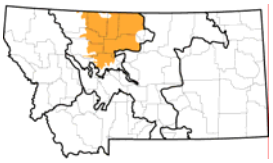
UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

ECOLOGICAL SITE DESCRIPTION



ECOLOGICAL SITE CHARACTERISTICS

Site Type: Rangeland

Site Name: Shallow to Gravel 10 -14 inch p.z. (precipitation zone)

Site ID: R052XN176MT

Major Land Resource Area: 52XN - Northern Glaciated Plains

Physiographic Features: This ecological site occurs on nearly level to steep terraces and knolls. Slopes usually range from 0 to 15%, can occur on slopes greater than 15%. Elevations normally vary from 2,200 to 3,500 feet.

Land Forms:
(1) outwash terrace
(2) alluvial fan
(3) knoll

	Minimum	Maximum
Elevation (feet):	1875	3800
Slope (percent):	0	35

Water Table Depth (inches):

Flooding:

Frequency: none
Duration: none

Ponding:

Depth (inches): none
Frequency: none
Duration: none

Runoff Class: low to high

Aspect: occurs on all aspects

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).

	Minimum	Maximum
Frost-free period (days):	74	113
>32F, 90% probability = Minimum 50% probability = Maximum		
Freeze-free period (days):	111	135
>28F, 90% probability = Minimum 50% probability = Maximum		
Mean annual precipitation (inches):	10	14

Climate Stations:
(1) #241722 - Chinook
(2) #241692 - Chester
(3) #243996 - Havre WSOAP
(4) #245340 - Malta 35S
(5) #247500 - Shelby
(6) #248939 - Whitewater

Influencing Water Features

This site is not influenced by water from wetlands or streams.

Representative Soil Features

These soils are moderately deep to very deep. Depth to sand and gravel is typically 10-20 inches. The soils occupy uplands and side slopes of valleys. These are well drained soils that formed in gravelly alluvium. Permeability class is moderate to moderately slow. The surface textures are loam, sandy loam and fine sandy loam. Subsurface textures are usually clay loam and sandy clay loam. The upper 10-12 inches of the soil has less gravel than the next 8-10 inches. Soil ph varies from 6.6 to 9.0. This site is characterized by the following soil components: Beaverell.

Predominant Parent Materials:
Kind: alluvium
Origin: mixed
Surface Texture: (1) loam
(2) sandy loam
(3) fine sandy loam
Surface Texture Modifier: (1) gravelly

Subsurface Texture Group: Loamy
Surface Fragments < = 3" (% cover): 0-15
Surface Fragments >3" (% cover): 0
Subsurface Fragments < = 3" (% Volume): 16-19

Subsurface Fragments > 3" (% Volume): 5-21
Drainage Class: Well
Permeability Class: Moderate to Moderately slow

	Minimum	Maximum
Depth (inches):	20	60
Electrical Conductivity (mmhos/cm):	0	4
Sodium Adsorption Ratio:	0	8
Calcium Carbonate Equivalent (percent):	0	10
Soil Reaction (1:1 Water):	6.6	9.0
Soil Reaction (0.1M CaC12):	---	---
Available Water Capacity (inches):	2	3

Plant Communities

Ecological Dynamics of the Site

This site developed through time under the influence of climate, geological materials, fire, plants and animals. Research on upland ecological sites consistently shows that precipitation is the principal factor altering productivity (Heitschmidt et al. 2005). The same authors concluded that grazing reduces herbage standing crop, whereas its effects on aboveground net primary production vary with timing of grazing and precipitation events, along with the functional and structural composition of the plant community. Some ecologists believe that these lands may have burned on a natural interval of 10-12 years (Frost 1998). However, environmental characteristics of this site limit herbage production and subsequent fuel accumulation. Therefore, in comparison to normal upland range sites, the role of natural fire is probably less significant in the development of this site.

The resultant historic climax plant community (HCPC) is the basis for plant community interpretations. The HCPC has been determined by evaluating rangeland relic areas, and other areas protected from excessive disturbance.

The HCPC is comprised of a mixture of cool and warm season grasses, forbs and shrubs. About 85% of the annual production is from grasses and sedges, most of which is produced during the cool season. Forbs and shrubs contribute 10% and 5%, respectively, to total annual production. Total vegetative production averages 1000 lbs/ac in normal years, 700 lbs/ac in "unfavorable" years, and 1200 lbs/ac in "favorable" years.

This site is resistant to disturbance when late-successional plants dominate the site. Departures from the HCPC generally result from management actions, drought, and/or a change in the natural fire regime. The site is considered fragile in the sense that vegetative vigor and composition will rapidly decline with continued adverse impacts. Plant communities that retain a high percentage of late successional species are resilient. With favorable precipitation and/or

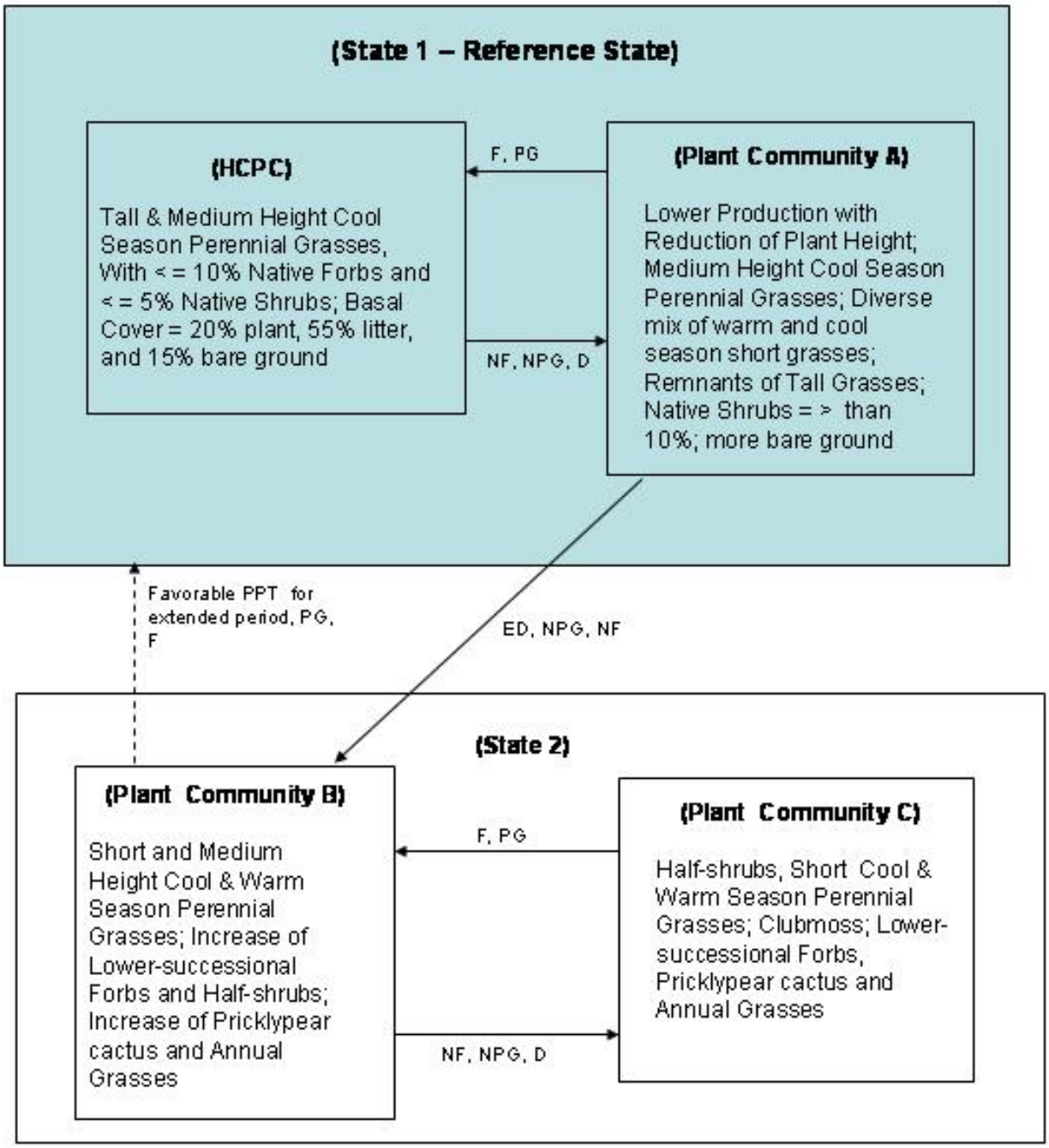
prescribed grazing treatments these plant communities can return to the HCPC. In contrast, significant succession is unusual within early-seral communities.

State and Transition Diagram

Successional pathways of Shallow to Gravel 10-14" p.z. ecological sites cannot be satisfactorily described using traditional theories of plant succession leading to a single climax community (Briske et al. 2005). As the HCPC regresses to an early seral state, it is theorized that a threshold is crossed somewhere within the mid-seral state. Plant communities occurring below this threshold are in a steady state. Succession back to the HCPC often does not occur within a reasonable length of time, or without a large input of energy.

Two plant communities and the successional pathways that commonly occur within the Reference State (State #1) are shown in the following diagram. The transition from State #1 to State #2, and two plant communities representative of State #2 are also illustrated. Ecological processes are discussed in the plant community descriptions that follow the diagram.

Shallow to Gravel 10-14" p.z. RRUs 52XC and 52XN



LEGEND:

NF – No Fire
F – Fire
NPG – Non-Prescribed Grazing
PG – Prescribed Grazing
D – Drought (3-5 years)
PD – Prolonged Drought (5-7 years)
ED – Extended Drought (> 7 years)
PPT -- Precipitation

State #1: Historic Climax Plant Community (HCPC):

Three cool season perennial grasses (western wheatgrass, thickspike wheatgrass and bluebunch wheatgrass) are the dominant plants in this community. They account for about 75% of the total annual production in the HCPC. One high-successional warm season short grass (plains muhly) commonly occurs in the HCPC communities, while the distribution of a second species (little bluestem) is restricted to the central glaciated plains (RRU 52XC). Drought and non-prescribed grazing reduces the competitiveness of the dominant species, and allows lower successional grasses (plains reedgrass, prairie junegrass, needleandthread, sandberg bluegrass, and blue grama) to increase on the site. Although it is a fairly palatable cool season grass, needleandthread is well-adapted to the droughty conditions of this site, and acts as an indicator species. Needleandthread's contribution to total annual production varies from < 5% in the HCPC to > 30% in the early seral state. About 10% of the total production is made by a mix of warm and cool season short grasses and sedges.

Forbs contribute about 10% of the total annual production. Two warm season legumes (purple and white prairie clover) and a cool season legume (American vetch) are important components of the HCPC. They fix nitrogen, and are highly palatable forage for livestock and many species of wildlife. Scurfpea is another warm season legume that fixes nitrogen, but it is not a desirable forage plant. Dotted gayfeather is another high-successional warm season species that occurs in the HCPC communities. Stemless hymenoxys, scarlet globemallow, white milkwort, hairy goldenaster, prairie coneflower, manyflowered aster, green sagewort, hoods phlox and biscuitroot may occur in the HCPC, but should contribute no more than a few pounds of annual production per acre. The latter group contains a mix of warm and cool season species whose relative occurrence on the site is largely influenced by the timing and amount of precipitation.

Creeping juniper, yucca, silver sagebrush and fringed sagewort are common shrubs. Although these species have some value as browse for deer and antelope, they are highly valued as forage. Pricklypear cactus and brittle cactus may occur as a trace or very small components of the total community. Shrubs normally make up about 5% of the total annual production.

Dense clubmoss, often occurs as a minor component in the HCPC. However, it often increases when the plant community is stressed by drought or other environmental factors. Although it is difficult to explain the density of clubmoss in specific communities, some soil scientists believe that heavy infestations of dense clubmoss are associated with the presence of an argillic layer in the soil. Broom snakeweed, annual bromes, and annual forbs are not a part of the HCPC. Their presence indicates possible ecological deterioration or downward trend.

Total annual production averages 1000 lbs/ac during normal years. However, production declines as the site regresses from the HCPC to lower successional communities. Regression may result from grazing management strategies that do not allow adequate recovery periods between grazing events, drought, and/or the disruption of the normal fire regime. The above disturbances favor the replacement of bluebunch wheatgrass, plains muhly, thickspike wheatgrass and western wheatgrass by lower successional species (blue grama, sandberg bluegrass, prairie junegrass, scarlet globemallow, etc.). Young fringed sagewort plants become more apparent as range health declines. Cheatgrass and Japanese brome may invade the site. As the result of these vegetative changes, there is less litter to protect the soil and less infiltration. Hydrologic cycles are impaired when plant communities are unable to effectively use precipitation.

Plant basal cover averages about 20%, while litter varies from 50-60%. Bare ground averages 15%. Although runoff and erosion are not major concerns in the HCPC, they are increasing concerns as the HCPC regresses to earlier seral states.

(Insert HCPC Plant Community photo)

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 moisture cycle.

Historic Climax Plant Community Plant Species Composition:

GRASSES /GRASSLIKES					Annual Production in
85% of Community			Group Allowable		Pounds Per Acre
Common Name	Scientific Name	Group	Pounds Per Acre		Low	High
			Low	High		
Bluebunch wheatgrass	*Pseudoroegneria spicata*				400	700
Western wheatgrass	*Pascopyrum smithii*	1	100	250	50	125
Thickspike wheatgrass	*Elymus macrourus*	1			50	125
Plains muhly	*Muhlenbergia cuspidata*				100	200
Little bluestem	*Schizachrium scoparium*				50	150
Needleandthread	*Hesperostipa comata*				150	300
Blue grama*	*Bouteloua gracilis**				0	50
Sand dropseed*	*Sporobolus cryptandrus**		*100 lbs/ac is max		0	50
Plains reedgrass*	*Calamagrostis montanensis**		allowed for all		0	50
Threadleaf sedge*	*Carex filifolia**		species in this group;		0	50
Needleleaf sedge*	*Carex duriuscula**		no more than 30 lbs		0	50
Sandberg bluegrass*	*Poa secunda**		for any one species.		0	50
Praire junegrass*	*Koeleria macrantha**				0	50
Other native grasses*					0	50

FORBS		Annual Production in
10% of Community	Group Allowable	Pounds Per Acre

Common Name	Scientific Name	Group	Pounds Per Acre		Low	High
			Low	High		
American vetch	*Vicia americana*				50	100
Purple prairieclover	*Dalea purpurea*	4	100	200	50	100
White prairieclover	*Dalea candida*	4			50	100
Scarlet globemallow*	*Sphaeralcea coccinea**				0	50
Aster*	*Aster spp.**				0	50
Scurfpea*	*Psoralidium spp.**		100 lbs/ac is		0	50
Western yarrow*	*Achillea millefolium**		maximum allowed for		0	50
Bastard toadflax*	*Comandra umbellate**		all forbs.		0	50
Milkvetch*	*Astragalus spp.**				0	50
Hoods phlox*	*Phlox hoodii**		*60 lbs/ac is max		0	50
Onion*	*Allium spp.**		allowed for total		0	50
Dense clubmoss	*Selaginella densa*		group; No more than		0	T
Other native forbs*			20 lbs/ac for a single species within these groups.		0	50

SHRUBS AND HALF-SHRUBS
5% of Community

Common Name	Scientific Name	Group	Group Allowable Pounds Per Acre		Annual Production in Pounds Per Acre Low	High
			Low	High		
Creeping juniper	*Juniperus horizontalis*				0	50
Yucca	*Yucca glauca*				0	50
Silver sagebrush	*Artemisia cana*				0	50
Fringed sagewort	*Artemisia frigida*				0	50
Prairie rose	*Rosa arkansana*		50 lbs/ac is the max		0	50
Broom snakeweed	*Gutierrezia sarothrae*		allowed for all shrubs.		0	50
Plains pricklypear	*Opuntia polyacantha*				0	T
Brittle pricklypear	*Opuntia fragilis*				0	T
Other native shrubs					No more than 20 lbs/ac for any one species.	

Structure and Cover

Soil Surface (%)

Basal Cover				Non-Vascular Plants	Biological Crust	Litter	Surface Fragments >1/4 & <= 3"	Surface Fragments > 3"	Bedrock	Water	Bare Ground
Grass/ Grasslike	Forb	Shrub/ Vine	Tree								
15	1-5	1-5	0								

Ground Cover (%)

Vegetative Cover						Non-Vegetative Cover					
Grass/ Grasslike	Forb	Shrub/ Vine	Tree	Non-Vascular Plants	Biological Crust	Litter	Surface Fragments >1/4 & <= 3"	Surface Fragments > 3"	Bedrock	Water	Bare Ground
			0	0-1	0-1	55	0-T	0-T	T	0	15

Structure of Canopy Cover (%)

	Grass/Grasslike	Forb	Shrub/Vine	Tree
<= 0.5 feet	20	25	T	0
>0.5 - <=1 feet	50	50	40	0
>1 - <=2 feet	25	25	50	0
>2 - <=4.5 feet	5		10	0
>4.5 - <=13 feet				0
>13 - <= 40 feet				0

Annual Production by Plant Type:

Plant	Annual Production (lbs/AC)		
Type	Low	RV*	High
Grasses/Grasslike	600	850	1020
Forb	20	50	60
Shrub	80	100	120
Total	700	1000	1200

*RV means "representative value".

***Successional Pathway from HCPC to Plant Community A:**
Non-prescribed grazing, drought and/or a cessation of the natural fire regime will cause regression from HCPC to Community A.

Plant Community A (State #1):

Non-prescribed grazing and drought reduce plant height and plant litter. Total annual production is about 80% of production in the HCPC. Surface runoff and soil temperature increases, and infiltration decreases. Shallow-rooted short grasses (sandberg bluegrass, blue grama, and prairie junegrass) and sedges gain a competitive advantage over medium height, deep-rooted perennial grasses (bluebunch wheatgrass, thickspike wheatgrass and western wheatgrass). They are able to compete more successfully with the mid-grasses because of the ability of relatively shallow root systems to utilize shallowly penetrating moisture.

Western wheatgrass, bluebunch wheatgrass, and thickspike wheatgrass contribute from 40-50% of the total annual production. Vigor of these high successional grasses declined, and individual plant growth is reduced from what it is in the HCPC. Production of the short grasses increases to about 35% of total annual production. Forb production increases (> 15% of total annual production) significantly above production in the HCPC. Fringed sagewort increased, but total shrub production remains at about 5% of total annual production.

Plant community A is called the "pre-threshold community". It is critical that this community be recognized. Range inventory data collected by the NRCS on Fort Peck and Fort Belknap Reservations from 2001-2004 indicate that this community is characterized by 10-12% needleandthread and 25-35% short grasses. Compared to the HCPC, water flow patterns are more numerous than expected, there is slight to moderate active pedestalling, there is more bare

ground than expected, there is moderate movement of smaller size litter deposits into depressions or up against obstructions, infiltration is slightly to moderately affected by the shift toward more short grasses in the plant community. The reproductive capabilities of bluebunch wheatgrass and western wheatgrass are somewhat limited relative to recent climatic conditions (USDI and USDA 2000). Except for in the western portions of the Glaciated Plains where it often remains as the dominant species, bluebunch wheatgrass composition significantly declines in the central glaciated plains. Community A is less resilient and much less resistant than the HCPC. Although it can improve to the HCPC through successional processes, further disturbance will result in regression to a lower state. Once Community A regresses to a lower state, normal successional processes are often restricted.

(Insert Plant Community A photo)

***Successional Pathway from Community A to HCPC:**
Favorable growing conditions, the implementation of prescribed grazing, or periodic fire will move Plant Community A to the HCPC. This succession is possible within a couple of years.

***Transition from Community A (State #1) to State #2:**
Community A will regress to Communities B or C in State #2 under non-prescribed grazing, prolonged drought, or an extended period lacking a natural fire regime. The rate of regression varies with the intensity of the disturbances. Severe drought may cause retrogression within a couple of years.

Plant Community B (State #2):

This Community is dominated by a mix of short height, cool and warm season grasses. Western wheatgrass and bluebunch wheatgrass represent less than 10% of total annual production. Blue grama, threadleaf sedge, sandberg bluegrass and other low successional grasses expanded their influence in the community. Needleandthread represents about 30% of total annual production.

Hoods phlox, wild onion, western yarrow, green sagewort, scarlet globemallow and clubmoss increased and now contribute 15-20% of the total annual production. Clubmoss cover is often positively related to the presence of an argillic horizon in the soil. The density of fringed sagewort and broom snakeweed (warm season half-shrubs) increased relative to their presence in the higher successional communities. Pricklypear and brittle cactus are usually present in this community. Japanese brome, cheatgrass, and other annual plants are present in most disturbed areas.

Total annual production varies from 200-400 lbs/ac. In comparison to the HCPC, litter varies from 20-30%. Bare ground increases to 30-40%.

Plant Community C (State #2):

This community is dominated by fringed sagewort and broom snakeweed. Silver sagebrush and pricklypear cactus are usually present. Short grasses (blue grama, prairie junegrass, sandberg blue grass, etc.) contribute from 50-60% of the total annual production. The short grasses, along with clubmoss often form a dense sod. Needleandthread contributes another 30% of the total annual

production. High-successional perennial grasses contribute less than 5% of total annual production. Japanese brome and cheatgrass occur in disturbed areas, and as scattered plants dispersed throughout the shortgrass sod.

Total annual production varies from 200-350 lbs/ac. Litter averages 15%. Bare ground usually varies from 20-35%.

***Successional Pathways between Communities B and C:**
Communities B and C are resistant to disturbances. However, they do not have a precise assemblage of species for which the proportions are the same from place to place or from year to year. Variability is apparent in productivity and occurrence of individual species. Environmental factors such as rainfall, grazing pressure, and fire will cause species composition shifts within these communities. Community B usually shifts toward C with adverse conditions, while Community C tends to shift to B with favorable conditions.

***Transition from Communities B & C (State #2) to State #1:**
Communities B and C are resistant to change and do not readily shift to another State. Prescribed grazing reduces the probability of further regression in this State, but it does not ensure significant succession to State #1. In some places the soil and hydrology of the site has been altered by the shift from tall and mid grasses in the HCPC to the short grasses and half shrubs in these communities. Therefore, these communities represent a steady state, and they often remain there. Steady-state plant communities change only as a result of natural events that are beyond the normal range of events or as a result of human actions. An extended period of favorable precipitation combined with prescribed grazing and the re-introduction of fire into the system may induce significant succession (Branson and Miller 1981). This potential is depicted by the dashed line in the state and transition diagram. Mechanical treatments and range seeding are not normally recommended on this site.

Ecological Site Interpretations

Animal Community

Livestock Management

The Shallow to Gravel 10-14" p.z. ecological site is fairly productive and is suited for livestock grazing. However, prescribed grazing management is needed. This site is often associated with slopes that may be susceptible to erosion. Species composition is favorable to livestock and is susceptible to heavy stocking and season long grazing. The cool season medium height grasses are generally selectively grazed giving the short grasses a competitive advantage. Grazing during early spring may also result in soil compaction. Any additional factor reducing infiltration and increasing runoff on this site is a management concern. Shorter grazing periods developed in conjunction with adequate periods of deferment to facilitate regrowth, replenish carbohydrate pools, and accumulate litter on the soil surface are recommended.

This ecological site, as do most other sites in the northern mixed prairie, has a short grass component. The short grasses usually increase with grazing and decrease with protection or prescribed grazing. However, succession in direct

response to a change in grazing pressure is not guaranteed in the Northern Great Plains.

Sampling four-year old ungrazed exclosures and grazed areas with 35% utilization, Vogel and Van Dyne (1966) found essentially the same basal cover of grasses, sedges, forbs, litter and bare soil on protected and grazed sites. They concluded that four years was too short of a time for cover to change significantly. Hofmann and Ries (1989) observed similar results following a four-year study in North Dakota. Even after 41 years of exclosure, changes in species composition can be relatively small when the site is in the dry, low production portion of northern mixed prairie (Brand and Goetz, 1986). They concluded that site characteristics limited the development of potential vegetation with the exclusion of grazing, but the potential impacts of prescribed grazing on succession were not discussed. This ecological site is not as productive as the sites evaluated by Vogel and Van Dyne, Hofmann and Ries, or by Brand and Goetz. Therefore, range managers should recognize the environmental limitations of this site. While a prescribed grazing system is always a good recommendation, it may not guarantee significant succession.

Poisonous plants are not normally a problem on this site. Losses that do occur are usually result in livestock being forced to consume the poisonous plants because of an inadequate supply of desirable forage.

Wildlife Interpretations

The HCPC associated with this ecological site provides diverse and valuable wildlife habitat. This site often occurs as a mosaic with other ecological sites, thus creating "ecotones" that serve as a magnet to attract many species of wildlife. Antelope and mule deer prefer grazing this site because of its position in the landscape. However, its value for thermal and escape cover is limited by the lack of shrubs.

This ecological site becomes less valuable for deer and antelope when plant diversity declines with regression. For example, the disappearance of the bluebunch wheatgrass and western wheatgrass shorten the length of the "green forage" season. The increase of blue grama, hoods phlox, etc. is associated with the loss of palatable forbs. These changes also adversely impact foraging opportunities for deer, antelope, upland birds, etc. Because of insufficient vegetative structural diversity, residual grass carry-over and litter cover, the value of Plant Communities in State #2 are greatly reduced for wildlife habitat.

Hydrology Functions

Water is the main factor limiting vegetative production on this site. Soil components in this ecological site are normally classed into Hydrologic Group B. When cover conditions are good, these soils have a low runoff potential.

Recreational Uses

This site provides hunting opportunities for upland game species. Outdoor enthusiasts may also appreciate the serenity and openness of this site.

Wood Products

This site has no significant value for wood products.

Other Products

Other Information

This ecological site is not highly resistant to disturbances. Species diversity is adversely affected by season-long continuous grazing and by heavy stocking. Medium height grasses are replaced by short grasses. The number of structural/functional groups is reduced with regression from the HCPC. The amount of solar energy that is captured and converted to carbohydrates for plant growth is reduced in State #2. A reduction in total vegetative growth results in less potential vegetation that can be transformed into litter. Litter reductions result in less infiltration, and more runoff and soil erosion.

Supporting Information

Associated Sites The following sites may be found in association with the Shallow to Gravel 10-14" p.z. ecological site. The Site ID indicates in which Rangeland Resource Units (RRU) these sites occur. For example, Site ID R052XN162MT occurs in RRU 52XN.

Site Name	Site ID	Site Narrative
Clayey 10-14" p.z.	R052XN162MT	soils >20 inches in depth, higher production, and no hardpan, different species composition
Overflow 10-14" p.z.	R052XN166MT	different position on landscape, site benefits from extra moisture, more production, different species, permanent water table > 42 inches
Shallow clay 10-14" p.z.	R052XN179MT	soils 10-20" deep to bedrock' soils are clayey over clayey shale
Shallow 10-14" p.z.	R052XN178MT	soil depth less than or equal to 20 inches to a restrictive layer; less forage production; parent material variable

Dense Clay 10-14" p.z.	R052XN172MT	has a hard restrictive layer in the soil at or near the surface, salt tolerant plants may be present but are rarely dominant

Similar Sites

Site Name	Site ID	Site Narrative
Shallow to Gravel 10-14" p.z.	R052XC216MT R053AE079MT	

State Correlation

This site has been correlated with the following states: Montana

Inventory Data References

Data Source	Number of Records	Sample Period	State	County
SCS-Range-417	0			
ECS-1				
Modified Double Sampling	12	2002-2004	MT	Phillips, Blaine, Valley, Roosevelt, Daniels

Ross, R. L. and H. E. Hunter. 1976. Climax vegetation of Montana. USDA Soil Conservation Service. Bozeman, MT.

USDA-SCS-MT 1981 Technical Range Site Description

Type Locality

State: MT
County:
Township:
Range:
Section:
UTM: Datum: NAD__ _____E ____N
General Description:
Sensitivity: Yes___ No___

Relationship to Other Classifications:

Other References

Brand, M.D. and H. Goetz. 1986. Vegetation of exclosures in Southwestern North Dakota. J. Range Manage. 39:434-437.

Branson, F. A., and R. F. Miller. 1981. Effects of increased precipitation and grazing management on northeastern Montana rangelands. J. Range Manage. 34(1): 3-11.

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Frost, C. C. 1998. Presettlement fire frequency regimes of the United States: a first approximation. Pages 70-81. in Teresa L. Pruden and Leonard A. Brennan (eds.). Fire in ecosystem management: shifting paradigm from suppression to prescription. Tall Timbers Fire Ecology Conference Proceedings. No. 20. Tall Timbers Research Station, Tallahassee, FL.

Heitschmidt, R. K., K. D. Klement, and M. R. Haferkamp. 2005. Interactive effects of drought and grazing on Northern Great Plains rangelands. Rangeland Ecol. Manage. 58:11-19.

Hofmann, L. and R.E. Ries. 1989. Animal performance and plant production from continuously grazed cool-season reclaimed and native pastures. J. Range Manage. 42:248-251.

U.S. Department of Interior and U.S. Department of Agriculture. 2000. Interpreting indicators of rangeland health. Tech. Ref. 1734-6.

Vogel, W.G. and G.M. Van Dyne. 1966. Vegetation responses to grazing management on a foothill sheep range. J. Range Manage. 19:80-85.

Site Description Revisions

The 2005 Shallow to Gravel 10-14" p.z. ecological site description replaces earlier dated versions of the Shallow to Gravel 10-14" p.z. description 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
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