USDA Natural Resources Conservation Service

Ecological site R052XN164MT
Clayey-Steep (CySTp) 10-14" p.z.

Last updated: 1/24/2024
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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): 052X–Brown Glaciated Plains

The Brown Glaciated Plains, MLRA 52, is an expansive, agriculturally and ecologically significant area. It consists of approximately 14.5 million acres and stretches across 350 miles from east to west, encompassing portions of 15 counties in north-central Montana. This region represents the southwestern limit of the Laurentide Ice Sheet and is considered to be the driest and westernmost area within the vast network of glacially derived prairie pothole landforms of the northern Great Plains. Elevation ranges from 2,000 feet (610 meters) to 4,600 feet (1,400 meters).

Soils are primarily Mollisols, but Entisols, Inceptisols, Alfisols, and Vertisols 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, and in some areas glacially deformed bedrock occurs at or near the soil surface (Soller, 2001). Underlying sedimentary bedrock largely consisting of Cretaceous shale, sandstone, and mudstone (Vuke et al., 2007) is commonly exposed on hillslopes, particularly along drainageways. Significant alluvial deposits occur along glacial outwash channels and major drainages, including portions of the Missouri, Teton, Marias, Milk, and Frenchman Rivers. Large glacial lakes, particularly in the western half of the MLRA, deposited clayey and silty lacustrine sediments (Fullerton et al., 2013).

Much of the western portion of this MLRA was glaciated towards the end of the Wisconsin age, with the maximum glacial extent occurring approximately 20,000 years ago (Fullerton et al., 2004). The result is a geologically young landscape that is predominantly a level till plain interspersed with lake plains and dominated by soils in the Mollisol and Vertisol orders. These soils are very productive and generally are well suited to dryland farming. Much of this area is aridic-ustic. Crop-fallow dryland wheat farming is the predominant land use. Areas of rangeland typically are on steep hillslopes along drainages.

The rangeland, much of which is native mixedgrass prairie, increases in abundance in the eastern half of the MLRA. The Wisconsin-age till in the north-central part of this area typically formed large disintegration moraines with steep slopes and numerous poorly drained potholes. A large portion of Wisconsin-age till occurring on the type of the level terrain that would typically be optimal for farming has large amounts of less-suitable sodium-affected Natrustalfs. Significant portions of Blaine, Phillips, and Valley Counties were glaciated approximately 150,000 years ago during the Illinoisan age. Due to erosion and dissection of the landscape, many of these areas have steeper slopes and more exposed bedrock than areas glaciated during the Wisconsin age (Fullerton and Colton, 1986).

While much of the rangeland in the aridic-ustic portion of MLRA 52 is classified as belonging to the “dry grassland” climatic zone, sites in portions of southern MLRA 52 may belong to the “dry shrubland” climatic zone. The dry shrubland climatic zone represents the northernmost extent of the big sagebrush (Artemisia tridentata) steppe on the Great Plains. Because similar soils occur in both southern and northern portions of the MLRA, it is currently hypothesized that climate is the primary driving factor affecting big sagebrush distribution in this area. However, the precise factors are not yet fully understood.

Sizeable tracts of largely unbroken rangeland in the eastern half of the MLRA and adjacent southern Saskatchewan

are home to the northern Montana population of greater sage grouse (Centrocercus urophasianus), and large portions of this area are considered to be a Priority Area for Conservation (PAC) by the U.S. Fish and Wildlife Service (U.S. Fish and Wildlife Service, 2013). This population is unique among sage grouse populations in the fact that many individuals overwinter in the big sagebrush steppe (dry shrubland) in the southern portion of the MLRA and then migrate to the northern portion of the MLRA, which lacks big sagebrush (dry grassland), to live the rest of the year (Smith, 2013).

Areas of the till plain near the Bearpaw and Highwood Mountains as well as the Sweetgrass Hills and Rocky Mountain foothills are at higher elevations, receive higher amounts of precipitation, and have a typic-ustic moisture regime. These areas have significantly more rangeland production than the drier aridic-ustic portions of the MLRA and have enough moisture to produce crops annually rather than just bi-annually, as in the drier areas. Ecological sites in this higher precipitation area are classified as the Moist Grassland climatic zone.

Classification relationships

NRCS Soil Geography Hierarchy
• Land Resource Region: Northern Great Plains
• Major Land Resource Area (MLRA): 052 Brown Glaciated Plains
• Climate Zone: Dry Shrubland

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: Northwestern Glaciated Plains 331D
• Subsection: Montana Glaciated Plains 331Dh
• Landtype Association/Landtype Phase: N/A

National Vegetation Classification Standard (Federal Geographic Data Committee, 2008)
• Class: Xeromorphic Woodland, Scrub and Herb Vegetation Class (3)
• Subclass: Cool Semi-Desert Scrub and Grassland Subclass (3.B)
• Formation: Cool Semi-Desert Scrub and Grassland Formation (3.B.1)
• Division: Cool Semi-Desert Scrub and Grassland Division (3.B.1.Ne)
• Macrogroup: Artemisia tridentata - Artemisia tripartita ssp. tripartita - Purshia tridentata Steppe and Shrubland Macrogroup (3.B.1.Ne.3)
• Group: Artemisia tridentata - Artemisia tripartita - Purshia tridentata Big Sagebrush Steppe and Shrubland Group (3.B.1.Ne.3.b)
• Alliance: Artemisia tridentata ssp. wyomingensis Mesic Steppe and Shrubland Alliance
• Association: Artemisia tridentata ssp. wyomingensis / Pascopyrum smithii Shrub Grassland or Artemisia tridentata ssp. wyomingensis / Pseudoroegneria spicata Shrub Grassland

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

Ecological site concept

This ecological site occurs on hillslopes, badlands, and bluffs where clay content of the soil is greater than 35 percent. Slopes vary from 15 to 60 percent.

The distinguishing characteristics of this site are moderately steep to very steep slopes, a relatively well developed soil profile, and clayey textures in the upper 4 inches of soil. Soils are typically moderately deep to very deep (between 20 to 60 inches to bedrock), are derived from shale residuum or clayey till, and typically have an ochric epipedon. Textures in the upper 4 inches of soil are in the fine textural family and contains greater than 35 percent, but not more than 45 percent, clay. Sometimes the underlying horizons exhibit shrink swell characteristics such as slickensides. This site is typically nonacid, with pH values greater than 5.6 throughout the soil profile. Characteristic

vegetation is western wheatgrass (Pascopyrum smithii), green needlegrass (Nassella viridula), and Wyoming big sagebrush (Artemisia tridentata subsp. wyomingensis).

Associated sites

R052XN166MT	**Overflow (Ov) 10-14" p.z.** Receives additional run-in moisture from surrounding landscape; different species composition, higher productivity.
R052XN178MT	**Shallow (Sw) 10-14" p.z.** Soil depth less than or equal to 20 inches to a restrictive layer; less forage production.
R052XN168MT	**Silty-Steep (SiStp) 10-14" p.z.** Similar landscape position; different species composition and coarser soil texture.
R052XN163MT	**Sandy (Sy) 10-14" p.z.** Is not located on steep slopes, different species composition and soil texture.
R052XN161MT	**Silty (Si) 10-14" p.z.** Slopes <15%; more forage production; different species composition.

Table 1. Dominant plant species

Tree	Not specified
Shrub	(1) *Krascheninnikovia lanata* (2) *Atriplex nuttallii*
Herbaceous	(1) *Pseudoroegneria spicata* (2) *Pascopyrum smithii*

Physiographic features

This site occurs on slopes of till plains, hills and ridges that drain into stream valleys and channels. Slopes are usually greater than 15%. This site occurs on all exposures. Elevations normally range from 2200 to 3500 feet.

Table 2. Representative physiographic features

Landforms	(1) Till plain (2) Ridge (3) Hill
Runoff class	High to very high
Flooding frequency	None
Ponding frequency	None
Elevation	671–1,067 m
Slope	15–55%
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Runoff class	Not specified
Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	610–1,219 m
Slope	Not specified

Climatic features

A semi-arid, temperate climate characterizes the Glaciated Plains. The predominance of cool season species has

evolved to take advantage of the precipitation regime that peaks in late spring-early summer (June). Seventy-five percent of the annual precipitation usually falls as steady, soaking, frontal system rains. Summer rains usually come with thunderstorms. Precipitation is the most important factor influencing production (Heitschmidt et al 2005). Severe drought occurs on average in two out of every ten years (Cooper, et al., 2001).

Table 4. Representative climatic features

Frost-free period (characteristic range)	85-123 days
Freeze-free period (characteristic range)	116-142 days
Precipitation total (characteristic range)	254-356 mm
Frost-free period (average)	94 days
Freeze-free period (average)	125 days
Precipitation total (average)	305 mm

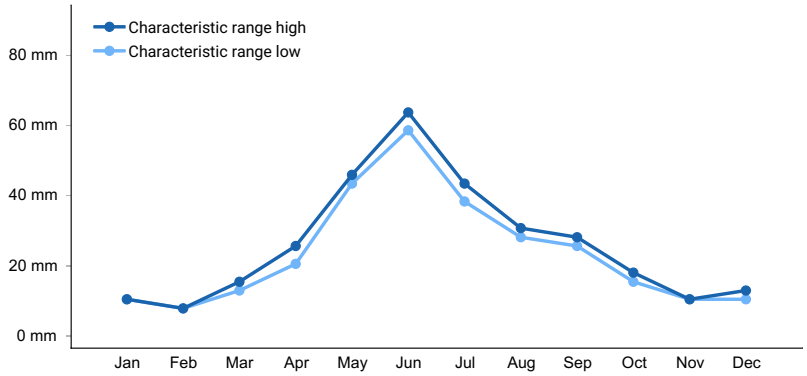


Figure 1. Monthly precipitation range

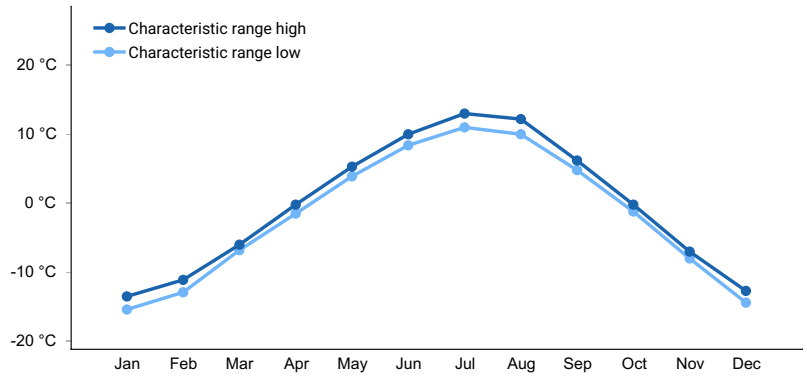


Figure 2. Monthly minimum temperature range

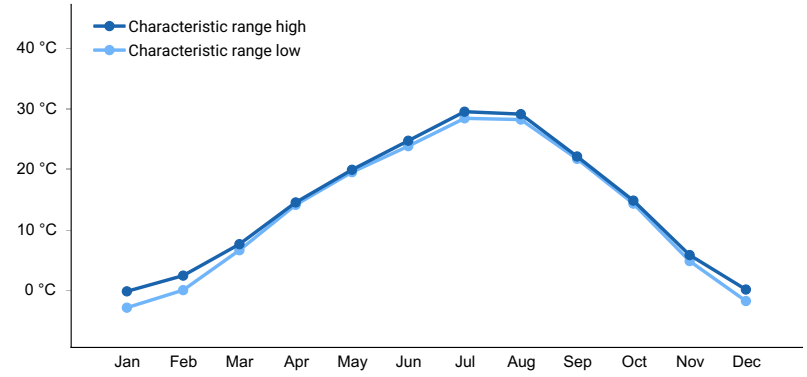


Figure 3. Monthly maximum temperature range

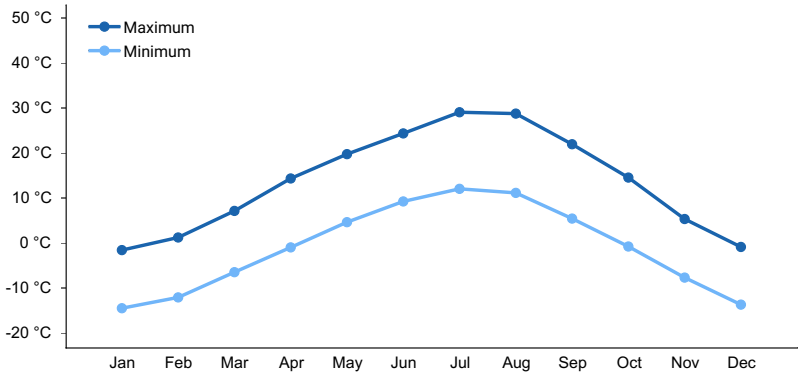


Figure 4. Monthly average minimum and maximum temperature

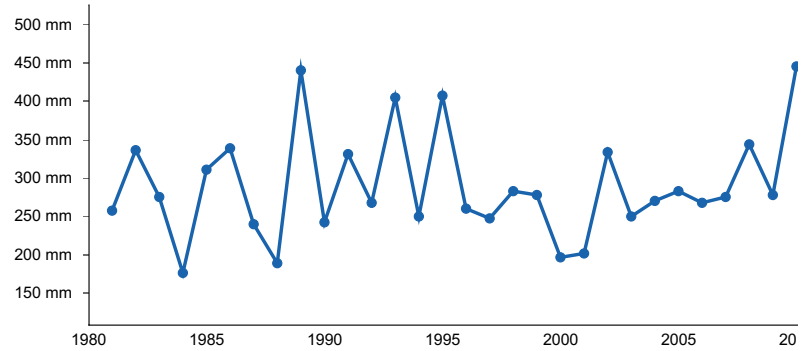


Figure 5. Annual precipitation pattern

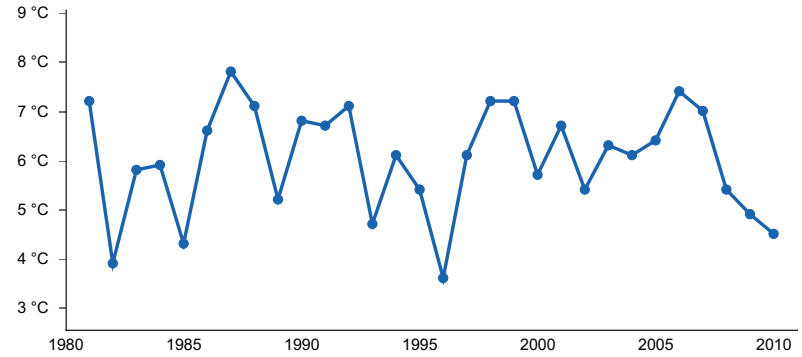


Figure 6. Annual average temperature pattern

Climate stations used

- (1) CHESTER [USC00241692], Chester, MT
- (2) GLASGOW [USW00094008], Glasgow, MT
- (3) HAVRE CITY CO AP [USW00094012], Havre, MT
- (4) SHELBY [USC00247500], Shelby, MT

Influencing water features

This site is not influenced by water from streams.

Wetland description

This site is not influenced by water from wetlands.

Soil features

These soils were formed in glacial till. They occur on steep or hilly landscapes. The surface layer of these soils are usually less than 3 inches in depth and typically have a clay loam, silty clay loam, silty clay, sandy clay, sandy clay

loam, and clay texture. The underlying material is typically a clay loam to a depth of 60 inches or more. Soils are often calcareous. Soils are well drained and permeability is very slow. This site is characterized by the following soil components: Sunburst, Bascovy, and Abor. Soil ph varies from 7.4 to 9.0.

Table 5. Representative soil features

Parent material	(1) Till (2) Glaciofluvial deposits
Surface texture	(1) Clay loam (2) Silty clay loam (3) Silty clay
Family particle size	(1) Fine
Drainage class	Well drained
Permeability class	Very slow
Soil depth	51–198 cm
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (Depth not specified)	10.16–17.78 cm
Calcium carbonate equivalent (Depth not specified)	0–10%
Electrical conductivity (Depth not specified)	0–8 mmhos/cm
Sodium adsorption ratio (Depth not specified)	0–10
Soil reaction (1:1 water) (Depth not specified)	7.4–9
Subsurface fragment volume <=3" (Depth not specified)	0–10%
Subsurface fragment volume >3" (Depth not specified)	0–3%

Ecological dynamics

This ecological site developed under Northern Great Plains climatic conditions, the natural influence of large herbivores and a fire frequency of 5-7 years (Frost 1998).

Plant community interpretations are based on the Historic Climax Plant Community (HCPC). Changes in the HCPC are brought about by frequency, timing and intensity of past grazing use, series of dry or wet years, or disturbances by fire, insect infestations, noxious weed invasions, etc. As the HCPC regresses to lower seral stages, the deep-rooted cool season perennial grasses are replaced by warm season perennial grasses (blue grama, sandberg bluegrass, etc), and warm season forbs and half-shrubs (fringed sagewort, hoods phlox, threadleaf sedge, hairy goldaster, and dense clubmoss). The dominance of these short grasses, warm season forbs and half-shrubs in the plant community disrupts ecological processes, impairs the biotic integrity of the site, and adversely affects resiliency. The system’s ability to recover to higher seral states is restricted or impeded.

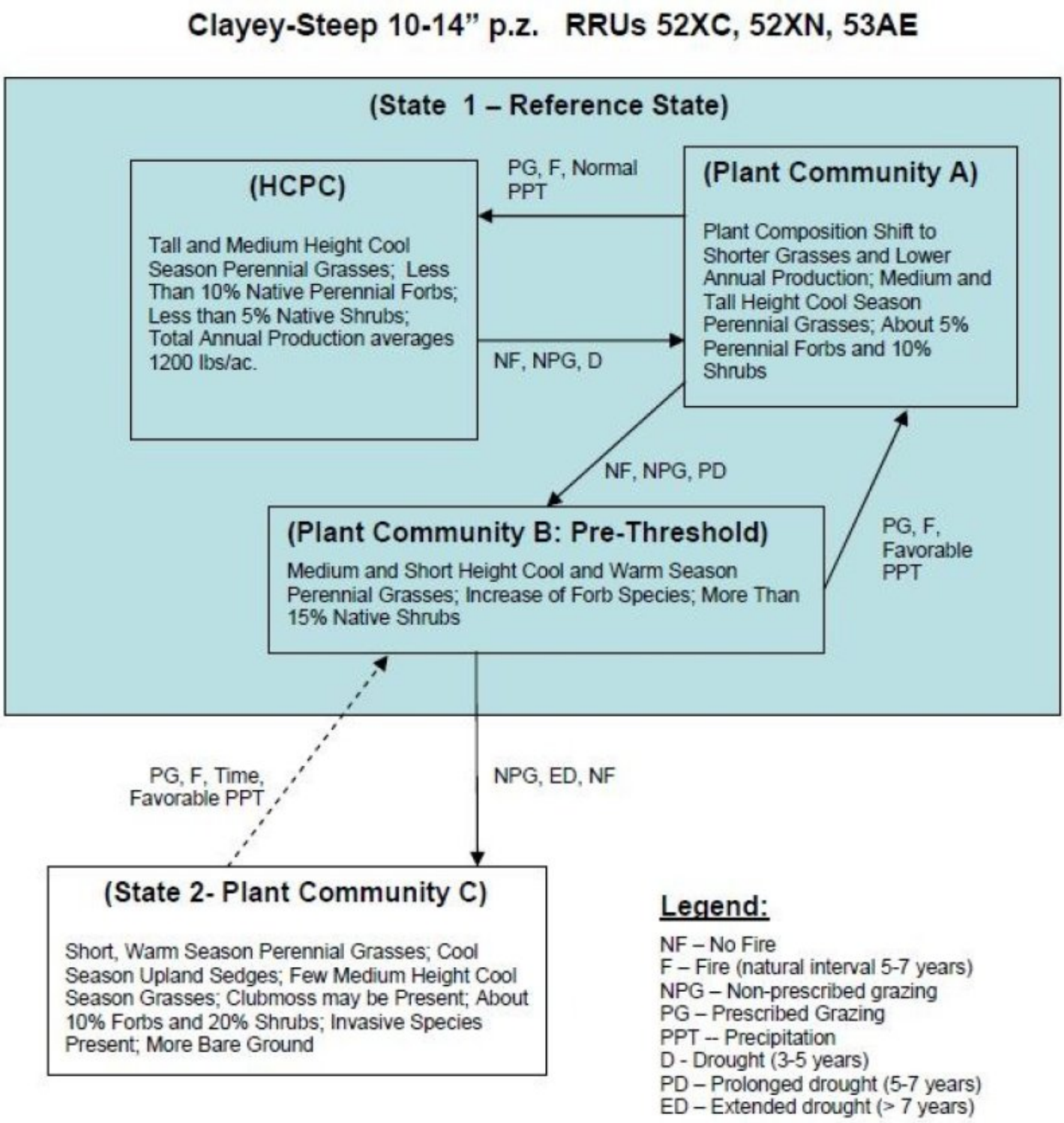
State and Transition Diagram

Traditional theories of plant succession leading to a single climax community are inadequate for understanding the complex successional pathways of this ecological site in the glaciated plains (Stringham et al. 2003). This ecological site is more aptly described using state-and-transition vegetation dynamics in a non-linear framework. A “state” is an alternative, persistent vegetation community that is not simply reversible in the linear successional framework. States are depicted as seral stages, while pathways between states are “transitions.” The latter can be transient or persisting (crosses a threshold). Transitions may be triggered by climatic events, fire, grazing, farming, etc.

Three important plant communities and associated successional pathways for the Reference state (State 1), and the transitions across a threshold to State 2 are illustrated below for a Clayey-Steep 10-14” p.z. site in the Glaciated

Plains.

State and transition model



State 1
Reference State

Community 1.1
Historic Climax Plant Community (HCPC) Tall- and medium-height cool-season perennial grasses, less than 10 percent native perennial forbs, less than 5 percent native shrubs.

Tall- and medium-height cool-season perennial grasses, less than 10 percent native perennial forbs, less than 5 percent native shrubs, total annual production averages 1200 lbs/ac. The interpretive plant community for this site is

the Historic Climax Plant Community (HCPC). This community is highly resistant and resilient to change. Cool season, tall and mid-grasses (such as green needlegrass, bluebunch wheatgrass, western wheatgrass, and thickspike wheatgrass) dominate the HCPC. Bluebunch wheatgrass is dominant on this site in the northern Glaciated Plains. Plains muhly and blue grama are the only common warm season grasses. Prairie junegrass, plains reedgrass, and threadleaf sedge are common, cool season short grasses and grasslike plants. Grasses represent about 85% of the total annual production in the community. Dotted gayfeather, white prairie clover, and purple prairie clover are warm season forbs that commonly occur on Clayey-Steep 10-14" p.z. sites. American vetch is a highly palatable, common cool season forb. American vetch and the prairie clovers are nitrogen-fixing plants. Although these have a much lower value as forage, ground plum milkvetch, milkvetch, prairie thermopsis and scurfpea are also nitrogen-fixing legumes. White milkwort, biscuitroot, wild onion and western yarrow may be present as a minor component of the plant community. Forbs represent about 5% of the total annual production. Winterfat, silver sagebrush and rose are common shrubs. Winterfat is valuable forage for wildlife and livestock. Silver sagebrush and fringed sagewort, two warm season shrub species, may represent a minor component of the HCPC. One would not expect to find more than a trace of broom snakeweed and prickly pear cactus in the HCPC. Very few cool-season shrubs grow on the site. Overall, shrubs account for about 10% of the annual plant production. Historic NRCS data indicate that total annual production averages 1200 lbs/ac during normal years on Clayey-Steep 10-14" p.z. ecological sites. Average annual production is expected to increase and decrease, respectively on more mesic and xeric portions of the northern Glaciated plains. Although similarity indices (SI) >75% are expected to be associated with the HCPC, none were recorded during recent range inventories. Annual bromes and other annual species may colonize the HCPC following a drought or periods of non-prescriptive grazing. Continual adverse impacts over a period of several years will cause a shift in species composition from the mid and tall cool season grasses to prairie junegrass, plains reedgrass, white milkwort, fringed sagewort, etc. With proper grazing management and non-drought conditions, the higher successional cool season perennial plants regain vigor and will replace the lower successional species within a few years. Litter is in contact with 50-60% of the soil surface. Less than 10% of the soil surface should be bare, or unprotected by litter, rock, moss, and plant canopy. Rills should not be present and water flow patterns should be barely observable. Soil erosion by wind and water should be minimal. Runoff and soil erosion increase as the HCPC regresses to earlier seral states. The major plant species composition and production by dry weight are shown for the HCPC in the following table. Total annual production has been derived from several sources, and has been adjusted to represent a typical annual precipitation cycle.

Table 6. Annual production by plant type

Plant Type	Low (Kg/Hectare)	Representative Value (Kg/Hectare)	High (Kg/Hectare)
Grass/Grasslike	813	1143	1379
Shrub/Vine	95	135	168
Forb	45	67	78
Total	**953**	**1345**	**1625**

Table 7. Ground cover

Tree foliar cover	0%
Shrub/vine/liana foliar cover	0%
Grass/grasslike foliar cover	0%
Forb foliar cover	0%
Non-vascular plants	0-5%
Biological crusts	0-2%
Litter	45-55%
Surface fragments >0.25" and <=3"	0-3%
Surface fragments >3"	0-2%
Bedrock	0%
Water	0%

Bare ground	10-20%

Table 8. Soil surface cover

Tree basal cover	0%
Shrub/vine/liana basal cover	5-10%
Grass/grasslike basal cover	20-25%
Forb basal cover	1-5%
Non-vascular plants	0%
Biological crusts	0%
Litter	0%
Surface fragments >0.25" and <=3"	0%
Surface fragments >3"	0%
Bedrock	0%
Water	0%
Bare ground	0%

Table 9. Canopy structure (% cover)

Height Above Ground (M)	Tree	Shrub/Vine	Grass/ Grasslike	Forb
<0.15	–	0-20%	0-10%	0-40%
>0.15 <= 0.3	–	0-40%	0-40%	0-50%
>0.3 <= 0.6	–	0-30%	0-40%	0-8%
>0.6 <= 1.4	–	0-10%	0-10%	0-2%
>1.4 <= 4	–	–	–	–
>4 <= 12	–	–	–	–
>12 <= 24	–	–	–	–
>24 <= 37	–	–	–	–
>37	–	–	–	–

Community 1.2
Plant Community A Plant composition shift to shorter grasses and lower annual production, medium- and tall-height cool-season perennial grasses, about 5 percent perennial forbs and 10 percent shrubs.

Plant composition shift to shorter grasses and lower annual production, medium- and tall-height cool-season perennial grasses, about 5 percent perennial forbs and 10 percent shrubs. Total plant production averages about 1,000 lbs/ac in this Plant Community, or 200 lbs/ac less than the HCPC. The decrease in production results from a shift in species composition. Western/thickspike wheatgrasses, threadleaf sedge, blue grama and plains reedgrass increase at the expense of the tall, cool season grasses (bluebunch wheatgrass and green needlegrass). In comparison to the HCPC, production of blue grama, prairie junegrass, plains reedgrass, threadleaf sedge and other short grasses now accounts for about 20% of the total annual production. Exact responses of these species vary with the kind, intensity, frequency and duration of disturbance (drought, grazing, etc.) and precipitation (amount and timing). Total production of native forbs remains at about 5% of annual production of the community. However, the palatable species (prairie clovers, American vetch and dotted gayfeather) decrease in abundance (relative to the HCPC). The open niches allow hairy goldenaster, bastard toadflax, prairie thermopsis, etc. to become more abundant. Shrubs continue to account for about 10% of the total production. However, species such as fringed sagewort and silver sagebrush increased (relative to the HCPC). SI indices from 55-75% are associated with this community. In contrast to the HCPC, range conservationists have serious concerns regarding lower infiltration rates

and potentially higher runoff rates, plant functional/structural group shifts, and decreasing amount of litter.

Community 1.3
Plant Community B - Pre-threshold Medium- and short-height cool- and warm-season perennial grasses, increase of forb species, more than 15 percent shrubs.

Medium- and short-height cool- and warm-season perennial grasses, increase of forb species, more than 15 percent shrubs. Plant Community B is dominated by needle and thread grass, blue grama, plains reedgrass, prairie junegrass and upland sedges. Individual plants and remnants of bluebunch wheatgrass, green needlegrass, and western/thickspike wheatgrasses remain in the Community. They have low vigor and there is little successful regeneration. There is an increased presence of lower successional plants. The short grasses and grasslike plants make up about 30% of the total production. Japanese brome, cheatgrass, and lower successional forbs colonize disturbed areas. Total vegetative production declines to about 800 lbs/ac in a normal year. Hairy goldenaster, scarlet globemallow, scurfpeas, cudweed sagewort and other warm season forbs increase at the expense of the prairie clovers and American vetch. Forbs increase and account for about 10% total annual production. Fringed sagewort, a half-shrub, increases at the expense of winterfat. Silver sagebrush, rose and prickly pear cactus also increase in some locations on this site. Shrubs account for about 15% of the total plant production. SI indices for this community vary from 35-55%. Litter provides cover for about 25-30% of the ground, while bare ground increases to about 25%. Rills, water flow patterns and litter movement are evident on the site. The tall cool season grasses have poor vigor, with little seed production. Most of the seedlings and young plants appear to represent short grasses and warm season forbs. Regeneration of desired species is inadequate. Plant Community B is fairly resilient, but it is not highly resistant to disturbance. It is the “pre-threshold” community. Therefore, it is critical that this community be recognized and management strategies implemented to prevent further regression (USDI and USDA 2000). Community B can readily regress to a lower state (State 2), from which succession back to any community within State 1 is restricted without significant energy inputs.

Pathway 1.1A
Community 1.1 to 1.2

No fire, non-prescribed grazing, drought (3 to 5 years) Successional pathways from the HCPC are influenced by frequency, timing and intensity of grazing, precipitation patterns, fire, insect infestations, noxious weed colonization and recruitment, etc. As communities regress from HCPC, medium and short grasses increase at the expense of mid and tall cool season grasses. The medium and short grasses are comprised of cool and warm season species.

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing, fire (natural interval 5 to 7 years), normal precipitation Plant Community A is resilient. Successional processes can readily return Plant Community A to the HCPC. The process can be facilitated by prescribed grazing, the incorporation of the natural fire regime into the system, etc. Prior to the arrival of European man, fire occurred at natural intervals of 5-7 years. This succession can occur during normal precipitation regimes.

Pathway 1.2B
Community 1.2 to 1.3

No fire, non-prescribed grazing, drought (3 to 5 years) Prolonged drought, non-prescribed grazing, and the failure to re-introduce fire into the system will result in retrogression to Community B. The causative factors of regression at a specific site should be apparent with careful observation.

Pathway 1.3A
Community 1.3 to 1.2

Prescribed grazing, fire (natural interval 5 to 7 years), favorable precipitation Favorable precipitation, re-introduction of the natural fire regime, and prescribed grazing are normally required for succession to higher communities (HCPC and/or Community A). Management strategies should focus on grazing deferment to increase vigor and seed production of desirable plants, and to increase litter cover. Increasing litter is extremely critical to protect soils from erosion due to the steepness of the slopes.

State 2
Degraded State

Community 2.1
Plant Community C Short, warm-season perennial grasses, cool-season upland sedges, few medium height cool-season grasses, clubmoss may be present, about 10 percent forbs and 20 percent shrubs, invasive species present, more bare ground

Short, warm-season perennial grasses, cool-season upland sedges, few medium height cool-season grasses, clubmoss may be present, about 10 percent forbs and 20 percent shrubs, invasive species present, more bare ground Community C is dominated by blue grama, prairie junegrass, sandberg bluegrass, plains reedgrass, other short grasses, and clubmoss. There are usually some individual western wheatgrass, bluebunch wheatgrass, etc. plants scattered throughout the Community. The ability of these individuals to persist in this state may be due to the relative inaccessibility of the site to grazing. Red threeawn, Japanese brome and cheatgrass are the most common opportunistic plants that colonize this Community. Wooly plantain, hoods phlox, hairy goldenaster, cudweed sagewort and bastard toadflax are common forbs. Fringed sagewort usually increases. Silver sagebrush and rose may also increase. Pricklypear cactus is common in most locations. The most palatable shrubs are nearly absent. SI indices of less than 25% are probably associated with State 2, but none were recorded during the range inventories on Fort Peck and Fort Belknap Reservations in 2001 and 2004. Because of slope and texture, surface runoff and soil erosion should always be concerns on this site. However, wind and water erosion are critical concerns in State 2. As plant cover and litter decrease, rills, water flow patterns and litter movement become more apparent and the potential for erosion escalates. In comparison to the State 1 plant communities, Plant Community C (State 2) is less efficient in capturing solar energy and converting it to carbohydrates for plant growth. Total aboveground vegetation production averages about 400 lbs/ac. The scarcity of tall and mid cool season perennial grasses, plus the shift from cool season plants to warm season plants, indicates that the structural and functional processes of the site have been disrupted.

Transition T1A
State 1 to 2

Non-prescribed grazing, extended drought (greater than 7 years), no fire Any combination of extended drought, non-prescribed grazing and unfavorable climatic patterns can cause regression from Plant Community B to State 2. As bare ground increases, infiltration decreases and/or surface runoff and soil evaporation increases. Because ecological processes of the site are no longer balanced and sustained, shallow rooted, warm season species continue to gain a competitive advantage over the deep rooted, cool season species. The biotic integrity of the site is degraded (USDI, USDA 2000). Thus, the transition from Community B to State 2 represents a threshold. Thresholds are defined as a point in space and time at which one or more of the primary ecological processes responsible for maintaining the sustained equilibrium of the state degrade beyond the point of self-repair.

Restoration pathway R2A
State 2 to 1

Prescribed grazing, fire (natural interval 5 to 7 years), time, favorable precipitation Succession from State 2 to State 1 is favored by the implementation of prescribed grazing, a favorable precipitation pattern, and the re-introduction of the natural fire regime. The rate of this succession is influenced by the genetic pool of HCPC plants (seed plants, rhizomes, and seed bank) remaining on the site (Dyksterhuis 1949). In rare instances of prolonged favorable climatic conditions combined with proper management, the significant input of energy that is normally required to move this site from across the threshold from State 2 to State 1 may not be needed. More research is needed on this assertion. Because of the steep slopes, mechanical treatments and range seeding are not recommended. Ranchers should be aware of the limitations of this site. Rather than trying to change nature, managers must learn to live within the environmental boundaries of this site.

Additional community tables

Table 10. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Kg/Hectare)	Foliar Cover (%)
Grass/Grasslike					

Grass/Grasslike					
1	**Tall cool-season Bunchgrasses**			67–202	
	green needlegrass	NAVI4	*Nassella viridula*	67–202	–
2	**Medium cool-season Bunchgrasses**			415–874	
	bluebunch wheatgrass	PSSP6	*Pseudoroegneria spicata*	392–673	–
	needle and thread	HECO26	*Hesperostipa comata*	22–202	–
1	**Rhizomatous Wheatgrasses**			202–404	
	western wheatgrass	PASM	*Pascopyrum smithii*	101–202	–
	tufted wheatgrass	ELMA7	*Elymus macrourus*	101–202	–
4	**Warm-season Bunchgrasses**			22–269	
	plains muhly	MUCU3	*Muhlenbergia cuspidata*	22–202	–
	little bluestem	SCSC	*Schizachyrium scoparium*	0–67	–
5	**Miscellaneous Grasses**			11–135	
	threadleaf sedge	CAFI	*Carex filifolia*	11–67	–
	Sandberg bluegrass	POSE	*Poa secunda*	11–67	–
	prairie Junegrass	KOMA	*Koeleria macrantha*	11–67	–
	plains reedgrass	CAMO	*Calamagrostis montanensis*	11–67	–
	blue grama	BOGR2	*Bouteloua gracilis*	11–67	–
	Grass, native	2GN	*Grass, native*	11–67	–
Forb					
6	**Dominant Forbs**			22–135	
	dotted blazing star	LIPU	*Liatris punctata*	11–67	–
	American vetch	VIAM	*Vicia americana*	11–67	–
2	**Clovers**			22–112	
	purple prairie clover	DAPU5	*Dalea purpurea*	11–67	–
	white prairie clover	DACA7	*Dalea candida*	11–67	–
8	**Miscellaneous Forbs**			0–45	
	Forb, native	2FN	*Forb, native*	0–56	–
	Missouri goldenrod	SOMI2	*Solidago missouriensis*	0–56	–
	common yarrow	ACMI2	*Achillea millefolium*	0–56	–
	aster	ASTER	*Aster*	0–56	–
	scarlet globemallow	SPCO	*Sphaeralcea coccinea*	0–56	–
	scurfpea	PSORA2	*Psoralidium*	0–56	–
	hairy false goldenaster	HEVI4	*Heterotheca villosa*	0–56	–
	prairie thermopsis	THRH	*Thermopsis rhombifolia*	0–56	–
	pussytoes	ANTEN	*Antennaria*	0–56	–
	bastard toadflax	COUM	*Comandra umbellata*	0–56	–
	white milkwort	POAL4	*Polygala alba*	0–56	–
	milkvetch	ASTRA	*Astragalus*	0–56	–
	groundplum milkvetch	ASCR2	*Astragalus crassicarpus*	0–56	–
	beardtongue	PENST	*Penstemon*	0–56	–
	spiny phlox	PHHO	*Phlox hoodii*	0–56	–
	buckwheat	ERIOG	*Eriogonum*	0–56	–
	lesser spikemoss	SEDE2	*Selaginella densa*	0–1	–

Shrub/Vine					
9	**Dominant Shrubs**			27–135	
	winterfat	KRLA2	*Krascheninnikovia lanata*	13–67	–
	Nuttall's saltbush	ATNU2	*Atriplex nuttallii*	13–67	–
10	**Miscellaneous Shrubs**			0–90	
	rubber rabbitbrush	ERNA10	*Ericameria nauseosa*	0–67	–
	silver sagebrush	ARCA13	*Artemisia cana*	0–67	–
	snowberry	SYMPH	*Symphoricarpos*	0–67	–
	prairie sagewort	ARFR4	*Artemisia frigida*	0–67	–
	rose	ROSA5	*Rosa*	0–67	–
	creeping juniper	JUHO2	*Juniperus horizontalis*	0–67	–
	broom snakeweed	GUSA2	*Gutierrezia sarothrae*	0–67	–
	Shrub (>.5m)	2SHRUB	*Shrub (>.5m)*	0–67	–
	plains pricklypear	OPPO	*Opuntia polyacantha*	0–1	–
	brittle pricklypear	OPFR	*Opuntia fragilis*	0–1	–

Animal community

Livestock Management
This site evolved with trampling, defoliation (ungulates, grasshoppers and jackrabbits, and other herbivores), fire and drought. The site is moderately resistant and resilient to disturbances which may alter its ecological processes. Following perturbations such as drought, which allows blue grama and other lower successional plants to increase at the expense of the mid and tall grasses, succession occurs with subsequent rainfall. Thus, the HCPC, or Communities A or B may be present at any given time in State 1. During “average” years, the site has the potential to produce 1200 lbs of forage per acre.
Forage production shows far greater variations in response to changes in annual precipitation than to different grazing intensities (Heitschmidt et al 2005). However, proper stocking rates and prescribed grazing is needed to ensure that the site remains in State 1. Without proper grazing management the mid-to-tall grass community will transition to State 2 plant community species. In comparison to State 1, suggested stocking rates on sites in State 2 represent a 4-fold reduction. Experience indicates that prescribed grazing prevents further deterioration in State 2. However, significant plant succession may not occur within a reasonable time frame.
Death camas, milk vetch (Astragalus spp.), and white point loco may occur on this ecological site. However, in the Glaciated Plains there are few reported incidences of livestock losses from these potentially poisonous plants. It is likely that forage production and livestock numbers are balanced, and livestock are not forced to graze the plant when it is most toxic.
This site is suitable for livestock grazing from May through October. The grass dominated plant community is better suited for cattle, rather than sheep grazing.
However, sheep are better adapted to grazing the steep slopes, especially if watering facilities are relatively distant. Therefore, a mix of cattle and sheep usage often merits consideration.

Wildlife Interpretations
State 1 of the Clayey-Steep 10-14” p.z. ecological site includes the HCPC and two additional communities. This state provides forage for mule deer during most of the year. Low shrub cover limits the potential of the site for thermal and escape cover. Most deer use occurs along the edges of the site where it borders woody draws, badlands, etc.
Species diversity and cover associated with the HCPC or other communities in the Reference State (State 1) also provide habitat for sharp-tailed grouse and other upland birds. Most wildlife usage occurs along the transitions between the Clayey-Steep 10-14” p.z. site and deciduous wooded draws. The relative absence of big sagebrush limits the potential of this site for sage grouse habitat. The few sage grouse that exist in the Glaciated Plains are usually associated with silver sagebrush.
Species diversity and litter also provide favorable habitats for deer mice, rabbits and other small mammals. Golden eagles, redtail and ferruginous hawks are often circling over the landscape searching for prey.
Communities that are in State 2 are much less suitable for big game, upland birds and most species of small

mammals. Prairie dogs usually are not found inhabiting Clayey-Steep sites because slopes exceed 15%. Prairie dogs typically prefer upland sites of <8% slope.

Plant Preferences by Animal Kind
Refer to NRCS Field Office Technical Guide, Section IIE, General Information, for tables displaying plant preferences by livestock and wildlife.

Hydrological functions

Soils associated with this ecological site are in Hydrologic Soil Groups B and C. Infiltration rates are generally moderate to slow. Permeability class is very slow. The runoff potential is high to very high, depending on slope and ground cover.
Good hydrologic conditions exist on Clayey-Steep 10-14” p.z. sites that are either in a high seral state or at the HCPC (State 1). Canopy cover (grasses, forbs and shrubs) is greater than 80% in these communities, which is conducive to moderately high infiltration rates and minimizes runoff and erosion.
Communities in early seral states (State 2) are generally considered to be in poor hydrologic condition. The potential for soil erosion increases in State 2. Plant cover and litter are inadequate to protect the soil surface and the amount of bare ground is excessive. As infiltration decreases, surface runoff and soil erosion increases. Thus, the site gradually becomes more xeric and also loses much of its organic matter and nutrients that are needed for the growth of higher successional plants.

Recreational uses

Hunters are probably the most common recreational user of this ecological site. The site is also used by hikers and photographers. The Clayey-Steep 10-14” p.z. site that is located near roads and towns often show symptoms of exuberant off-road ATV use. Unauthorized ATV use on this site increases susceptibility to erosion and to noxious weed invasion.

Wood products

This site has no significant value for wood products.

Other information

The Clayey-Steep 10-14” p.z. ecological site in the Glaciated Plains is resistant to perturbations. However, the site loses its resiliency when the plant community regresses from State #1 to State #2. Reproductive capability of higher successional plants and annual aboveground production decline as the site moves toward the threshold separating State #1 from State #2. Production in State #2 is less than 1/4 of the potential at HCPC. Thus, litter and the number of plant structural/functional groups are adversely affected.

Inventory data references

Data Source Number of Records Sample Period State County
SCS-Range-417 (#501) 1972 MT Phillips
ECS-1
Modified Double Sampling 5 2001-2004 MT Blaine, Roosevelt, Sheridan,
Phillips, Valley
USDA-SCS-MT. 1981. Technical Range Site Description

Other references

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Dyksterhuis, E. J. 1949. Condition and management of rangeland based on quantitative ecology. J. Range Manage. 2:104-115.
Frost, Cecil C. 1998. Presettlement fire frequency regimes of the United States: a first approximation. Pages 70-81

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Contributors

Kirt Walstad

Approval

Kirt Walstad, 1/24/2024

Acknowledgments

Site Description Revisions
The 2005 Clayey-Steep 10-14” p.z. ecological site description replaces earlier dated versions of Clayey-Steep 10-14” p.z., Thin Clayey 10-14” p.z. and Thin Hilly 10-14” p.z. descriptions in Rangeland Resource Unit 52XN. This 2005 revision incorporates the State and Transition Model theory, additional data on site productivity, and an improved understanding of many rangeland health indicators.
Site Description Approval
This ecological site description is approved with the understanding that it is no more than another step in our continual effort to update the NRCS technical guide. In order to facilitate the process, NRCS field personnel are encouraged to forward existing information and/or new data that can be used to improve the utility of this site description. Please forward the information and data to the State Rangeland Management Specialist.
Authors Date Approval Date
Dr. John Lacey 02/28/2005 Loretta J. Metz 03/19/2005
Maxine Rasmussen, Area RMS, Glasgow, MT
Jon Siddoway, Area RMS, Great Falls, MT
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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)	Siddoway/Bandy
Contact for lead author	Great Falls Area Office, Great Falls, MT Reference site used? No
Date	04/19/2005
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** Slopes most common on this site are between 15–45% and with at least 90% of the soil surface well-covered, rills, if evident will be rare, but may occur in bare areas after extreme convection storms – rills in this case would be narrow and less than 5 feet in length.

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2. **Presence of water flow patterns:** Will be rare, generally, on this site, but with the steeper slopes, and up to 10% bare ground, there may be areas which show accumulations of litter due to water movement, especially after severe storms.

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3. **Number and height of erosional pedestals or terracettes:** Wind and water erosion will be rare on this site, but with the
steeper slopes there may be rare plants that could have pedestals which could be 0.5 inch in height.

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4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Bare ground should be 10% or less on this site.

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5. **Number of gullies and erosion associated with gullies:** Gully erosion will not be evident on this site.

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6. **Extent of wind scoured, blowouts and/or depositional areas:** Appearance or evidence of these erosional features or the landscape would not be present on this site.

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7. **Amount of litter movement (describe size and distance expected to travel):** Because there is little bare ground, litter movement will be minimal at most. Because the site is dominated by the taller bunchgrasses, litter size will reflect the height and
diameter of the reproductive culms and leaves of these grasses as well as the lesser dominate mid-size grasses.

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8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Resistance to erosion will be high with soil stability values of 5 or 6; areas of bare soil on this site may have values between 1 and 4 if not under plant canopy.

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9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface structure is granular; A horizon depth is 1 – 3”.

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10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Dominance of taller, deep rooted bunchgrasses will maximize infiltration and minimize runoff throughout the site.

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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):** Will not be present generally, but there may be areas that have “healed” from former bison trails and wallows as well as more current livestock trails which could have a compaction layer below the soil surface.

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: Cool season, taller grasses (Bluebunch wheatgrass) >> cool season mid-grasses (Needleandthread) = cool season rhizomatous grasses (Western wheatgrass) > cool season short grasses (Sandberg bluegrass) = shrubs > warm season shortgrass (Blue grama) = perennial forbs.

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Will be low for all functional groups in a given year. Prolonged droughts which last more than 3 years may show increases in mortality and decadence for all plant groups.

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):** 850 - 1450 #/acre. This would be the expected production for the reference state during adequate moisture years. 1200 pounds would be the expected production in a 12 inch precipitation zone.

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:** Blue grama, Red threeawn, Japanese brome, a variety of annual or biennial weedy forbs, fringed sagewort, broom snakeweed, prickly pear cactus, cheatgrass.

17. **Perennial plant reproductive capability:** During adequate moisture years bunchgrasses will generally produce seeds, however the cool season rhizomatous grasses may not necessarily produce seed even with adequate moisture.