Ecological Sites of North Dakota

A PICTORIAL GUIDE OF ECOLOGICAL SITES COMMON TO NORTH DAKOTA

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Herbage production will vary by ecological site within an area or between areas of a state due to differences in soil, water and topographical relationship. These areas are categorized by the USDA Natural Resource Conservation Service (NRCS) as Major Land Resource Areas (MLRA). Major ecological site factors that influence kinds and amounts of plants produced include:

- Surface soil depth
- Soil texture
- Available soil moisture
- Land slope and exposure
- Precipitation
- Soil fertility and salinity

The kind and amount of vegetation produced on an ecological site will vary within an area due to soil type differences and topography or location on the landscape (Figure 1). Vegetation production differences are due primarily to plant and soil moisture relationships.

**Major Land Resource Areas (MLRAs)**

Major Land Resource Areas (MLRAs) are geographically associated land resource units. Identification of these large areas is important in statewide agricultural planning and has value in interstate, regional and national planning. The NRCS has recognized 278 MLRAs that are designated and identified by a descriptive geographic name. An MLRA is a broad geographic area that is characterized by a particular pattern of soils, climate, water resources, vegetation and land use. Eight MLRAs represent the majority of North Dakota (Figure 2).

Each MLRA will comprise numerous ecological sites due to this broad pattern of soils, vegetation and water resources. However, not all ecological sites described in this publication will be found in every MLRA or region of the state. Refer to Table 1 (page 4) for a list of ecological sites found in North Dakota and the MLRA with which they may be associated.
Table 1. Ecological Site Descriptions (ESD) identified in North Dakota by Major Land Resource Area (MLRA), the accepted abbreviation for the ecological site and the correlation to the previous range site name. The ESDs are not completed for all MLRAs.

<table>
<thead>
<tr>
<th>MLRA (abbreviation)</th>
<th>Original Range Site Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choppy Sands (CS)</td>
<td>Thin Sands</td>
</tr>
<tr>
<td>Clayey (Cy)</td>
<td>Clayey</td>
</tr>
<tr>
<td>Clayey Terrace (CyT)</td>
<td>Clayey</td>
</tr>
<tr>
<td>Claypan (Cp)</td>
<td>Claypan</td>
</tr>
<tr>
<td>Closed Depression (CD)</td>
<td>Closed Depression</td>
</tr>
<tr>
<td>Limy Sands (LSa)</td>
<td>Sands</td>
</tr>
<tr>
<td>Limy Subirrigated (LSb)</td>
<td>Limy Subirrigated</td>
</tr>
<tr>
<td>Limy Backslope (LB)</td>
<td></td>
</tr>
<tr>
<td>Linear Meadow (LrM)</td>
<td></td>
</tr>
<tr>
<td>Loamy (Ly)</td>
<td>Silty</td>
</tr>
<tr>
<td>Loamy Overflow (LyOv)</td>
<td>Overflow</td>
</tr>
<tr>
<td>Loamy Terrace (LyT)</td>
<td></td>
</tr>
<tr>
<td>Saline Overflow (SOv)</td>
<td>Saline Overflow</td>
</tr>
<tr>
<td>Saline Lowland (SL)</td>
<td>Saline Lowland</td>
</tr>
<tr>
<td>Saline Subirrigated (SSb)</td>
<td>Saline Lowland</td>
</tr>
<tr>
<td>Sands (Sa)</td>
<td>Sands</td>
</tr>
<tr>
<td>Sandy (Sy)</td>
<td>Sandy</td>
</tr>
<tr>
<td>Sandy Claypan (SyCp)</td>
<td>Sandy Claypan</td>
</tr>
<tr>
<td>Sandy Terrace (SyT)</td>
<td>Sandy</td>
</tr>
<tr>
<td>Savannah (Sv)</td>
<td>Savannah</td>
</tr>
<tr>
<td>Shallow Clayey (SwCy)</td>
<td>Shallow</td>
</tr>
<tr>
<td>Shallow Loamy (SwLy)</td>
<td>Shallow</td>
</tr>
<tr>
<td>Shallow Sandy (SwSy)</td>
<td>Shallow</td>
</tr>
<tr>
<td>Shallow Gravel (SwG)</td>
<td>Shallow to Gravel</td>
</tr>
<tr>
<td>Shallow Marsh (SwM)</td>
<td></td>
</tr>
<tr>
<td>Stony Hills (SH)</td>
<td></td>
</tr>
<tr>
<td>Subirrigated (Sb)</td>
<td>Subirrigated</td>
</tr>
<tr>
<td>Subirrigated Sands (SbSa)</td>
<td>Subirrigated</td>
</tr>
<tr>
<td>Thin Claypan (TCp)</td>
<td>Thin Claypan</td>
</tr>
<tr>
<td>Thin Loamy (TLY)</td>
<td>Thin Upland</td>
</tr>
<tr>
<td>Very Shallow (VS)</td>
<td>Very Shallow</td>
</tr>
<tr>
<td>Wet Land (WL)</td>
<td>Wetland</td>
</tr>
<tr>
<td>Wet Meadow (WM)</td>
<td>Wet Meadow</td>
</tr>
</tbody>
</table>

Ecological Site Plant Community Dynamics

The plant communities occupying an ecological site are dynamic and highly variable. Their composition changes in response to climatic patterns and management conditions.

Historically (prior to European occupation), weather, precipitation, fire and grazing by free-roaming herbivores were the primary disturbances that shaped the composition of the plant communities. For example, prolonged periods of drought would have shifted the plant communities to shorter-statured, more drought-tolerant species of grasses and forbs.

Ecological site descriptions attempt to describe the composition and ecological function of these “historic” and other plant communities. The ecological dynamics of each site are represented through the use of a state and transition model (STM).

The STM depicts our current understanding of the ecological dynamics of the site in response to various disturbance regimes (for example, drought, overgrazing, fire and no grazing). The STM, along with the ecological dynamics narratives, identify and describe the different plant community states, phases, thresholds, transitional pathways and drivers that may occur on a site. Understanding these dynamics helps a manager predict how a plant community will respond to changes in management.
The reference plant community phase describes the plant community that would have occupied the site under the historic disturbance regime. This is the plant community that would have had the highest ecological function in terms of hydrology, species diversity and nutrient cycling. The “historic” plant communities are referred to as the “Reference State.”

One of the plant communities that occurred within the reference state usually is selected as the “Reference Plant Community” phase for inventory and evaluation purposes (i.e. similarity index).

The composition of the reference plant community is described based upon species composition data collected from sites determined to best represent this historic condition.

Additional information is gathered from other reference sources that describe the plant communities occupying the region prior to settlement when the natural disturbance regime would have occurred.

Since settlement, the natural disturbance regime has been altered. Fire, as a primary disturbance, essentially has been eliminated from the ecosystem. Grazing disturbances have been altered from intensive and infrequent to intensive and frequent. In other cases, fire and grazing have been eliminated entirely. Additionally, non-native species such as Kentucky bluegrass, smooth bromegrass, crested wheatgrass and sweetclover have invaded into the sites.

Depending upon the degree of the invasion, species diversity, hydrology and nutrient cycling may be altered significantly. Invasion by these species is occurring regardless of management, especially during a wet cycle period (for example, Kentucky bluegrass encroachment throughout much of the northern Plains during the wet cycle starting in 1993).

However, management intensity may limit their spread and prevent the plant community from crossing an ecological threshold. Once a threshold is crossed, major management changes and dollar investments are required for restoration.

Complete versions of ecological site descriptions are available on the Web at http://esis.sc.egov.usda.gov/.

If the ecological site descriptions for your area of interest are not available on this website, contact your local Natural Resources Conservation Service county office.

Ecological site maps for your area of interest are available via Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/).
Using the Ecological Site Description Guide

The following is a pictorial guide of ecological sites common to North Dakota. Some sites are represented by a series of photos depicting a very simplified state and transition model describing the ecological dynamics of the site as explained in the previous section. Other sites are represented by a single photo while still others (generally minor components) are described without pictorial images.

This guide is intended to assist in identification of ecological sites when developing management plans for rangeland and also may provide assistance when teaching or conducting range judging activities.

Ecological sites play a major role in herbage and subsequent forage production of the plant community. This production and the ecological dynamics of the sites have a direct impact on the carrying capacity of the land (pasture unit). To further understand the use of this guide for determining carrying capacity, we need to better describe the difference between carrying capacity and stocking rate.

Stocking rate: It is defined as the number of specific kinds and classes of animals grazing or utilizing a unit of land for a specified time period, commonly expressed as animal units per acre.

An animal unit (AU) is considered to be one mature cow of approximately 1,000 pounds with a calf up to 6 months of age (see animal unit equivalent guide for proper conversions for other classes or kinds of grazing animals).

The stocking rate typically is expressed as the number of animal units grazed for a specific time period (days, months) in a given pasture or unit.

Carrying capacity: It is defined as the maximum stocking rate possible that is consistent with maintaining or improving vegetation or related resources. It may vary from year to year on the same area due to fluctuating forage production. Carrying capacity usually is expressed as the number of animal units that can be grazed for a specified time period. In short, carrying capacity is the amount of forage available for grazing animals and expressed as the number of available animal unit months (AUMs), or number of animal units grazed for one month.

Any given stocking rate should not be greater than the carry capacity to assure proper resource management, and frequently it should be lower due to different ecological and management objectives. Carrying capacity, or estimating forage quantity, can be estimated in several ways. A common technique used in the field is clip and weigh. The clip-and-weigh method requires actual harvesting of standing forage at a given time to predict available forage.

Clip and weigh: The most accurate method to assess the amount of forage in a pasture is to clip five to 15 samples of a 2-square-foot area, dry (air dry for two to four days, depending on moisture level) and weigh (using a gram scale) each sample. The average

<table>
<thead>
<tr>
<th>Kinds/Classes of Animals</th>
<th>Animal Unit Equivalent (AUE)</th>
<th>Forage Consumed in Pounds (air-dry)²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000-lb. cow, dry</td>
<td>0.92</td>
<td>28 851</td>
</tr>
<tr>
<td>1,000-lb. cow, with calf</td>
<td>1.00</td>
<td>30 913</td>
</tr>
<tr>
<td>1,200-lb. cow, with calf</td>
<td>1.15</td>
<td>35 1,064</td>
</tr>
<tr>
<td>1,400-lb. cow, with calf</td>
<td>1.29</td>
<td>39 1,186</td>
</tr>
<tr>
<td>Bison cow, mature</td>
<td>1.00</td>
<td>30 913</td>
</tr>
<tr>
<td>Bison bull, mature</td>
<td>1.50</td>
<td>45 1,368</td>
</tr>
<tr>
<td>Horse, mature</td>
<td>1.25</td>
<td>38 1,155</td>
</tr>
<tr>
<td>Sheep, mature</td>
<td>0.20</td>
<td>6 182</td>
</tr>
<tr>
<td>Goat, mature</td>
<td>0.15</td>
<td>5 152</td>
</tr>
<tr>
<td>Deer, white-tailed, mature</td>
<td>0.15</td>
<td>5 152</td>
</tr>
<tr>
<td>Deer, mule, mature</td>
<td>0.20</td>
<td>6 182</td>
</tr>
<tr>
<td>Elk, mature</td>
<td>0.60</td>
<td>18 547</td>
</tr>
<tr>
<td>Antelope, mature</td>
<td>0.20</td>
<td>6 182</td>
</tr>
<tr>
<td>Sheep, bighorn, mature</td>
<td>0.20</td>
<td>6 182</td>
</tr>
<tr>
<td>Jackrabbit, white-tailed</td>
<td>0.02</td>
<td>6 182</td>
</tr>
<tr>
<td>Prairie dog</td>
<td>0.004</td>
<td>0.1 3</td>
</tr>
</tbody>
</table>


2 Air-dry weight refers to forage that is allowed to dry under natural environmental conditions during an extended period of time, such as plants harvested for hay production. This value is approximately 87% dry matter versus oven-dry weight, which depicts 100% dry matter.
amount of forage available is equal to the dry weight of all samples collected divided by the number of samples, then multiplied by 50 to calculate the weight in pounds per acre.

Clip several samples within each ecological site and be sure these samples represent the variation of ecological sites within the pasture. Production amounts need to be adjusted to account for the time of year (plant growth curve), growing conditions and amount consumed by grazing animals or wildlife prior to clipping.

The number of samples necessary depends on the uniformity of the pasture. The more variable the forage growth, the greater the number of samples you need to collect.

Once forage production for the pasture is determined, the actual stocking rate will be calculated using a harvest efficiency multiplier. Harvest efficiency usually varies from 15 to 35 percent on rangeland, and 25 to 40 percent on tame pastureland, depending upon grazing management.

Estimated Stocking Rate Guide

When forage production samples are not available to calculate the stocking rate by ecological site, calculating an estimated stocking rate can be determined by ecological site using the 25 percent harvest efficiency and the forage intake for a 1,000-pound cow with calf. We are assuming average intake at 913 pounds per month (based on air-dried weights) and a calf less than 6 months of age.

See Table 2 for the recommended “estimated” stocking rate guide for the common ecological sites in animal unit months per acre (AUM/acre) for those multiple land resource areas (MLRAs) found in North Dakota.

NOTE: The estimated stocking rate could be based on local knowledge and past stocking rates if similarity index, health and trend have met the manager’s objectives without degrading the resource.

<table>
<thead>
<tr>
<th>Ecological Site</th>
<th>53A&amp;B</th>
<th>54</th>
<th>MLRA 55A&amp;B</th>
<th>56</th>
<th>58C&amp;D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clayey</td>
<td>0.63</td>
<td>0.57</td>
<td>0.66</td>
<td>0.82</td>
<td>0.52</td>
</tr>
<tr>
<td>Claypan</td>
<td>0.46</td>
<td>0.41</td>
<td>0.55</td>
<td>0.63</td>
<td>0.38</td>
</tr>
<tr>
<td>Limy Subirrigated</td>
<td>0.98</td>
<td>na</td>
<td>1.04</td>
<td>1.15</td>
<td>na</td>
</tr>
<tr>
<td>Loamy</td>
<td>0.66</td>
<td>0.66</td>
<td>0.71</td>
<td>0.85</td>
<td>0.57</td>
</tr>
<tr>
<td>Loamy Overflow</td>
<td>0.96</td>
<td>0.87</td>
<td>1.01</td>
<td>1.15</td>
<td>0.77</td>
</tr>
<tr>
<td>Saline Lowland</td>
<td>0.96</td>
<td>0.68</td>
<td>1.01</td>
<td>1.09</td>
<td>0.68</td>
</tr>
<tr>
<td>Sands</td>
<td>0.68</td>
<td>0.68</td>
<td>0.71</td>
<td>0.79</td>
<td>0.52</td>
</tr>
<tr>
<td>Sandy</td>
<td>0.68</td>
<td>0.66</td>
<td>0.77</td>
<td>0.85</td>
<td>0.55</td>
</tr>
<tr>
<td>Shallow Loamy</td>
<td>0.60</td>
<td>0.38</td>
<td>na</td>
<td>na</td>
<td>0.38</td>
</tr>
<tr>
<td>Shallow Sandy</td>
<td>0.00</td>
<td>0.38</td>
<td>na</td>
<td>na</td>
<td>0.38</td>
</tr>
<tr>
<td>Shallow Gravel</td>
<td>0.44</td>
<td>na</td>
<td>0.52</td>
<td>0.60</td>
<td>0.36</td>
</tr>
<tr>
<td>Subirrigated</td>
<td>1.37</td>
<td>1.09</td>
<td>1.28</td>
<td>1.37</td>
<td>na</td>
</tr>
<tr>
<td>Subirrigated Sands</td>
<td>na</td>
<td>na</td>
<td>0.87</td>
<td>0.93</td>
<td>na</td>
</tr>
<tr>
<td>Thin Claypan</td>
<td>0.27</td>
<td>0.25</td>
<td>0.36</td>
<td>0.41</td>
<td>0.22</td>
</tr>
<tr>
<td>Thin Loamy</td>
<td>0.52</td>
<td>0.46</td>
<td>0.60</td>
<td>0.71</td>
<td>0.41</td>
</tr>
<tr>
<td>Thin Sands</td>
<td>0.46</td>
<td>0.44</td>
<td>0.52</td>
<td>0.57</td>
<td>0.44</td>
</tr>
<tr>
<td>Very Shallow</td>
<td>0.33</td>
<td>0.22</td>
<td>0.38</td>
<td>0.46</td>
<td>0.22</td>
</tr>
</tbody>
</table>

1 In the absence of site-specific inventory data, this table can be used to establish an estimated stocking rate. Annual monitoring of utilization amounts and patterns is essential to establishing and adjusting the annual stocking rates to ensure landscape and production goals are met.

Wildlife Habitat

Rangeland provides all life requisites for various wildlife species. The potential wildlife habitat for these species can be predicated using ecological site descriptions and state and transition models. Habitat quality is a reliable indicator of presence and/or absence of species.

Habitat quality is based on plant community species composition and management of that plant community. The combination of management inputs, weather and plant species composition within an ecological site description and state and transition model provides the needed information to predicate wildlife responses.

Wildlife interpretations contained in the ecological site descriptions and state and transition models provide information that predicts the direct and indirect cumulative impacts of various management actions on vegetation composition and structure.

Table 2. Estimated stocking rate guide\(^1\) in animal unit months per acre (AUM/acre) by ecological site and multiple land resource areas (MLRA) for reference plant communities.

Example:

If the calculated herbage production is 2,000 pounds per acre on rangeland being managed using seasonlong grazing, the available forage would be 500 pounds per acre (2,000 lb/ac X 0.25 = 500 lb/ac). The 500 lb/ac then would be divided by the forage consumed in pounds per month by kind or class of animal.

See the Animal Unit Equivalent Guide on page 6 for monthly forage intake amounts. For example, if grazing a 1,000-pound cow with calf, forage consumption would be 913 pounds per month (based on air-dried weights). Because the available forage in our example is 500 pounds per acre, the stocking rate would be 0.54 animal unit months per acre (500 lb/ac divided by 913 lb/month = 0.54 animal unit months/acre).
Therefore, wildlife habitat quality is directly related to these various management actions. Ecological site descriptions, along with state and transition models, enable land managers and scientists to assess potential and current wildlife habitat suitability. Ecological site descriptions also enable managers to predict potential responses of wildlife populations to vegetation dynamics based on the ecological potential of the site.

To accurately use the information found in an ecological site descriptions and state and transitional models, a manager needs to complete a good inventory of current plant species composition.

Utilizing this inventory with the ecological site descriptions and an understanding of the habitat needs of the wildlife species of interest, the manager has the necessary background information to make sound resource management decisions.

Subsequent monitoring of both plant community and wildlife population changes as management is applied provides the feedback necessary to implement an effective adaptive management plan.

High Water Table Group

Closed Depression

The site is poorly drained, occurs on closed upland depressions and is associated with residual soils (nonglaciated). Although salinity does not occur on this site, the subsoil layers exhibit claypan characteristics due to sodium and will form a 2-inch or longer ribbon of silty clay to clay. These areas may pond water but do not flood.

Major species found in the reference plant community phase include western wheatgrass, slender wheatgrass, prairie cordgrass, smartweed, curlytop knotweed, alkali plantain, American Licorice and Pursh seepweed. Herbage production ranges from 3,500 pounds per acre in the east to 2,000 to 2,400 pounds per acre in the west.

Overgrazing will shift this community to one dominated by inland saltgrass, foxtail barley, curly dock, pepperweed and curlycup gumweed. Extended periods of nonuse will shift this plant community to one dominated by western wheatgrass and a variety of forbs.

Limy Subirrigated

The site is somewhat poorly drained and has strong to violent effervescence in all horizons of the subsoil. Carbonates occur within 16 inches of the surface. These sites occur on flood plains, drainage ways and around or between depressions.

Major species found in the reference plant community phase include little bluestem, big bluestem, sideoats grama, porcupine grass, green needlegrass, sedges, American licorice, Indian hemp dogbane, goldenrods, Maximilian sunflower and western snowberry.

Herbage production will range from 3,800 to 4,000 pounds per acre. With overgrazing, the tall and midstatured warm-season grasses and midstatured cool-season bunchgrasses decline and are replaced by grazing-tolerant forbs and Kentucky bluegrass. With extended periods of nonuse, these sites tend to become dominated by Kentucky bluegrass, smooth bromegrass and shrubs.
Example of a closed depression ecological site.

Example of a limy subirrigated ecological site.
Saline Lowland

Soils for these sites are moderately well to poorly drained and moderately to strongly saline. The subsoil forms a ribbon up to 2 inches in length. Salinity can be observed in the surface and/or subsoil layers.

Plant Community Phase 1  (Reference Plant Community)

Major species found in this reference phase include western wheatgrass, Nuttall’s alkaligrass, inland saltgrass, sedges and western dock.

Herbage production will range from 3,700 to 4,000 pounds per acre in the east and 2,000 to 2,500 pounds per acre in the west.

This plant community can be maintained utilizing good prescribed grazing management practices.

Practices include: 1) grazing rotation with proper recovery times between grazing events, 2) changing deferment periods (season-of-use) and 3) proper stocking rates adjusted annually to reflect growing conditions.

Plant Community Phase 2

This plant community phase results from long-term, heavy, continuous grazing and may be compounded by moderate to severe drought.

Nuttall’s alkaligrass will decrease while western wheatgrass and inland saltgrass initially increase. With continued overgrazing, western wheatgrass will decline, while inland saltgrass, foxtail barley, forbs and bare ground increase.

Due to lack of plant cover and increased bare ground, soil surface salinity may increase. Higher levels of salinity and loss of Nuttall’s alkaligrass may limit the manager’s ability to return to Phase 1.

Adoption of a prescribed grazing management practice that incorporates 1) proper recovery periods, 2) proper stocking rates and 3) changing deferment periods will result in this plant community phase shifting toward Phase 1 if a threshold has not been crossed.

Plant Community Phase 3

Extended periods of nonuse will result in a plant community dominated by Nuttall’s alkaligrass, western wheatgrass, foxtail barley, curly dock, other forbs, and possibly smooth bromegrass and Kentucky bluegrass, depending upon salinity levels.

The lack of disturbance (grazing or fire) allows dead plant material to increase, shading the crowns of grass plants, reducing sunlight needed for plant growth and shifting the competitive advantage to more shade-tolerant grass and forb species.
Subirrigated

The site is somewhat poorly drained and found on flood plains, drainage ways and alluvial areas. The upper part of the subsoil does not contain carbonates. Redoximorphic features are visible within 20 inches of the soil surface.

Major species found in the reference plant community phase include big bluestem, switchgrass, northern reedgrass, Canada wildrye, sedges, American licorice, Canada goldenrod, Maximilian sunflower, western yarrow, western snowberry, and scattered patches of chokecherry and plum, and Indiangrass in the east.

Herbage production will range from 4,700 to 5,100 pounds per acre in the east and 4,000 to 4,300 pounds per acre in the west. Overgrazing of these sites will result in a decrease in the big bluestem, switchgrass, Indiangrass and northern reedgrass, with a corresponding increase in spike rush, sedges and forbs. If present, Kentucky bluegrass will increase, resulting in a Kentucky bluegrass, rush, sedge, black medic, white clover and forb-dominated plant community.

Extended periods of nonuse will result in the site becoming dominated by Kentucky bluegrass, smooth bromegrass and western snowberry. Shrubs such as chokecherry also may increase, resulting in a shrub-dominated plant community with scattered trees such as green ash.

Wet Meadow

The site is poorly drained and in depressions or flood plains. Major species found in the reference plant community phase include prairie cordgrass, northern reedgrass, switchgrass, clustered field sedge, fescue sedge, woolly sedge, Indianhemp dogbane, goldenrods, Macoun’s buttercup and Rydberg’s sunflower. Herbage production will range from 6,500 pounds per acre in the east to 4,500 pounds per acre in the west.

Overgrazing of this site will result in a decrease in prairie cordgrass, northern reedgrass and sedges, with fowl bluegrass, spikerush, Baltic rush and forbs increasing. Nonuse of this site will reduce prairie cordgrass and switchgrass, increasing western wheatgrass, fowl bluegrass and the invasive grasses quackgrass and Kentucky bluegrass.
Wet Land (Shallow Marsh)

The site is very poorly drained. Major species found in the reference plant community phase include slough sedge, whitetop, American sloughgrass, water smartweed, bur-reed, northern water plantain and waterparsnip.

Herbage production will range from 6,000 to 6,500 pounds per acre in the east to 4,500 to 5,900 pounds per acre in the west. Overgrazing of this site will result in a decline in the amount of whitetop and slough sedge and increase the amount of smartweed, spikerush and Baltic rush. Sedimentation into these sites will result in a dominance of reed canarygrass, smartweed, Baltic rush and cattail.

Example of a shallow marsh ecological site.

Shallow and Very Shallow Group

Shallow Clayey

The site is shallow (10 to 20 inches) to weathered bedrock, shale or strongly cemented silcrete. The subsoil or substratum (not including the weathered bedrock) forms more than a 2-inch ribbon of silty clay loam to clay. The surface layer is from 1 to 6 inches thick.

Major species in the reference plant community phase include western wheatgrass, green needlegrass, plains muhly, little bluestem, sideoats grama, dotted gayfeather, Missouri goldenrod, prairie coneflower, Lambert crazyweed, western yarrow, winterfat, fringed sagewort and broom snakeweed.

Herbage production will range from 1,900 to 2,200 pounds per acre in the east and 1,200 to 1,400 pounds per acre in the west.

Overgrazing will shift this plant community to one dominated by blue grama, western wheatgrass, Sandberg bluegrass, red threeawn, cudweed sagewort, silverleaf scurfpea, western yarrow, fringed sagewort and broom snakeweed.

Extended periods of nonuse will shift this plant community to one dominated by western wheatgrass, Sandberg bluegrass, red threeawn, Kentucky bluegrass, cudweed sagewort, prairie coneflower, silverleaf scurfpea and fringed sagewort.
Shallow Gravel

The site is shallow (14 to 20 inches) to sand and gravel. The substratum contains up to 60 percent gravel and/or 25 to 75 percent sand.

Major species in the reference plant community phase include needle-and-thread, blue grama, western wheatgrass, plains muhly, threadleaf sedge, cudweed sagewort, cutleaf ironplant, green sagewort, Missouri goldenrod, prairie coneflower, fringed sagewort and rose.

Herbage production will range from 1,800 to 2,000 pounds per acre in the east and 1,300 to 1,600 pounds per acre in the west. Overgrazing will reduce the amount of needle-and-thread and western wheatgrass, while blue grama, sedges, red threeawn, gumweed, western salsify and fringed sagewort increase.

Nonuse will result in reduction in the warm-season grass component of the plant community and an increase in the sedges and invasion of Kentucky bluegrass and smooth bromegrass.

Example of a shallow clayey ecological site.

Example of a shallow gravel ecological site.
**Shallow Loamy**

The site is shallow (10 to 20 inches) to weathered bedrock, shale or strongly cemented silicrete. Surface and substratum layers form a less than 2-inch ribbon of silt loam to clay loam. Major species in the reference plant community phase include little bluestem, sideoats grama, porcupine grass, needle-and-thread, plains muhly, prairie coneflower, purple coneflower, scurfpea, fringed sagewort and leadplant. Herbage production is 1,400 pounds per acre in the west.

Overgrazing of this site will decrease the sideoats grama, plains muhly and porcupine grass, while blue grama, needle-and-thread, sedges and fringed sagewort will increase. With long-term overgrazing, needle-and-thread will decrease.

Nonuse of these sites will result in a decline in plant vigor and a decrease in the warm-season grasses such as sideoats grama and little bluestem. Invaders such as Kentucky bluegrass and smooth bromegrass will increase and, along with shrubs, will dominate the site.

Overgrazing will shift this plant community to one dominated by sedges, blue grama, needle-and-thread, American pasqueflower, cutleaf ironplant, hairy goldaster, Lambert crazyweed, scarlet globemallow, broom snakeweed and fringed sagewort.

**Shallow Sandy**

Surface and substratum layers will form a less than 1-inch ribbon and feel very gritty when excessively wet or will not ribbon but form a ball. These soils are shallow (10 to 20 inches) to weathered bedrock or hard sandstone bedrock, or are shallow (14 to 20 inches) to sand and gravel.

Major species in the reference plant community phase include prairie sandreed, needle-and-thread, sand bluestem, blue grama, sedges, dotted gayfeather, green sagewort, prairie clover, stiff sunflower, purple coneflower, winterfat, rose and broom snakeweed. Herbage production ranges from 1,300 to 1,400 pounds per acre in the west.

Extended periods of nonuse will shift this to one dominated by needle-and-thread, sedges, Kentucky bluegrass, American vetch, stiff sunflower, prairie coneflower, western yarrow, fringed sagewort, cactus and rose.

Example of a shallow loamy ecological site.

Example of a shallow sandy ecological site.
**Very Shallow**

The soils are very shallow (less than 10 inches) to soft weathered bedrock, very shallow (less than 14 inches) to sand and gravel, or shallow (10 to 20 inches) to porcellanite (commonly referred to as scoria).

Major species in the reference plant community phase include needle-and-thread, blue grama, threadleaf sedge, western wheatgrass, green sagewort, prairie coneflower, cutleaf ironweed, fringed sagewort and wild prairie rose, and bluebunch wheatgrass in the southwest. Rocky Mountain juniper may be found in this site in the badland region to west, primarily in MCRA 58C.

Herbage production will range from 1,400 to 1,700 pounds per acre in the east to 800 pounds per acre in the west. Overgrazing will result in a decrease in needle-and-thread and an increase in blue grama, sedges, red threeawn, curlycup gumweed, western salsify and fringed sagewort.

Due to the shallow nature of these sites, the plant community does not shift significantly with extended periods of nonuse, although if Kentucky bluegrass and smooth bromegrass are present, they will increase and may dominate the site.

![Example of a very shallow ecological site.](image-url)
**Claypan Group**

**Claypan**

The surface layer ranges from 6 to 14 inches. The subsoil layers exhibit claypan characteristics and form a 1-inch or longer ribbon of clay loam to clay. Salinity may be evident at depths of more than 16 inches.

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**Plant Community Phase 1 (Reference Plant Community)**

Major species in the reference plant community phase include western wheatgrass, blue grama, green needlegrass, threadleaf sedge, cudweed sagewort, heath aster, goldenrod, silverleaf scurfpea, fringed sagewort and rose. Reference plant community production will range from 2,000 to 2,300 pounds per acre in the east and 1,400 to 1,500 pounds in the west. This site often occurs in conjunction with thin claypan sites, giving the prairie an undulating appearance as the taller vegetation (claypan sites) grades into the shorter vegetation (thin claypan sites). This plant community can be maintained or enhanced utilizing good prescribed grazing management practices, which include a grazing rotation with proper recovery times between grazing events, change deferment periods (change season-of-use) and proper stocking rates adjusted annually to reflect growing conditions.

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**Plant Community Phase 2**

This plant community phase results from long-term, heavy, continuous grazing and may be compounded by moderate to severe drought. Overgrazing of this site will result in the community shifting to one dominated by blue grama, inland saltgrass, sedges, cudweed sagewort, curlycup gumweed and fringed sagewort. If present, Kentucky bluegrass also will increase. Overall production will be reduced due to the loss of western wheatgrass, green needlegrass and overall plant vigor. Adoption of a prescribed grazing management, which incorporates proper recovery periods following a grazing event, proper stocking rates and change deferment periods will result in this plant community shifting towards plant community phase 1.

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**Plant Community Phase 3**

Extended periods of nonuse will shift this plant community to one dominated by invaders such as Kentucky bluegrass and smooth bromegrass, and possibly crested wheatgrass. Overall productivity may increase initially, but plant community diversity will be decreased, reducing the plant community’s resilience to drought and other disturbances. Once a threshold is crossed by the invasion of these non-native species, the manager’s ability to return to plant community 1 will be limited.
**Thin Claypan**

The surface layer ranges from 0 to 6 inches. The subsoil layers exhibit claypan characteristics and form a 2-inch or longer ribbon of silty clay to clay. Salinity may be evident at depths less than 16 inches.

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**Plant Community Phase 1 (Reference Plant Community)**

Major species in the reference plant community include western wheatgrass, blue grama, threadleaf sedge, heath aster, scarlet globemallow, scurfpea, western yarrow, wild parsley, broom snakeweed and fringed sagewort. Reference plant community production will range from 1,300 to 1,600 pounds per acre in the east and 800 to 900 pounds per acre in the west. This site often occurs in conjunction with claypan sites, giving the prairie an undulating appearance as the taller vegetation (claypan sites) grades into the shorter vegetation (thin claypan sites). This plant community can be maintained or enhanced utilizing good prescribed grazing management practices, which include a grazing rotation with proper recovery times between grazing events, changing deferment periods (change season-of-use) and proper stocking rates adjusted annually to reflect growing conditions.

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**Plant Community 2**

This plant community results from long-term, heavy, continuous grazing and may be compounded by moderate to severe drought. Overgrazing of this site will result in the community shifting to one dominated by the short-statured grasses such as blue grama, buffalograss (in the west), inland saltgrass, and forbs such as western yarrow and curlycup gumweed. Further disturbance results in a plant community dominated by blue grama, buffalo grass and fragile cactus (brittle pricklypear). Soil surface temperatures will be elevated due to lack of vegetative cover. Overall production will be reduced due to the loss of western wheatgrass and overall plant vigor. Adoption of a prescribed grazing management, which incorporates proper recovery periods following a grazing event, proper stocking rates and changing deferment periods, will result in this plant community shifting toward community 1.

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**Plant Community 3**

Extended periods of nonuse will shift this plant community to one dominated by western wheatgrass, sedges, bluegrasses, heath aster and fringed sagewort. Due to soil chemistry, few invasive species are adapted to this site. so invasion by non-natives such as Kentucky bluegrass or smooth bromegrass is generally not an issue. However, crested wheatgrass has been observed invading onto these sites, which will alter the dynamics and shift the plant community to a predominately cool-season grass and forb community. Overall productivity may increase, depending upon the depth of the restrictive layer. Once a threshold is crossed, a manager’s ability to return to community 1 will be limited.
Sandy Claypan

The depth to claypan ranges from 6 to 18 inches. The subsoil layer exhibits claypan characteristics and forms a less than 1-inch ribbon of fine sandy loam. Salinity may be evident at depths of more than 16 inches.

Major species in the reference plant community phase include western wheatgrass, prairie sandreed, needle-and-thread, sedges, scurfpea, stiff sunflower, western wallflower, fringed sagewort and rose. Herbage production will range from 2,400 to 2,600 pounds per acre in the east and 1,600 to 2,000 pounds per acre in the west.

Overgrazing of this site will result in the community shifting to one dominated by blue grama, sedges, cudweed sagewort, green sagewort, western yarrow and fringed sagewort.

Extended periods of nonuse will shift this plant community to one dominated by species such as Kentucky bluegrass, smooth bromegrass, sedges, cudweed sagewort, goldenrod, heath aster, scurfpea, fringed sagewort and western yarrow.
Sandy Ecological Group

Sandy

Surface and subsoil layers form a ribbon of less than 1-inch fine sandy loam or sandy loam that feels very gritty when excessively wet. These sites occur on uplands.

Plant Community Phase 1  (Reference Plant Community)

Major species in the reference plant community phase include prairie sandreed, needle-and-thread, western wheatgrass, blue grama, cudweed sagewort, scurfpea, green sagewort, prairie coneflower, western ragweed, leadplant, rose and fringed sagewort. Herbage production will range from 2,800 to 3,000 pounds per acre in the east and 1,800 to 2,400 pounds per acre in the west. This plant community can be maintained or enhanced utilizing good prescribed grazing management practices, which include a grazing rotation with proper recovery times between grazing events, changing deferment periods (change season-of-use) and proper stocking rates adjusted annually to reflect growing conditions.

Plant Community Phase 2

This plant community results from long-term, heavy, continuous grazing and may be compounded by moderate to severe drought. Overgrazing of this site will result in the community shifting to one dominated by needle-and-thread, blue grama, sedges, green sagewort, western ragweed and fringed sagewort. If present, Kentucky bluegrass also will increase. Adoption of prescribed grazing management, which incorporates proper recovery periods following a grazing event, proper stocking rates and changing deferment periods, will result in this plant community shifting toward plant community 1.

Plant Community Phase 3

Extended periods of nonuse will shift this plant community to one dominated by Kentucky bluegrass, needle and thread, sedges, western ragweed, cudweed sagewort, scurfpea, green sagewort and fringed sagewort. Overall productivity initially may increase, but plant community diversity will be decreased, reducing the plant community’s resilience to drought and other disturbances. Once a threshold is crossed by the invasion of these non-native species, the manager’s ability to return to plant community 1 will be limited.
Sandy Terrace

Surface and subsoil layers form a less than 1-inch ribbon of fine sandy loam or sandy loam that feels very gritty when excessively wet. These sites are on low terraces or flood plains and may be flooded occasionally.

Major species in the reference plant community phase include prairie sandreed, sand bluestem, needle-and-thread, western wheatgrass, goldenrod, pentstemon, green sagewort, cudweed sagewort, prairie coneflower, leadplant, western snowberry, chokecherry and possibly scattered cottonwood and green ash.

Herbage production will range from 2,500 to 3,000 pounds per acre. Overgrazing of this site will result in the community shifting to one dominated by needle-and-thread, blue grama, sedges, western ragweed, western salsify and fringed sagewort or Kentucky bluegrass when present.

Extended periods of nonuse will shift this plant community to one dominated by Kentucky bluegrass, smooth bromegrass, sedges, goldenrod, prairie coneflower, hairy goldaster, western snowberry and green ash.

Limy Sands

Surface and subsoil layers do not form a ribbon and may form a ball when squeezed (loamy fine sand to fine sand). Typically these sites are calcareous throughout the soil profile (slight to strong effervescence) and are on uplands.

Major species in the reference plant community phase include prairie sandreed, little bluestem, sand bluestem, sideoats grama, porcupine grass, sedges, scurfpea, American pasqueflower, Lambert crazyweed, penstemon, fringed sagewort, leadplant and rose.

Herbage production is about 1,800 pounds per acre. Overgrazing of this site will shift the plant community to one dominated by blue grama, sedges, sand dropseed, green sagewort, western ragweed, fringed sagewort and Kentucky bluegrass.

Extended periods of nonuse will shift this plant community to one dominated by needle-and-thread, prairie sandreed, sedges, Kentucky bluegrass, hairy goldaster, prairie coneflower, western ragweed, fringed sagewort and creeping juniper.

Example of a limy sands ecological site.
Sands
Surface and subsoil layers do not form a ribbon and may form a ball when squeezed (loamy fine sand to fine sand). These sites occur on uplands.

Plant Community Phase 1 (Reference Plant Community)
Major species in the reference plant community phase include prairie sandreed, needle-and-thread, sand bluestem, sedges, green sagewort, goldenrod, cudweed sagewort, western ragweed, sunflower, leadplant, western snowberry and rose. Herbage production will range from 2,600 to 2,800 pounds per acre in the east and 1,900 to 2,500 pounds per acre in the west. This plant community can be maintained or enhanced utilizing good prescribed grazing management practices, which include grazing rotation with proper recovery times between grazing events, changing deferment periods (change season-of-use) and proper stocking rates adjusted annually to reflect growing conditions.

Plant Community Phase 2
This plant community results from long-term, heavy, continuous grazing and may be compounded by moderate to severe drought. Overgrazing of this site will result in the community shifting to one dominated by needle-and-thread, sand dropseed, blue grama, sedges, green sagewort, cudweed sagewort, western ragweed and fringed sagewort. If present, Kentucky bluegrass also will increase. Overall production will be reduced due to the loss of sand bluestem, prairie sandreed and plant vigor. Adoption of prescribed grazing management, which incorporates proper recovery periods following a grazing event, proper stocking rates and changing deferment periods, will result in this plant community shifting toward plant community 1.

Plant Community Phase 3
Extended periods of nonuse will shift this plant community to Kentucky bluegrass, smooth bromegrass, cudweed sagewort, green sagewort, sunflower and rose. Overall productivity initially may increase, but plant community diversity will be decreased, reducing the plant community’s resilience to drought and other disturbances. Once a threshold is crossed by the invasion of these non-native species, the manager’s ability to return to plant community 1 will be limited.
**Subirrigated Sands**

Surface and subsoil layers do not form a ribbon and may form a ball when squeezed (loamy fine sand to fine sand). These sites are moderately well-drained and occur on uplands. Redoximorphic features are visible from 20 to 40 inches.

Major species in the reference plant community phase include big bluestem, sand bluestem, prairie sandreed, porcupine grass, little bluestem, sideoats grama, sedges, goldenrods, heath aster, bracted spiderwort, Maximilian sunflower, purple prairie clover, silky prairie clover, prairie willow and rose.

Herbage production is about 3,200 pounds per acre. Overgrazing of this site will shift the plant community to one dominated by needle-and-thread, blue grama, sand dropseed, sedges, goldenrods, western ragweed and rose or Kentucky bluegrass when present.

Extended periods of nonuse will shift this plant community to one dominated by Kentucky bluegrass, smooth bromegrass, goldenrods, prairie willow and western snowberry.

**Choppy Sands (Thin Sands)**

Surface and subsoil layers do not form a ribbon and may form a ball when squeezed (loamy fine sand to fine sand). These sites are on flood plains, lake plains, outwash plains, residual plains and terraces. Typical landscapes are hummocks and dunes with slopes greater than 15 percent.

Major species in the reference plant community phase include sand bluestem, little bluestem, prairie sandreed, needle-and-thread, porcupine grass, blue grama, sedges, bracted spiderwort, dotted gayfeather, goldenrods, green sagewort, penstemon and leadplant.

Herbage production ranges from 1,900 pounds per acre in the east to 1,600 pounds per acre in the west. Overgrazing of this site will shift the plant community to one dominated by needle-and-thread, blue grama, sand dropseed, sedges, western ragweed, green sagewort, goldenrods and fringed sagewort or Kentucky bluegrass when present. Excessive localized disturbance may lead to blowouts.

Extended periods of nonuse will shift this plant community to one dominated by Kentucky bluegrass, sedges, goldenrods, horsetail, scurfpea, western ragweed and fringed sagewort.
Clayey Group

Clayey

The surface layer(s) is 5 to 14 inches thick and textures are loam (soil neither dominated by gritty nor smooth) to clay (soil feels neither gritty nor smooth) and forms a ribbon greater than 1 inch. The subsoil layer forms a 2-inch or longer ribbon of silty clay to clay.

Major species in the reference plant community phase include western wheatgrass, green needlegrass, porcupine grass, sedges, American vetch, cudweed sagewort, dotted gayfeather, heath aster, purple prairie clover, wavyleaf thistle, western yarrow and lead plant. Herbage production ranges from 2,400 to 3,000 pounds per acre in the east and 1,900 to 2,100 pounds per acre in the west.

Overgrazing of this site will shift the plant community to one dominated by blue grama, western wheatgrass, sedges, goldenrod, western yarrow and fringed sagewort or Kentucky bluegrass when present.

Extended periods of nonuse will shift this plant community to one dominated by Kentucky bluegrass, smooth bromegrass, goldenrods, scurfpea, cudweed sagewort and western snowberry.

Example of a clayey ecological site.
Loamy Group

Loamy

The surface layer forms a less than 2-inch ribbon of silt loam or loam. Subsoil layers form a less than 2-inch ribbon of silt loam to clay loam. The upper part of the subsoil is none to slightly effervescent. These sites are on uplands.

Plant Community Phase 1 (Reference Plant Community)

Major species in the reference plant community include green needlegrass, western wheatgrass, porcupine grass, prairie junegrass, big bluestem, American vetch, heath aster, prairie coneflower, purple prairie clover, stiff sunflower and lead plant. Reference plant community production ranges from 2,600 to 3,200 pounds per acre in the east and 2,050 to 2,400 pounds per acre in the west. This plant community can be maintained or enhanced utilizing good prescribed grazing management practices, which include a grazing rotation with proper recovery times between grazing events, changing deferment periods (change season-of-use) and proper stocking rates adjusted annually to reflect growing conditions.

Plant Community Phase 2

This plant community results from long-term, heavy, continuous grazing and may be compounded by moderate to severe drought. Overgrazing of this site will shift the plant community to one dominated by blue grama, western wheatgrass, sedges, western yarrow, goldenrods and fringed sagewort. If present, Kentucky bluegrass also will increase. Overall production may be reduced due to the loss of grass vigor and shift to less productive grasses. Forbs will constitute a greater proportion of the production. Infiltration rates will be less due to the loss or reduction in native bunchgrasses. Adoption of prescribed grazing management, which incorporates proper recovery periods following a grazing event, proper stocking rates and changing deferment periods, will result in this plant community shifting toward plant community 1.

Plant Community Phase 3

Extended periods of nonuse will shift any plant community to one dominated by Kentucky bluegrass, smooth bromegrass, cudweed sagewort, scurfpea, goldenrods and western snowberry. The lack of disturbance (grazing or fire) allows dead plant material to increase. This old material shades the crowns of the grass plants, reducing the amount of sunlight available for plant growth. This shifts the competitive advantage to the more shade-tolerant grasses such as Kentucky bluegrass and/or smooth bromegrass. Due to the loss of the dominant native grass species, this community has crossed a threshold and a simple change in management will not return it to plant community 1.
Loamy Overflow

The surface layer forms a less than 2-inch ribbon of silt loam or loam. The subsoil layer forms a less than 2-inch ribbon of silt loam to clay loam. These sites are in flood plains or swale positions of complex map units on slopes of less than 6 percent and include soils that are flooded frequently.

Major species in the reference plant community include big bluestem, switchgrass, green needlegrass, porcupine grass, western wheatgrass, American licorice, Maximilian sunflower, prairie coneflower, heath aster, western snowberry, leadplant and scattered patches of chokecherry, northern hawthorn and green ash.

Reference plant community production ranges from 3,700 to 3,900 pounds per acre in the east and 2,800 to 3,200 pounds per acre in the west. Overgrazing of this site will shift the plant community to one dominated by blue grama, sedges, western wheatgrass, western yarrow, goldenrods and fringed sagewort or Kentucky bluegrass when present.

Extended periods of nonuse will shift this plant community to one dominated by Kentucky bluegrass, smooth bromegrass, western snowberry, chokecherry and green ash.

Example of a reference plant community.

Example of a shrub-dominated loamy overflow plant community in the absence of fire.

Example of an overgrazed loamy overflow plant community.
**Loamy Terrace**

The surface layer forms a less than 2-inch ribbon of silt loam or loam. The subsoil layer forms a less than 2-inch ribbon of silt loam to clay loam. These sites are on low terraces or flood plains and may be flooded occasionally.

Major species in the reference plant community include western wheatgrass, green needlegrass, big bluestem, blue grama, needle-and-thread, sedges, American vetch, cudweed sagewort, Maximilian sunflower, prairie coneflower, western wallflower, silver sagebrush, western snowberry, chokecherry and plum, and scattered cottonwood, green ash and boxelder.

Reference plant community production ranges 2,500 to 2,900 pounds per acre. Overgrazing of this site will shift the plant community to one dominated by silver sagebrush with an understory of blue grama, western wheatgrass, needle-and-thread, sedges, western yarrow, cudweed sagewort and fringed sagewort.

Extended periods of nonuse will shift this plant community to one dominated by silver sagebrush, smooth bromegrass, annual bromes, western snowberry, chokecherry and possibly green ash and boxelder.

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Example of a loamy terrace ecological site.
**Thin Loamy**

The surface layer forms a less than 2-inch ribbon of silt loam or loam. The subsoil layer forms a less than 2-inch ribbon of silt loam to clay loam. These soils have none to strong effervescence in the surface layer and strong to violent effervescence in the subsoil. These sites occur on ridges and knolls.

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**Plant Community Phase 1** *(Reference Plant Community)*

Major species in the reference plant community include little bluestem, porcupine grass, sideoats grama, green needlegrass, plains muhly, blue grama, sedges, purple coneflower, American vetch, cutleaf ironweed, leadplant and fringed sagewort. Reference plant community production ranges from 2,200 to 2,700 pounds per acre in the east and 1,400 to 1,700 pounds per acre in the west. This plant community can be maintained or enhanced utilizing good prescribed grazing management practices, which include a grazing rotation with proper recovery times between grazing events, changing deferment periods (change season-of-use) and proper stocking rates adjusted annually to reflect growing conditions.

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**Plant Community Phase 2**

This plant community results from long-term, heavy, continuous grazing and may be compounded by moderate to severe drought. Overgrazing of this site will shift the plant community to one dominated by blue grama, needle-and-thread, sedges, goldenrods, purple coneflower, western yarrow, rose pussytoes, fringed sagewort and broom snakeweed. If present, Kentucky bluegrass also will increase. Overall production will be reduced due to the loss of grass vigor and shift to less productive grasses. Infiltration rates will be less due to the loss of midstatured bunchgrasses. Adoption of prescribed grazing management, which incorporates proper recovery periods following a grazing event, proper stocking rates and changing deferment periods, will result in this plant community shifting toward plant community 1.

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**Plant Community Phase 3**

Extended periods of nonuse will shift any plant community to one dominated by Kentucky bluegrass, smooth bromegrass, scurfpea, western yarrow, western snowberry and rose. The lack of disturbance (grazing or fire) allows dead plant material to increase. This old material shades the crowns of the native grass plants, reducing the amount of sunlight available for plant growth. This shifts the competitive advantage to the more shade-tolerant grasses such as Kentucky bluegrass and/or smooth bromegrass. Due to the loss of the dominant native grass species, this community has crossed a threshold and a simple change in management will not return it to plant community 1.