes, concentrated flow increases the hazard of gully erosion.

More 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 area of interest, or use the internet to access USDA’s Web Soil Survey.

Table 4. Representative soil features

Parent material	(1) Residuum–shale (2) Alluvium–limestone and shale
Surface texture	(1) Clay loam (2) Silty clay loam (3) Cobbly silty clay loam
Family particle size	(1) Clayey
Drainage class	Well drained
Permeability class	Very slow to slow
Depth to restrictive layer	51–102 cm
Soil depth	51–203 cm
Surface fragment cover <=3"	0–3%

Surface fragment cover >3"	0–10%
Available water capacity (0-101.6cm)	7.62–30.48 cm
Calcium carbonate equivalent (0-101.6cm)	0–15%
Electrical conductivity (0-101.6cm)	0–4 mmhos/cm
Sodium adsorption ratio (0-101.6cm)	0–5
Soil reaction (1:1 water) (0-101.6cm)	6.6–8.4
Subsurface fragment volume <=3" (0-101.6cm)	0–10%
Subsurface fragment volume >3" (0-101.6cm)	0–1%

Ecological dynamics

The Clayey - South ecological site developed under the Black Hills climatic conditions; light to severe grazing by bison, elk, insects, and small mammals; sporadic, natural or human-caused wildfire (often of light intensities); and other biotic and abiotic factors that typically influence soil and site development. Changes occur in the plant communities due to short-term weather variations, effects of native and exotic plant and animal species, and management actions. Severe disturbances, such as periods of well-below average precipitation, severe defoliation, or non-use and no fire can cause significant shifts in plant communities and species composition.

Continuous season-long grazing (grazing during the typical growing season of May through October, at moderate to heavy stocking levels for the full growing season each year without adequate recovery periods following each grazing occurrence) or heavy continuous grazing (e.g., grazing every spring or every summer at heavy stocking levels without adequate recovery periods following grazing events) will cause a departure from the Western Wheatgrass-Green Needlegrass Plant Community (1.1). Because of the predominance of non-native cool-season grasses, Kentucky bluegrass and potentially smooth brome will invade and eventually develop into a sod. Western wheatgrass will increase initially and then begin to decrease. Green needlegrass, needle and thread, and sideoats grama will decrease in frequency and production. Excessive defoliation can cause threeawn and annuals to increase and dominate the site. Extended periods of non-use or lack of fire will result in excessive litter and a plant community dominated by cool-season grasses such as green needlegrass, western wheatgrass, bluegrass, smooth brome and cheatgrass.

Long-term no fire and the encroachment and establishment of conifer trees will shift the

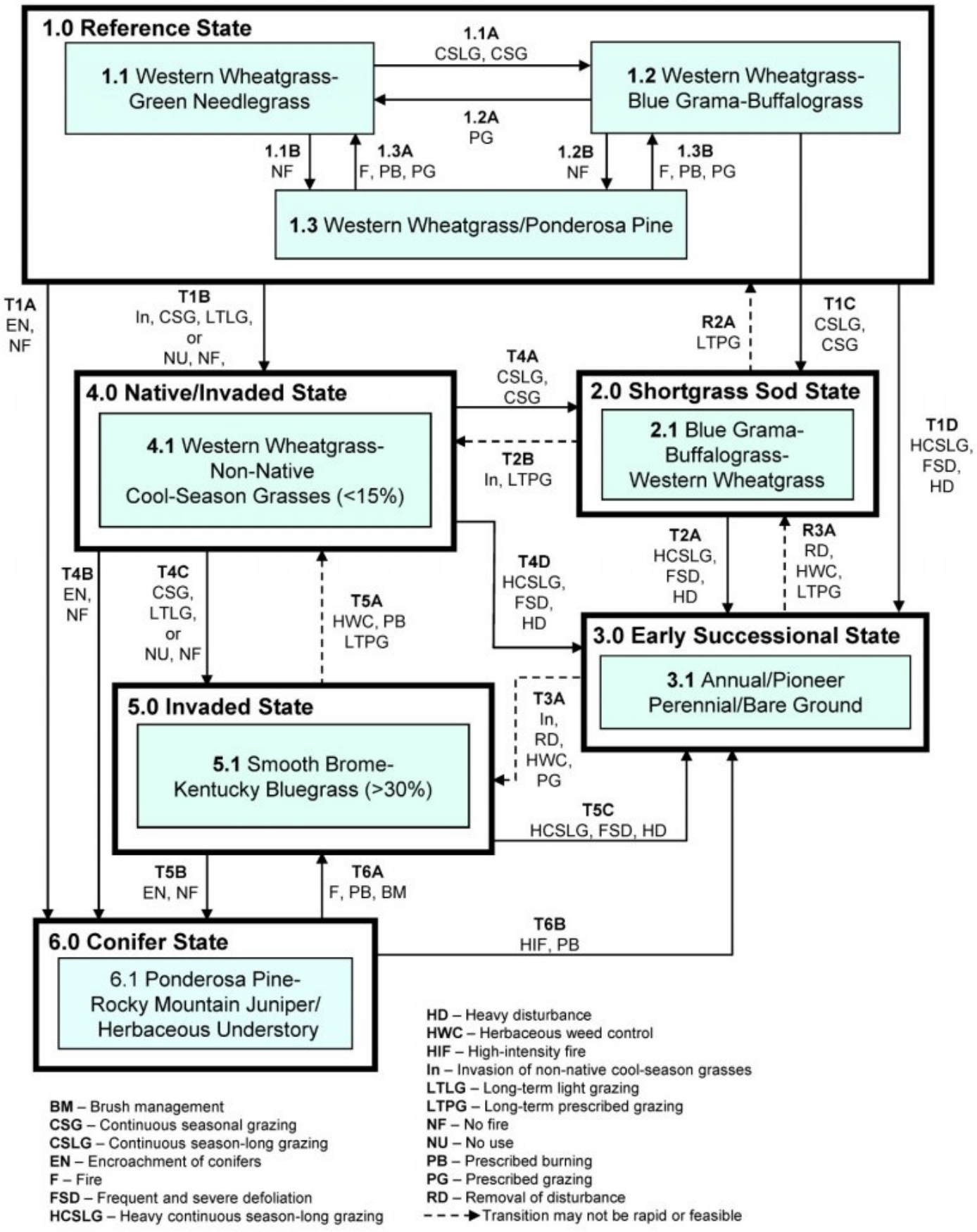
site to a conifer dominated plant community.

Interpretations are primarily based on the Western Wheatgrass-Green Needlegrass Plant 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 also have been used. Plant community phases, states, transitional pathways, and thresholds have been determined through similar studies and experience.

The following is a State-and-Transition diagram that illustrates the common plant communities that can occur on the site and the transition pathways between communities. The ecological processes will be discussed in more detail in the plant community descriptions following the diagram.

State and transition model

Clayey - South (LRU-C) - R062XC011SD 8/11/20



BM – Brush management
CSG – Continuous seasonal grazing
CSLG – Continuous season-long grazing
EN – Encroachment of conifers
F – Fire
FSD – Frequent and severe defoliation
HCSLG – Heavy continuous season-long grazing

HD – Heavy disturbance
HWC – Herbaceous weed control
HIF – High-intensity fire
In – Invasion of non-native cool-season grasses
LTLG – Long-term light grazing
LTPG – Long-term prescribed grazing
NF – No fire
NU – No use
PB – Prescribed burning
PG – Prescribed grazing
RD – Removal of disturbance
- - - → Transition may not be rapid or feasible

Diagram Legend: Clayey - South (LRU-C) - R062XC011SD

T1A	1.0 to 6.0	Encroachment and establishment of conifers, and long-term no fire.
T1B	1.0 to 4.0	Invasion of non-native cool-season grasses; continuous seasonal grazing; long-term light grazing; or non-use and no fire.
T1C	1.0 to 2.0	Continuous season-long grazing, or continuous seasonal grazing.
T1D	1.0 to 3.0	Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance.
T2A	2.0 to 3.0	Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance.
T2B	2.0 to 4.0	Invasion of non-native cool-season grasses; long-term prescribed grazing with proper stocking rates, change in season of use, and adequate time for plant recovery. Transition may not be fast or feasible.
T3A	3.0 to 5.0	Invasion of non-native cool-season grasses; removal of disturbance; herbaceous weed control; followed by prescribed grazing with proper stocking rates, change in season of use, and adequate time for plant recovery. Transition may not be fast or feasible.
T4A	4.0 to 2.0	Continuous season-long grazing, or continuous seasonal grazing.
T4B	4.0 to 6.0	Encroachment and establishment of conifers, and long-term no fire.
T4C	4.0 to 5.0	Continuous seasonal grazing; long-term light grazing; or non-use and no fire.
T4D	4.0 to 3.0	Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance.
T5A	5.0 to 4.0	Herbaceous weed control; possibly prescribed burning to reduce non-native cool-season grasses; and long-term prescribed grazing with proper stocking rates, change in season of use, and adequate time for plant recovery. Transition may not be fast or feasible.
T5B	5.0 to 6.0	Encroachment and establishment of conifers, and long-term no fire.
T5C	5.0 to 3.0	Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance.
T6A	6.0 to 5.0	Low-intensity fire, prescribed burning, or mechanical brush management to removes most of the conifer encroachment.
T6B	6.0 to 3.0	High-intensity fire or prescribed burning that removes all or most of the conifer encroachment. Fire intensity adversely affects the herbaceous understory.

R2A	2.0 to 1.0	Long-term prescribed grazing with proper stocking rates, change in season of use, and adequate time for plant recovery. This transition may not be fast or feasible.
R3A	3.0 to 2.0	Removal of disturbance coupled with long-term prescribed grazing including proper stocking rates, change in season of use, and adequate time for plant recovery. Herbaceous weed control may be needed. Transition may not be fast or feasible.

1.1A	1.1 to 1.2	Continuous seasonal grazing (spring or late winter), or continuous season-long grazing.
1.1B	1.1 to 1.3	No fire allowing conifers to encroach and establish.
1.2A	1.2 to 1.1	Prescribed grazing with proper stocking, change in season of use, and adequate time for plant recovery.
1.2B	1.2 to 1.3	No fire allowing conifers to encroach and establish.
1.3A	1.3 to 1.1	Low-intensity fire, or prescribed burning which removes all or most of the conifer encroachment, followed by with proper stocking, change in season of use, and adequate time for plant recovery.
1.3B	1.3 to 1.2	Low-intensity fire, or prescribed burning which removes all or most of the conifer encroachment, followed by with proper stocking, change in season of use, and adequate time for plant recovery.

State 1
Reference State

The Reference State represents what is believed to show the natural range of variability that dominated the dynamics of the ecological site prior to European settlement. This site in the Reference State (1.0) is dominated by cool-season grasses and subdominant warm-season grasses. Grazing or the lack of grazing, fire, and drought are the major drivers between plant communities. Continuous season-long grazing can push this state to a warm-season shortgrass-dominated State (2.0). Non-use, no fire, and invasion of non-native cool-season grasses will result in a transition to a Native/Invaded State (4.0). Long-term fire suppression and conifer encroachment can transition the Reference State (1.0) to the Conifer State (6.0).

Dominant plant species

- ponderosa pine (*Pinus ponderosa*), tree
- prairie sagewort (*Artemisia frigida*), shrub

- Woods' rose (*Rosa woodsii*), shrub
- western wheatgrass (*Pascopyrum smithii*), grass
- green needlegrass (*Nassella viridula*), grass
- American vetch (*Vicia americana*), other herbaceous
- dotted blazing star (*Liatris punctata*), other herbaceous

Community 1.1
Western Wheatgrass-Green Needlegrass

Interpretations are based primarily on the Western Wheatgrass-Green Needlegrass Plant Community, which is also considered to be Reference Plant Community (1.1). The potential vegetation is about 85 percent grasses or grass-like plants, 8 percent forbs, and 7 percent shrubs and trees. The community is dominated by a mix of cool- and warm-season grasses. The major grasses include western wheatgrass, green needlegrass, needle and thread, and sideoats grama. Other grass and grass-like species include big bluestem, little bluestem, Columbia needlegrass, blue grama, and needleleaf sedge. Common forbs include American vetch, dotted gayfeather, goldenrod, scurfpea, and purple prairie clover. Fringed sagewort, rose, and western snowberry are common shrubs. A few ponderosa pine will be scattered across this site. This plant community is resilient and well adapted to the Southern Black Hills climatic conditions. The diversity in plant species allows for high drought tolerance. This is a sustainable plant community in regard to site and soil stability, watershed function, and biologic integrity.

Table 5. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	1709	2191	2634
Forb	123	193	280
Shrub/Vine	73	168	280
Tree	–	26	56
Total	**1905**	**2578**	**3250**

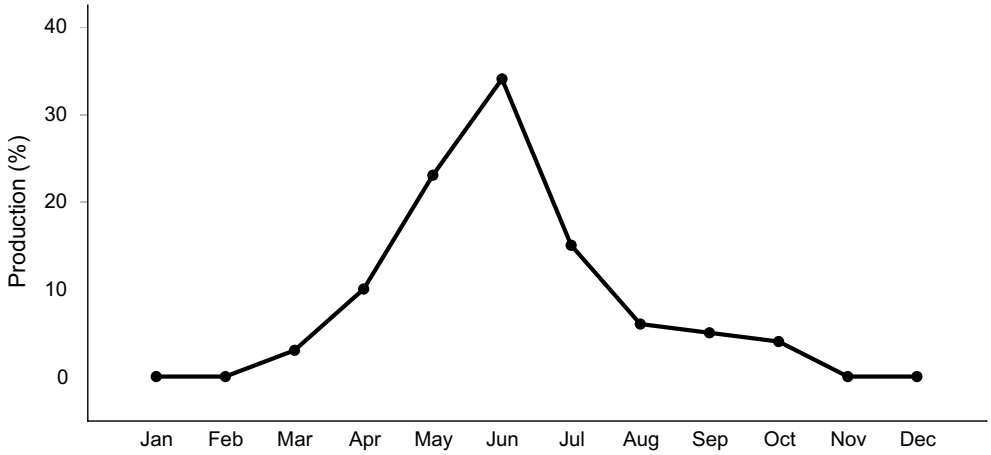


Figure 8. Plant community growth curve (percent production by month). SD6202, Black Hills, cool-season dominant, warm-season sub-dominant. Cool-season dominant, warm-season sub-dominant.

Community 1.2
Western Wheatgrass-Blue Grama-Buffalograss

This plant community evolved under continuous seasonal grazing (grazing at moderate to heavy stocking levels at the same time of year each year), or continuous season-long grazing (grazing at moderate to heavy stocking levels for the full growing season each year without adequate recovery periods following each grazing occurrence). The potential plant community is made up of approximately 85 percent grasses or grass-like plants, 8 percent forbs, and 7 percent shrubs and trees. Dominant grass and grass-like species include western wheatgrass, blue grama, buffalograss, needleleaf sedge, and sideoats grama. Grasses of secondary importance include green needlegrass, needle and thread, and prairie Junegrass. Forbs commonly found in this plant community include white sagebrush (cudweed sagewort), prairie coneflower, goldenrod, and western yarrow. When compared to the Western Wheatgrass-Green Needlegrass Plant Community (1.1), blue grama and buffalograss have increased. Green needlegrass and mid- and tall warm-season grasses have decreased. This plant community is moderately resistant to change. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term overgrazing. If the herbaceous component is intact, it tends to be resilient if the disturbance is not long-term. The hydrologic function of the site is beginning to be altered when this plant community phase is reached due to the shallow, compact nature of the roots of species such as blue grama, buffalograss, and needleleaf sedge.

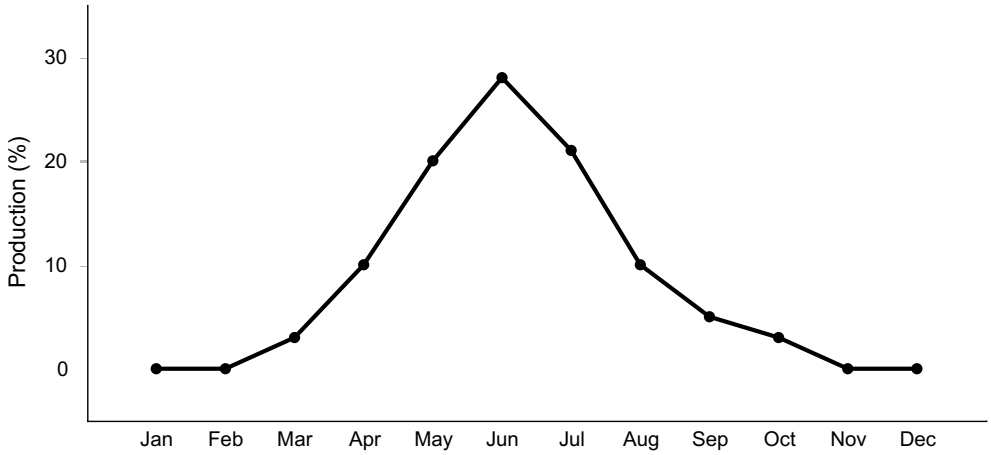


Figure 9. Plant community growth curve (percent production by month). SD6203, Black Hills, cool-season/warm-season co-dominant. Cool-season/warm-season co-dominant.

Community 1.3
Western Wheatgrass/Ponderosa Pine

This plant community evolved as a result of no fire, or when the normal fire interval has been extended allowing for conifers to encroach onto the site and become established.

Conifers are not the dominant species in this plant community. Conifer canopy cover will typically not exceed 15 percent, and most trees will be removed once the natural fire regime is reestablished. The potential plant community is made up of approximately 80 percent grasses or grass-like plants, 8 percent forbs, and 12 percent shrubs and trees. Dominant grass and grass-like species include western wheatgrass, green needlegrass, Columbia needlegrass, Richardson needlegrass, needleleaf sedge, and sideoats grama. Forbs commonly found in this plant community include white sagebrush (cudweed sagewort), prairie coneflower, goldenrod, and western yarrow. The herbaceous species present are well adapted to grazing; however, species composition can be altered through long-term overgrazing. If the herbaceous component is intact, it tends to be resilient if the disturbance is not long-term. This plant community is resilient and well adapted to the Black Hills climatic conditions. The diversity in plant species allows for high drought tolerance. This is a sustainable plant community in regard to site and soil stability, watershed function, and biologic integrity.

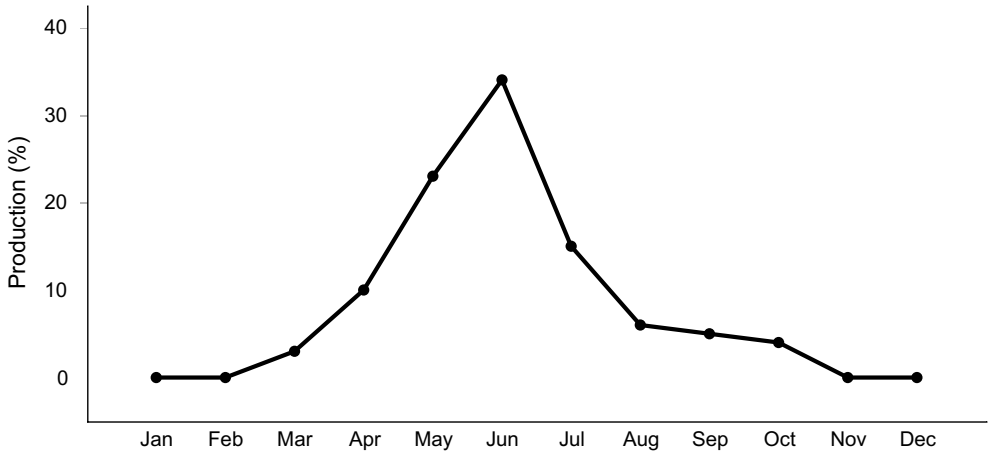


Figure 10. Plant community growth curve (percent production by month). SD6202, Black Hills, cool-season dominant, warm-season sub-dominant. Cool-season dominant, warm-season sub-dominant.

Pathway 1.1A
Community 1.1 to 1.2

Continuous seasonal grazing which includes grazing at moderate to heavy stocking levels at the same time of year each year, or continuous season-long grazing will shift the Western Wheatgrass-Green Needlegrass Plant Community (1.1) to the Western Wheatgrass-Blue Grama-Buffalograss Plant Community (1.2).

Pathway 1.1B
Community 1.1 to 1.3

Long-term no fire will allow for conifer encroachment and establishment on this site and will in time shift the Western Wheatgrass-Green Needlegrass Plant Community (1.1) to the Western Wheatgrass/ Ponderosa Pine Plant Community (1.3).

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing with proper stocking rates, alternating season of use, and providing adequate recovery periods, or periodic light to moderate grazing possibly including periodic rest will convert the Western Wheatgrass-Blue Gama-Buffalograss Plant Community (1.2) to the Western Wheatgrass-Green Needlegrass Plant Community (1.1).

Conservation practices

Prescribed Grazing

Pathway 1.2B
Community 1.2 to 1.3

Long-term no fire will allow for conifer encroachment and establishment on this site will shift the Western Wheatgrass- Blue Grama-Buffalograss Plant Community (1.2) to the Western Wheatgrass/ Ponderosa Pine Plant Community (1.3).

Pathway 1.3A
Community 1.3 to 1.1

Low-intensity fire or prescribed burning that removes most or all of the conifer encroachment in the site, followed by prescribed grazing. Prescribed grazing, including proper stocking rates, alternating season of use, and adequate recovery periods, or periodic light to moderate grazing possibly including periodic rest, will convert the Western Wheatgrass/Ponderosa Pine Plant Community (1.3) to the Western Wheatgrass-Green Needlegrass Plant Community (1.1).

Conservation practices

Prescribed Burning
Prescribed Grazing

Pathway 1.3B
Community 1.3 to 1.2

Low-intensity fire or prescribed burning that removes most or all of the conifer encroachment in the site, followed by prescribed grazing. Prescribed grazing, including proper stocking rates, alternating season of use, and adequate recovery periods will shift the Western Wheatgrass/Ponderosa Pine Plant Community (1.3) to the Western Wheatgrass-Blue Grama-Buffalograss Plant Community (1.2).

Conservation practices

Prescribed Burning
Prescribed Grazing

State 2
Shortgrass Sod State

This state occurs as a result of above recommended stocking levels, inadequate recovery periods between grazing events, or a combination of these disturbances. This state is dominated by warm--season grasses, with cool-season grasses being subdominant. The shallow, compact nature of the roots of the dominant species causes increased runoff and reduced infiltration. In addition, reduced shading due to a lesser amount of foliar cover causes increased soil temperatures and increased evaporation of the surface soil moisture. These conditions combine to cause the site to become more droughty, and thus reduce the opportunity for recruitment and establishment of the taller statured grasses. This state is relatively stable and resistant to change.

Dominant plant species

- prairie sagewort (*Artemisia frigida*), shrub
- broom snakeweed (*Gutierrezia sarothrae*), shrub
- blue grama (*Bouteloua gracilis*), grass
- buffalograss (*Bouteloua dactyloides*), grass
- white sagebrush (*Artemisia ludoviciana*), other herbaceous
- goldenrod (*Solidago*), other herbaceous

Community 2.1
Blue Grama-Buffalograss-Western Wheatgrass

This plant community developed with continuous seasonal grazing (stocking levels above carrying capacity for extended portions of the growing season, and at the same time of year each year), or continuous season-long grazing (grazing at moderate to heavy stocking levels for the full growing season each year without adequate recovery periods following each grazing occurrence). The potential plant community is made up of approximately 85 percent grasses and grass-like species, 8 percent forbs, and 7 percent shrubs and trees. Dominant grass and grass-like species include blue grama, buffalograss, and western wheatgrass. Grasses of secondary importance include green needlegrass, needle and thread, sideoats grama, annual brome, and possibly Kentucky bluegrass. Forbs commonly found in this plant community include white sagebrush (cudweed sagewort), goldenrod, scurfpea, Cumin ragweed, and western yarrow. Dominant shrubs include fringed sagewort, broom snakeweed, and rose. When compared to the Western Wheatgrass-Green Needlegrass Plant Community (1.1), blue grama, needleleaf sedge, and buffalograss increased on this plant community. Cool-season grasses have decreased significantly. This plant community is very resistant to change. The herbaceous species present are well adapted to grazing; however, composition can be altered through

long-term prescribed grazing. This plant community is less productive than other plant communities. The thick sod prevents other species from establishing. Lack of litter and reduced plant vigor causes higher soil temperatures, poor water infiltration rates, and high evapotranspiration which gives shortgrasses a competitive advantage over cool-season mid-grasses.

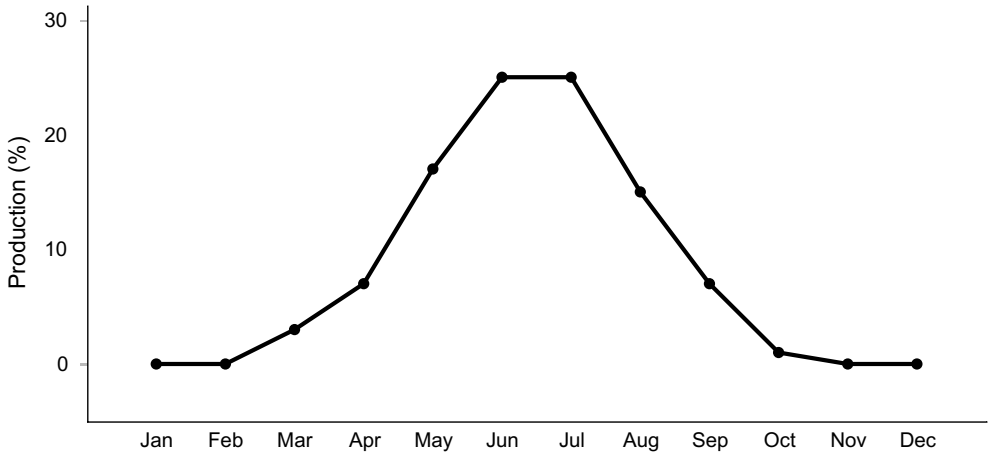


Figure 11. Plant community growth curve (percent production by month). SD6204, Black Hills, warm-season dominant, cool-season sub-dominant. Warm-season dominant, cool-season sub-dominant.

State 3
Early Successional State

This state occurs as a result of extreme disturbance that typically removes most of the native species normally present on this site. Disturbance in the form of severe grazing over several years are the most typical. Occupation by black-tailed prairie dogs may also result in this transition. The dominant species present is highly variable, but the common characteristics include high amounts of bare ground, reduced soil aggregate stability, increased runoff and increased erosion (including increased sediment loads in the runoff). Restoration of the ecological processes will be very difficult.

Dominant plant species

- prairie sagewort (*Artemisia frigida*), shrub
- broom snakeweed (*Gutierrezia sarothrae*), shrub
- threeawn (*Aristida*), grass
- cheatgrass (*Bromus tectorum*), grass
- fetid marigold (*Dyssodia papposa*), other herbaceous
- sweetclover (*Melilotus*), other herbaceous

Community 3.1
Annual/Pioneer Perennial, Bare Ground

This plant community developed under heavy, continuous season-long grazing (grazing at heavy stocking levels for the full growing season each year without adequate recovery

periods following each grazing occurrence); frequent and severe defoliation; or other excessive disturbances (e.g., heavy use areas, or livestock or wildlife concentration areas. The potential plant community is made up of approximately 60 to 80 percent grasses and grass-like species, 15 to 35 percent forbs, and 2 to 5 percent shrubs and trees. The dominant grass is often threeawn. Other grasses may include cheatgrass, field brome, sedge, blue grama, sand dropseed, bluegrass, and western wheatgrass. The dominant forbs include fetid marigold, sweetclover, Cumin ragweed, white sagebrush (cudweed sagewort), and other invader-like species. The dominant shrubs include fringed sagewort, broom snakeweed and cactus. A wide variety of other early successional plant species can occupy this site in varying amounts. This plant community is susceptible to invasion of Canada thistle and other non-native species because of the relatively high percent of bare ground. Compared to the Western Wheatgrass-Green Needlegrass Plant Community (1.1), threeawn, annual brome grasses, and percent of bare ground has increased. Western wheatgrass, needlegrasses and other cool-season grasses have decreased as have the warm-season species including sideoats grama, and little bluestem. Plant diversity is low (plant richness may be high, but areas are often dominated by a few species). The ecological processes are difficult to restore because of the loss of plant diversity and overall soil disturbance. Soil erosion is potentially very high because of the bare ground and shallow rooted herbaceous plant community. Water runoff will increase, and infiltration will decrease due to animal related soil compaction and loss of root mass due to low plant diversity and vigor. This plant community will require significant economic inputs and time to move towards another plant community. This movement is highly variable in its succession. This is due to the loss of diversity (including the loss of the seed bank), within the existing plant community, and the plant communities on adjacent sites.

State 4
Native/Invaded State

The Native/Invaded State is dominated by native cool- and warm-season grasses, and subdominant non-native cool-season grasses (< 15 percent composition by weight). It can be found on areas that would appear to be properly managed with grazing and possibly prescribed burning. Extended periods of non-use and no fire, or long-term light grazing can result in the invasion and establishment of non-native cool-season grasses on this site. As native cool-season grasses decline a corresponding increase of non-native cool-season grasses will occur. The non-native cool-season grasses will include, smooth brome, Kentucky bluegrass, cheatgrass, field brome, and timothy. This a sustainable state in regard to site and soil stability, and watershed function.

Dominant plant species

- western wheatgrass (*Pascopyrum smithii*), grass
- green needlegrass (*Nassella viridula*), grass

Community 4.1
Western Wheatgrass-Non-Native Cool-Season Grasses (< 15%)

This plant community develops when non-native cool-season grasses, such as Kentucky bluegrass or smooth brome invade and become established on the site. This may occur due to the sites close proximity to seed sources, expansion from road ditches, improved pastures, other invaded sites, or from contaminated hay. Repeated seasonal grazing (typically during the summer), or long-term light grazing, or extended periods of non-use and no fire, will allow these non-native cool-season grasses to increase in the plant community. Plant litter will accumulate in large amounts when this community first develops. Litter buildup reduces mature native plant vigor and density, and seedling recruitment declines. Eventually litter levels become high enough that plant density decreases. Typically, rhizomatous grasses form small colonies because of a lack of tiller stimulation. The potential vegetation is about 85 percent grasses or grass-like plants, 10 percent forbs, and 5 percent shrubs and trees. The community is dominated by cool-season grasses. The major grasses include western wheatgrass, green needlegrass, Kentucky bluegrass, and smooth brome. Other grass and grass-like species include sideoats grama, needle and thread, slender wheatgrass, Columbia needlegrass, and needleleaf sedge. This plant community is resilient and well adapted to the Black Hills climatic conditions. The non-native species typically do not increase to the point of dominance; however, their presence tends to reduce the overall diversity of the plant community. As such, this is a somewhat sustainable plant community in regard to site and soil stability, watershed function, and biologic integrity.

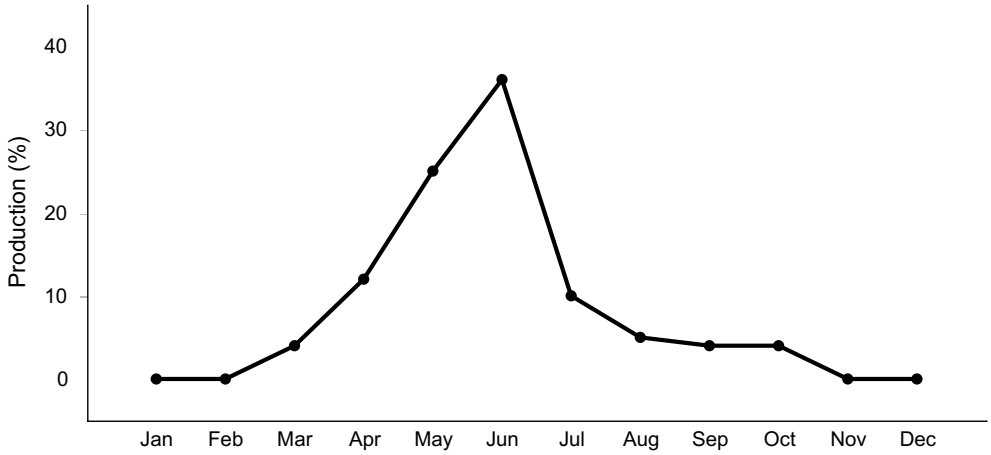


Figure 12. Plant community growth curve (percent production by month). SD6201, Black Hills, cool-season dominant. Cool-season dominant.

State 5
Invaded State

This State is the result of invasion and dominance of non-native cool-season grass species. This State is characterized by the dominance of smooth brome and Kentucky bluegrass. Continuous seasonal grazing (typically during the summer), or long-term light grazing (understocked) will tend to result in an increase of smooth brome. Non-use and no fire will tend to benefit Kentucky bluegrass due to an increasing thatch layer that effectively blocks the introduction of other plants into the system. Plant litter accumulation tends to favor the more shade-tolerant introduced grass species. The nutrient cycle is impaired,

and the result is typically a higher level of nitrogen which also favors the introduced species. Increasing plant litter decreases the amount of sunlight reaching plant crowns, thereby shifting competitive advantage to shade-tolerant, introduced grass species. Studies indicate that soil biological activity is altered, and this shift apparently exploits the soil microclimate and encourages growth of the introduced grass species. Once the threshold is crossed, a change in grazing management alone cannot cause a reduction in the invasive grass dominance. Preliminary studies indicate this threshold may exist when Kentucky bluegrass exceeds 30 percent of the plant community and native grasses represent less than 40 percent of the plant community composition. Plant communities dominated by Kentucky bluegrass have significantly less cover and diversity of native grasses and forb species (Toledo, D. et al., 2014).

Dominant plant species

- smooth brome (*Bromus inermis*), grass
- Kentucky bluegrass (*Poa pratensis*), grass
- white sagebrush (*Artemisia ludoviciana*), other herbaceous
- goldenrod (*Solidago*), other herbaceous

Community 5.1
Smooth Brome-Kentucky Bluegrass (>30%)

This plant community evolved under no use and no fire, or continuous seasonal grazing with no change in season of use, or long-term light grazing. This plant community is typically dominated by smooth brome and Kentucky bluegrass. This plant community is made up of approximately 85 percent grasses and grass-like species, 10 percent forbs, and 5 percent shrubs and trees. Dominant grasses include Kentucky bluegrass, and smooth brome. Western wheatgrass and some needlegrass may still be found in the plant community. Forbs commonly found in this plant community include white sagebrush (cudweed sagewort), goldenrod, scurfpea, and Cuman ragweed. Infiltration and runoff will be moderately reduced as will energy capture. Production can be relatively high however, the period that palatability is high is relatively short, as these cool-season species mature rapidly.

State 6
Conifer State

This Conifer State consists of areas where tree canopy increases to a level that impedes the reproductive capability of the major native perennial grass species. The increase in conifer canopy is a result of encroachment from forest sites, or from rangeland sites that have been invaded; and the disruption of the natural historic fire regime that kept the trees in an immature stage. This state is reached when mature conifer canopy reaches approximately 25 percent or more. The canopy typically is dominated by ponderosa pine, but Rocky Mountain juniper may also be present in varying amounts. With continued long-term fire suppression and no brush management, the conifer canopy can eventually

become closed with much of the herbaceous understory lost. This loss is partly driven by the interception of precipitation. Ponderosa pine canopy can significantly reduce precipitation reaching the ground due to canopy interception. In areas with intermediate and dense canopy's, the expected reduction can reach 30 percent (Wrage, 1994).

Dominant plant species

- Rocky Mountain juniper (*Juniperus scopulorum*), tree
- ponderosa pine (*Pinus ponderosa*), tree
- western snowberry (*Symphoricarpos occidentalis*), shrub
- Woods' rose (*Rosa woodsii*), shrub
- western wheatgrass (*Pascopyrum smithii*), grass
- needlegrass (*Nassella*), grass
- white sagebrush (*Artemisia ludoviciana*), other herbaceous
- white prairie aster (*Symphyotrichum falcatum*), other herbaceous

Community 6.1
Ponderosa Pine-Rocky Mountain Juniper/Herbaceous Understory

This plant community develops where trees from adjacent sites encroach or trees naturally occurring on the site increase and begin to shade out the herbaceous component. Ponderosa pine is the most common species to occupy the site, but encroachment of Rocky Mountain juniper can also occur. These species expand on this site due to suppression of fire and no brush management. The mature tree canopy is 25 percent or greater. The potential plant community is made up of approximately 35 percent grasses and grass-like species, 5 percent forbs, 10 percent shrubs, and 50 percent trees. Dominant grass and grass-like species include western wheatgrass, needlegrass, and non-native cool-season grasses. As the conifer canopy increases, cool-season native grasses tend to decrease, and more shade-tolerant non-native cool-season grasses increase. Forbs commonly found in this community include cudweed sagewort, white prairie aster, silverleaf scurfpea, and pussytoes. Shrubs will include snowberry, and rose. A significant reduction of tree canopy can be accomplished through fire, mechanical brush management, or prescribed burning. The vegetation in the understory is capable of enduring fire; however, very hot crown fires will have a detrimental effect to the plant community.

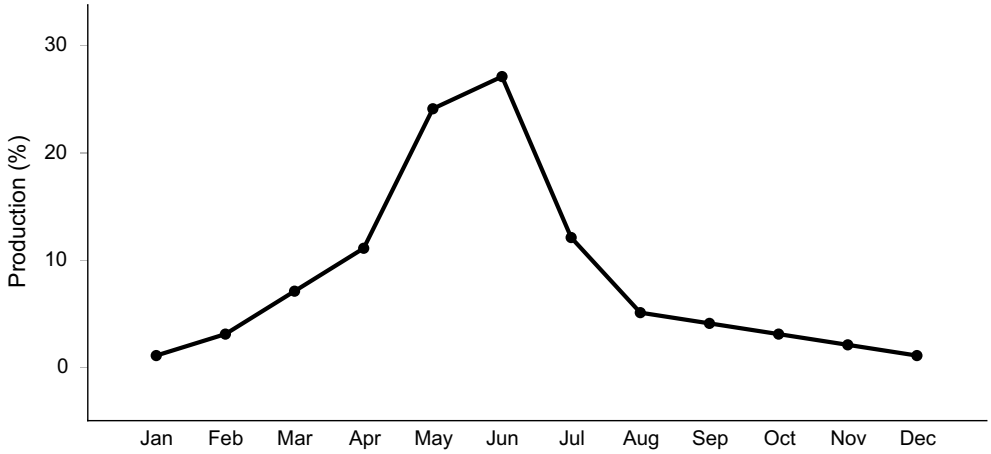


Figure 13. Plant community growth curve (percent production by month). SD6211, Black Hills, heavy conifer canopy. Mature ponderosa pine overstory.

Transition T1C
State 1 to 2

Continuous seasonal grazing (stocking levels above carrying capacity for extended portions of the growing season, and at the same time of year each year, typically beginning early in the season) or continuous season-long grazing will transition the Reference State (1.0) to the Shortgrass Sod State (2.0). This transition is most likely to occur from the Western Wheatgrass-Blue Grama-Buffalograss Plant Community (1.2).

Transition T1D
State 1 to 3

Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance areas such as livestock or wildlife concentration areas will transition the Reference State (1.0) to the Early Successional State (3.0).

Transition T1B
State 1 to 4

The invasion of non-native cool-season grasses; continuous seasonal grazing (stocking levels above carrying capacity for extended portions of the growing season, and at the same time of year each year, typically beginning early in the season); long-term light grazing; or no use and no fire will transition the Reference State (1.0) to the Native/Invaded State (4.0).

Transition T1A
State 1 to 6

Long-term no fire and the encroachment and establishment of conifers will transition the Reference State (1.0) to the Conifer State (6.0).

Restoration pathway R2A
State 2 to 1

Long-term prescribed grazing (moderate stocking levels coupled with adequate recovery periods, or periodic light to moderate stocking levels possibly including periodic rest) may lead the Shortgrass Sod State (2.0) over a threshold to the Reference State (1.0). This is assuming adequate seed and vegetative sources are present. This could require significant time and inputs to achieve and, in the end, may not meet management objectives.

Conservation practices

Prescribed Grazing

Transition T2A
State 2 to 3

Heavy, continuous season-long grazing; frequent severe defoliation; or heavy disturbance will likely move the Shortgrass Sod State (2.0) to the Early Successional State (3.0).

Transition T2B
State 2 to 4

The invasion of non-native cool-season perennial grasses; long-term prescribed grazing with proper stocking rates, change in season of use, and adequate time for recovery will transition the Shortgrass Sod State (2.0) towards the Native/Invaded State (4.0). This transition could require significant time and inputs to achieve and, in the end, may not meet management objectives.

Conservation practices

Prescribed Grazing

Restoration pathway R3A
State 3 to 2

Removal of disturbances coupled with long-term prescribed grazing with proper stocking levels, change in season of use, and adequate recovery time following grazing event may return the Early Successional State (3.0) to the Shortgrass Sod State (2.0). Herbaceous weed control may also be needed. This transition could require significant time and input to achieve and, in the end, may not meet management objectives.

Conservation practices

Prescribed Grazing
Herbaceous Weed Control

Transition T3A
State 3 to 5

Invasion of non-native cool-season grasses; removal of disturbances; herbaceous weed control; followed by prescribed grazing that includes proper stocking, change in season of use, and deferment that provides time for adequate recovery, will likely transition the Early Successional State (3.0) to the Invaded State (5.0). This transition may not meet management objectives.

Conservation practices

Prescribed Grazing
Herbaceous Weed Control

Transition T4A
State 4 to 2

Continuous season-long grazing or continuous seasonal grazing will transition the Native/Invaded State (4.0) to the Shortgrass Sod State (2.0).

Transition T4D
State 4 to 3

Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance will transition the Native/Invaded State (4.0) to the Early Successional State (3.0).

Transition T4C
State 4 to 5

Continuous seasonal grazing, or long-term light grazing will transition the Native/Invaded State (4.0) to the Invaded State (5.0). With extended periods of non-use and no fire, heavy litter layer build-up will favor cool-season non-natives grasses such as Kentucky bluegrass, smooth brome, and timothy. This major shift in functional groups will also transition the Native/Invaded State (4.0) to the Invaded State (5.0).

Transition T4B
State 4 to 6

Long-term no fire and the encroachment and establishment of conifers will transition the

Native/Invaded State (4.0) to the Conifer State (6.0).

Transition T5C
State 5 to 3

Heavy, continuous season-long grazing; frequent and severe defoliation; or heavy disturbance will transition the Invaded State (5.0) to the Early Successional State (3.0).

Transition T5A
State 5 to 4

Herbaceous weed control; followed by long-term prescribed grazing that includes proper stocking, change in season of use, and deferment that provides time for adequate plant recovery may transition the Invaded State (5.0) to the Native/Invaded State (4.0). This transition could require significant time and input to achieve and, in the end, may not meet management objectives.

Conservation practices

Prescribed Grazing
Herbaceous Weed Control

Transition T5B
State 5 to 6

Long-term no fire and the encroachment and establishment of conifers will transition the Invaded State (5.0) to the Conifer State (6.0).

Transition T6B
State 6 to 3

High-intensity fire or prescribed burning that removes all or most of the conifer encroachment, and adversely affects the herbaceous understory will likely transition the Conifer State (6.0) to the Early Successional State (3.0).

Conservation practices

Prescribed Burning

Transition T6A
State 6 to 5

Low-intensity fire; prescribed burning; or mechanical brush management will treat conifer encroachment on this site and will transition the Conifer State (6.0) to the Invaded State

(5.0)

Conservation practices

Brush Management
Prescribed Burning

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					
1	**Rhizomatous Wheatgrass**			516–1031	
	western wheatgrass	PASM	*Pascopyrum smithii*	387–1031	–
	thickspike wheatgrass	ELLAL	*Elymus lanceolatus ssp. lanceolatus*	129–258	–
2	**Cool-Season Bunchgrass**			387–773	
	green needlegrass	NAVI4	*Nassella viridula*	258–644	–
	needle and thread	HECOC8	*Hesperostipa comata ssp. comata*	129–258	–
	Columbia needlegrass	ACNE9	*Achnatherum nelsonii*	0–129	–
	porcupinegrass	HESP11	*Hesperostipa spartea*	0–129	–
	slender wheatgrass	ELTR7	*Elymus trachycaulus*	0–129	–
3	**Tall Warm-Season Grasses**			174–387	
	big bluestem	ANGE	*Andropogon gerardii*	52–258	–
	composite dropseed	SPCOC2	*Sporobolus compositus var. compositus*	0–77	–
4	**Mid- Warm-Season Grasses**			174–258	
	sideoats grama	BOCU	*Bouteloua curtipendula*	52–258	–
	little bluestem	SCSC	*Schizachyrium scoparium*	26–129	–
5	**Short Warm-Season Grasses**			52–258	
	blue grama	BOGR2	*Bouteloua gracilis*	26–206	–
	buffalograss	BODA2	*Bouteloua dactyloides*	26–103	–
	threeawn	ARIST	*Aristida*	0–52	–

6	**Other Native Grasses**			52–129	
	Grass, perennial	2GP	*Grass, perennial*	0–103	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	26–77	–
	Cusick's bluegrass	POCU3	*Poa cusickii*	26–52	–
	Sandberg bluegrass	POSE	*Poa secunda*	0–26	–
7	**Grass-Likes**			52–129	
	needleleaf sedge	CADU6	*Carex duriuscula*	26–129	–
	threadleaf sedge	CAFI	*Carex filifolia*	26–129	–
	sedge	CAREX	*Carex*	0–77	–
8	**Non-Native Cool-Season Grasses**			–	
Forb					
9	**Forbs**			129–258	
	Forb, perennial	2FP	*Forb, perennial*	26–103	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	26–52	–
	goldenrod	SOLID	*Solidago*	26–52	–
	white prairie aster	SYFA	*Symphyotrichum falcatum*	26–52	–
	leafy wildparsley	MUDI	*Musineon divaricatum*	26–52	–
	American vetch	VIAM	*Vicia americana*	26–52	–
	white sagebrush	ARLU	*Artemisia ludoviciana*	26–52	–
	desert biscuitroot	LOFO	*Lomatium foeniculaceum*	26–52	–
	dotted blazing star	LIPU	*Liatris punctata*	26–52	–
	beardtongue	PENST	*Penstemon*	26–52	–
	prairie clover	DALEA	*Dalea*	26–52	–
	upright prairie coneflower	RACO3	*Ratibida columnifera*	26–52	–
	scarlet beeblossom	GACO5	*Gaura coccinea*	26–52	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	26–52	–
	silverleaf Indian breadroot	PEAR6	*Pediomelum argophyllum*	26–52	–
	slimflower scurfpea	PSTE5	*Psoralidium tenuiflorum*	26–52	–
	spiderwort	TRADE	*Tradescantia*	0–26	–

	Cuman ragweed	AMPS	*Ambrosia psilostachya*	0–26	–
	western yarrow	ACMIO	*Achillea millefolium var. occidentalis*	0–26	–
	blacksamson echinacea	ECAN2	*Echinacea angustifolia*	0–26	–
	buckwheat	ERIOG	*Eriogonum*	0–26	–
	fleabane	ERIGE2	*Erigeron*	0–26	–
	bluebells	MERTE	*Mertensia*	0–26	–
	cinquefoil	POTEN	*Potentilla*	0–26	–
	bellflower	CAMPA	*Campanula*	0–26	–
	Forb, introduced	2FI	*Forb, introduced*	–	–
Shrub/Vine					
10	**Shrubs**			77–258	
	rose	ROSA5	*Rosa*	26–103	–
	pricklypear	OPUNT	*Opuntia*	0–77	–
	prairie sagewort	ARFR4	*Artemisia frigida*	26–52	–
	skunkbush sumac	RHTR	*Rhus trilobata*	26–52	–
	western snowberry	SYOC	*Symphoricarpos occidentalis*	26–52	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–52	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	26–52	–
	leadplant	AMCA6	*Amorpha canescens*	0–26	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–26	–
Tree					
11	**Trees**			0–52	
	ponderosa pine	PIPO	*Pinus ponderosa*	0–52	–
	Rocky Mountain juniper	JUSC2	*Juniperus scopulorum*	0–26	–

Animal community

Wildlife Interpretations
The Black Hills and Bear Lodge Mountains of South Dakota and Wyoming are truly a forested island in a grassland sea. To regional Native Americans, they are ‘Paha Sapa” or “hills that are black”, and from a distance, the ponderosa pine-covered slopes do appear like black hills (Larson, 1999).

The Black Hills and Bear Lodge Mountains are located in the drier areas of a northern mixed-grass prairie ecosystem in which sagebrush steppes to the west yield to grassland steppes to the east. Prior to European settlement, MLRA 62 consisted of diverse grassland, shrubland, and forest habitats interspersed with varying densities of depressional, instream wetlands and woody riparian corridors. These habitats provided critical life cycle components for many users. Many species of grassland birds, small mammals, reptiles, and amphibians and herds of roaming bison, elk, and pronghorn were among the inhabitants adapted to this semi-arid region. Roaming herbivores, as well as several species of small mammals and insects, were the primary consumers linking the grassland resources to large predators, such as the wolf, mountain lion, and grizzly bear, and to smaller carnivores, such as the coyote, bobcat, fox, and raptors.

Beaver inhabited surface waters associated with instream wetlands and woody riparian corridors along streams and drainages. Beaver occupation served as a mechanism to maintain water tables along flood plains and valley floors. During pre-European times, the extent of the wet land sites was likely much more wide-spread and persistent during dry periods, however excessive trapping and removal since that time has changed the hydrology and limited the extent of these site while drying former mesic areas throughout the MLRA.

Grazing Interpretations
Production and accessibility of plant communities described in the Clayey - South ecological site can be highly variable, a complete resource inventory is necessary to document plant composition and production. Accurate estimates of carrying capacity should be calculated using vegetative clipping data, animal preference data, and actual stocking records.

Initial suggested stocking rates should be calculated using a base of 912 lb/acre (air-dry weight) per animal-unit-month (AUM). Use a 25 percent harvest efficiency of preferred and desirable forage species (refer to USDA-NRCS National Range and Pasture Handbook). An AUM is defined as the equivalent amount of forage required by a 1,000-pound cow with or without calf, for one month.

Grazing by domestic livestock is one of the major income-producing industries in the area. Rangeland in this area may provide yearlong forage for livestock. During the dormant period, the forage for livestock likely has insufficient protein to meet livestock requirements. Added protein allows ruminants to better utilize the energy stored in grazed plant materials. A forage quality test should be used to determine the level of supplementation needed.

Hydrological functions

This site is dominated by soils in hydrologic groups C and D. Infiltration and runoff potential for this site varies from moderate to high depending on soil hydrologic group, slope and ground cover. Refer to the USDA-NRCS National Engineering Handbook, Part

630, for hydrologic soil groups, runoff quantities, and hydrologic curves.

Recreational uses

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

Wood products

No appreciable wood products are typically present on this site.

Other products

Harvesting of native plant seeds can provide additional income on this site.

Other information

Revision Notes: Provisional
This provisional ecological site description (ESD) has passed quality control (QC) and quality assurance (QA) to ensure the it meets the 2014 NESH standards for a provisional ecological site description. This site should not be considered an Approved ESD, as it is only the foundational site concepts and requires further data collection, site investigations, and final State-and-Transition Model (STM) reviews before it can be used as an Approved ESD meeting NESH standards.

Site Development and Testing Plan
Future work, as described in an official project plan, is necessary to validate the information in this provisional ecological site description. The plan will include field activities for low-, medium-, and high-intensity sampling, soil correlations, and analysis of the data. Annual field reviews should be done by soil scientists and vegetation specialists. Final field review, peer review, quality control, and quality assurance reviews are required to produce the final document.

Inventory data references

Information presented here has been derived from NRCS clipping data and other inventory data. Field observations from range-trained personnel were also used. Those involved in developing this site include Stan Boltz, range management specialist (RMS), NRCS; Dan Brady, soil scientist (SS), NRCS; Mitch Faulkner, RMS, NRCS; Rick Peterson, (RMS), NRCS; Mathew Scott, RMS, USFS; and Jim Westerman, (SS), NRCS. All inventory information and data records are compiled within the Rapid City, SD USDA-NRCS Shared “S” network drive.

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This ecological site description developed by Rick L. Peterson on April 27, 2020.

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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	05/20/2025
Approved by	Suzanne Mayne-Kinney
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):**

---

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

---

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

---

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

---

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):**

---

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):**

---

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:**

---

17. **Perennial plant reproductive capability:**
