



Forest Service  
U.S. DEPARTMENT OF AGRICULTURE

Rocky Mountain Region / Black Hills National Forest

October 2023

# Black Hills National Forest

## Revised Forest Assessment: Ecological Integrity of Rangeland/Non-Forested Ecosystems: Status, Trend, and Use



A dirt road traversing typical grasslands and shrublands in the Black Hills National Forest.

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## Chapter 1. Introduction

This assessment addresses the ecosystem integrity of the non-forested terrestrial ecosystems (grasslands and shrublands) in the Black Hills National Forest and the use of those ecosystems, following direction outlined in FSH 1909.12 *Land Management Planning Handbook, Chapter 10 – The Assessment: Section 13.32 – Assessing Multiple Uses for Range Resources*. The assessments of non-forested ecosystem integrity and livestock grazing use are combined in this document because the two are intertwined. Forest, riparian, wetland, aquatic, and cave ecosystems are addressed in other assessments.

An ecosystem consists of living organisms and their nonliving environment. These components interact so that the system captures and stores energy as biomass, has a trophic structure, circulates nutrients, and changes over time. Assessing ecosystem integrity is required by the Forest Service Planning Rule. Ecological integrity is the quality or condition of an ecosystem when its dominant ecological characteristics (e.g., composition, structure, function, and connectivity) act to maintain that quality or condition and maximize its ability to withstand or recover from perturbations imposed by natural environmental dynamics or human influence.

A discussion of the drivers, stressors, and threats to the ecosystem integrity in the national forest is included. Separate assessment reports address the ecosystem integrity of forested ecosystems, and aquatic, riparian, and wetland ecosystems. Understory vegetation associated with forested ecosystems is discussed briefly in this document as it often serves as transitory or secondary forage for permitted livestock and provides habitat and forage for big game animals.

The Black Hills is ecologically significant for its convergence of grasslands, shrublands, woodlands, forests, and wetlands. As an ecotone between ecological communities, the Black Hills function as a place for intermingling of species from disparate portions of North America. As stated in the Black Hills Phase II Amendment FEIS (USDA Forest Service 2005):

*The Black Hills is an isolated, unglaciated, and distinctive group of rugged mountains rising above the surrounding plains. It is variously described as an “island on the plains,” and species from diverse environments, including the Rocky Mountains, northern coniferous forests, eastern hardwoods, and the surrounding Great Plains, have populated the “island.” As such the area forms an “ecological crossroads” and has been described as one of the nation’s greatest national treasures (USDA Forest Service 1996b).*

Grassland and shrubland ecosystems make up about 10 percent of the Black Hills National Forest. They serve as vital watershed cover, break up continuity of conifer vegetation, and may serve as a fuel break. They provide a diversity of plants vital for ecological integrity and serve as habitat for numerous wildlife species and pollinating insects.

As discussed in the *Ecosystems Services* section of this document, livestock grazing has been, and continues to be, an important use on the Black Hills National Forest. Supporting ranches that rely on public land grazing helps ensure the vitality of those operations and ultimately the maintenance of open spaces. Maintaining the sustainability of ecological resources through ecological integrity is therefore important for continuing the social, cultural, and economic benefits for local communities.

Goal 3 of the current forest plan states “...livestock grazing will occur without impairing the health of ecosystems and in a manner compatible with other Forest uses.” An accompanying objective (objective 302) states: “Maintain rangelands in satisfactory condition.” To maintain rangelands, livestock grazing is administered under policy detailed in Forest Service Manual 2200 and Forest Service Handbook 2209. Administration of livestock grazing permits includes permittee compliance with permit terms and conditions, allotment management plans, and annual operating instructions.

The U.S. Forest Service has a history of actively cooperating with the South Dakota Game, Fish, and Parks Department and Wyoming Fish and Game Department to ensure that big game population levels (elk, deer, bighorn sheep) are compatible with existing uses and consistent with forage resource availability. Other important cooperators for management consultation and cost-share projects have included (but are not limited to) livestock grazing permittees, the Rocky Mountain Elk Foundation, National Turkey Federation, Mule Deer Foundation, Ducks Unlimited, Rocky Mountain Bighorn Sheep Society, National Resource Conservation Service, and Spearfish Livestock Association.

## Use of Best Available Science and Information Gaps

Information sources used for this assessment include data from agency-wide databases including the Natural Resource Manager (INFRA) and Forest Activity Tracking System databases, as well as databases specific to the Black Hills, such as the Black Hills Geographic Information System (GIS) database. Monitoring data have been analyzed by the Black Hills National Forest rangeland management specialists, range technicians, and botanists, informed by the Region 2 Rangeland Analysis and Management Training Guide (USDA Forest Service 1996a).

## Chapter 2. Non-forested Ecosystems – Conditions and Trends

Non-forested ecosystems make up about 12 percent of the Black Hills National Forest land base (table 1), with grasslands and shrublands comprising approximately 10 percent. This assessment focuses on the grassland and shrubland ecosystems; the riparian and aquatic ecosystems are addressed in other assessments.

**Table 1. Area of non-forested ecosystem types in the Black Hills National Forest**

[Source: GIS data]

Non-forested Ecosystem Type	Acres	Percentage of the Black Hills National Forest
Grasslands	104,255	8.4%
Shrublands	6,984	1%
Riparian: Palustrine – marshes, swamps, bogs, fens, and ponds	4,254	<1%
Riparian: Riverine – rivers and creeks	13,581	1%
Aquatic: Lacustrine – lakes and reservoirs	6,862	1%
Total	135,936	

The 1996 Final Environmental Impact Statement (FEIS) for the Revised Land and Resource Management Plan categorized four major vegetative complexes on the forest: Rocky Mountain Coniferous Forest dominated by ponderosa pine (*Pinus ponderosa*), Northern Coniferous Forest Complex dominated by white spruce (*Picea glauca*), Deciduous Forest Complex of hardwood trees and shrubs, and a Grassland Complex of the Northern Great Plains.

These complexes were updated in the Phase II Amendment to the forest plan for the Black Hills National Forest and are refined further in *Black Hills Community Inventory Final Report* (Marriott et al. 1999). That report groups the upland grasslands and shrublands in the Black Hills as Dry Plains Shrublands, Dry

Mixedgrass Prairies, Mesic Mixedgrass Prairies, and Black Hills Montane Grasslands. Community types for each ecological group are described in appendix A.

When conducting site-specific analyses these broad community types can be further refined to ecological sites, as defined by the Natural Resource Conservation Service (NRCS). The accompanying ecological site descriptions detail potential plant communities as well as state and transition modeling which discloses expected changes in those plant communities as a result of management activities or disturbance. Forest Service staff from the Black Hills National Forest are working cooperatively with local NRCS staff to finalize ecological site descriptions for the grasslands across the forest.

The 1996 FEIS states that herbaceous and shrub vegetation has been impacted by four major factors during the last century: 1) high livestock densities reduced the abundance of palatable plants; 2) non-native plant species have become naturalized enough to become substantial floral components; 3) higher conifer densities reduced understory plant production and variety of grasses, forbs, and shrubs; and 4) fire suppression nearly eliminated a rejuvenating process for grasslands and shrublands.

Historic heavy grazing pressure from the late 1870s until creation of the Forest Service in 1905 led to replacement of shrubs and tall native grasses of meadows and prairies (grasslands). It also allowed shrubs such as snowberry (*Symphoricarpos occidentalis*) to become dominant. Combined with fire exclusion, fire-adapted shrubs such as willow (*Salix* spp.) and dogwood (*Cornus* spp.) aged and decreased from mortality.

Rocky Mountain Research Station and other researchers have conducted several studies of Black Hills vegetation. The species composition, density, and productive capacity of the herbaceous and shrub communities vary as a function of the soils and overstory canopy density (Uresk and Severson 1998). Understory production decreases as tree density increases, and conversely may be increased with logging and prescribed fire application. Conversely grasslands, shrublands, and herbaceous species beneath conifers decline with higher pine and spruce densities and encroachment, but two stressors in the past 25 years had noticeable impact. The two prominent stressors (mid-1990s to mid-2010s) are mountain pine beetle infestations and large wildfires. These stressors re-opened canopies of mature and densely stocked ponderosa pine stands. They also removed encroaching conifers from grasslands in some areas. Such removal is beneficial for forage production. However, ponderosa pine is a prolific regenerative species, and new seedlings and saplings are increasingly providing more surface shading, canopy cover closure, and encroachment into grasslands.

The Black Hills Montane Grassland community type described by Marriot and Faber-Langendoen (2000) is a plant assemblage unique to the Black Hills. Additional survey and mapping since 1999 resulted in identification of eight high-quality sites: Gillette Canyon Upper, Smith Draw, Lemming Draw Upper, Redbird Canyon South, West Hell Canyon Upper, Gillette Canyon Headwaters, Redbird Canyon at Sixmile, and Lemming Draw Lower (Marriott and Faber-Langendoen 2000, Marriott 2000, Marriott 2012). In 2000, the forest supervisor issued direction requiring consideration of high-quality montane grasslands before commencing ground-disturbing actions. The following specific activities were covered: logging, skidding, road construction or relocation (reconstruction of an existing prism is allowed), prescribed burning, large recreational group events, and ground-disturbing heavy maintenance or reconstruction of range improvements. Livestock grazing under a valid permit was identified as an activity to be continued. That direction has been followed since 2000 but has not been formally incorporated into the forest plan.

## **Ecosystem Drivers and Stressors**

Ecosystem drivers are factors or processes that affect ecosystem characteristics and contribute to the natural range of variation. Stressors are defined as factors that may directly or indirectly degrade ecosystem composition, structure, or processes in a manner that may impair its ecological integrity (36

CFR 219.19). Many system drivers can be stressors if they are operating in atypical ways, outside of their natural range of variability. Management influences can be drivers or stressors.

## Timber Harvest

Timber harvest has historically been a dominant ecosystem driver and stressor on public lands within the Black Hills. Commercial and pre-commercial activities often resulted in short-term forage opportunities for permitted livestock and big game wildlife, but they also introduce and exacerbate current infestations of noxious weeds and other non-native invasive plants which stress the ecological integrity of the grasslands and shrublands.

## Natural Disturbances

Ecological disturbances may shape non-forest structural diversity and composition at a range of spatial and temporal scales. Weather (e.g., wind, hail, tornados, and snow), wildfire, insects, parasites, pathogens, and wildlife individually and in combination may create openings in conifer canopies and promote vegetative diversity through new herbaceous and shrub growth. Each of these native disturbance agents influences the array of ecosystems in the Black Hills in different ways.

Mountain pine beetle infestations during 1996–2016 have re-opened canopies of mature and densely stocked ponderosa pine stands. This has affected approximately 15 percent of the national forest. They also removed encroaching larger conifers from grasslands in some areas. Such removal increases forage production because less competition for water and nutrients occurs for grasses and forbs. However, ponderosa pine is a prolific regenerative species, and seedlings and saplings are slowly restocking areas opened by fires and mountain pine beetles. This new growth slowly reduces available forage.

Native grasshoppers and Mormon crickets may compete for annual forage production when their populations greatly increase over baseline levels. In 2012, drought conditions facilitated brittle grass vegetation and increased insect use, and regular Black Hills National Forest grazing seasons were moderately to severely reduced, particularly by grass breakage from livestock passage.

Weather, in the form of wind, snow, ice, tornados, and hail, intermittently damages and kills ponderosa pine trees and stands throughout the Black Hills. Effects from weather are discussed in the *Forested Ecosystem* assessment. This mortality can and has provided short-term forage increases for permitted livestock and big game, when animal access into these affected areas is not blocked by downed trees. The rate of ponderosa pine mortality from weather and disease may continue and increase because of climate change as severe storms become more common and promote drought-induced tree disease.

## Fire and Fire Exclusion

Wildfire and fire exclusion have been dominant drivers and stressors in forested and non-forested ecosystems, particularly the ponderosa pine and grassland ecosystems in the Black Hills. Fire exclusion likely led to expansion of forests into grasslands in the Black Hills, although change in climate and/or historic livestock grazing may also have contributed (Murphy 2017, Brown and Sieg 1999).

It is likely that the extent of Rocky Mountain juniper (*Juniperus scopulorum*) has increased due to fire exclusion, and that other factors such as climate change and grazing have allowed for the expansion of juniper woodlands into meadows, grasslands, and other types (Scher 2002).

Fire and fire exclusion may both also affect the prevalence of invasive species in the grasslands and shrublands.

## Grazing

Grazing results in direct impacts of defoliation to individual plants and an alteration of canopy structure to the plant community. Plant reactions to those direct impacts depend on the ability of the individual plant to compensate for defoliation and the relative impact of the removal on competitive relationships in the canopy. In general, the replacement of tall and/or midgrasses by shortgrasses is a common response to grazing pressure across plant communities worldwide (Milchunas and Lauenroth 1993). With the removal of livestock grazing pressure the initial response is expected to be the reverse, i.e., an increase in the amount of tall and/or midgrasses and a decrease in the amount of shortgrasses. However, as Ruyle and Dyess (2010) summarize, vegetation changes occur as a result of many factors other than grazing, and disturbance is a natural feature of plant communities. Grazing is not necessarily a primary driver of vegetation change and even when grazing has been the cause of vegetation change, completely removing grazing will not always result in a return to historical conditions. In some areas, such as those currently dominated by non-native grasses, the altered plant communities can no longer achieve what may have been historic condition because of lack of a current seed source and/or changes in soil characteristics (such changes are considered state changes in vegetation).

Excessive grazing, browsing, and trampling can make bare mineral soil seedbeds for conifer establishment into grasslands and shrublands. The same result may occur under forested canopies, enhancing successful pine regeneration (USDA Forest Service 1996b). In both instances such overuse can alter original composition, allow for expansion of less desirable plant species, and lower plant root reserves. Conversely, proper grazing use can stimulate growth and reduce fire hazards by reducing fine fuels and incorporating litter and manure into the soil surface, which aids in watershed protection and site productivity.

## Invasive Species

Invasive species are one of the predominant stressors in grasslands ecosystems on the Black Hills National Forest. As discussed further in the *Ecological Integrity* section, non-native plants are the primary reason some rangelands on the forest are considered to be in unsatisfactory condition. Some of these areas are a result of the Forest Service intentionally seeding with non-native, cool season perennial grasses in the past (see the *Historical Use* section), effectively converting primary grazing areas to non-native plant communities. For example, numerous meadows were planted with forage species such as timothy (*Phleum pratense*) and smooth brome (*Bromus inermis*), and managed as hay grounds (Graves 1899, MacIntosh 1928). These non-native perennial grasses were intentionally seeded because of their ability to germinate, survive, and reproduce under poor soil conditions and altered hydrologic states. Their forage value is recognized and included when developing desired conditions during site-specific allotment planning. However, in many places, they have increased beyond what was identified as desirable to the point where their continued expansion is detrimental to native heterogeneity and resilient landscapes.

The forage quality of cool season grasses is high in the spring but decreases through the season, resulting in reduced overall forage quality during the summer (Patton et al. 2012). When native warm season grasses are lost, or severely reduced, the plant community is left without the component that would naturally respond to precipitation received throughout the summer. Thus the non-native cool season perennial grasses that were planted for their forage value do not produce quality forage throughout the season, and because of their invasive nature they have displaced the native grasses that would naturally fill that void later in the season.

The undesirable non-native plant component of many non-forested ecosystems, as well as the understory in forested ecosystems also includes legally designated noxious weeds. Despite coordinated control treatments by the Forest Service and numerous cooperators in the Black Hills Invasive Plant Partnership, invasive plants have proliferated across the Black Hills National Forest, particularly in the northern Black

Hills. A variety of vectors enable their active spread. Invasive plants, particularly noxious weeds, on the Black Hills National Forest are discussed further in the *Insects, Disease, and Invasive Species* assessment.

## Climate Change

Information in this section about the vulnerability of grasslands and shrublands to climate change was obtained from Timberlake and others (2022).

Ponderosa pine ecosystems have moderate vulnerability to climate change in the Rocky Mountain region, including the Black Hills (Rice et al. 2018). Drought conditions increases the susceptibility of trees to other disturbances, including insects (Rice et al. 2018) and fire.

Climate projections for the Black Hills are generally uncertain for precipitation but suggest there may be an increase in winter and spring precipitation, which could potentially benefit the herbaceous and browse vegetation associated with ponderosa pine as well as grasslands and shrublands. Such climate change may promote cool season grasses. Morgan and others (2008) note the expected increase in carbon dioxide over the coming decades is expected to enhance the production of cool season (C3) grasses over warm season (C4) grasses. This could exacerbate the spread of non-native cool season perennial grasses the Black Hills is already experiencing.

Projections show wide variation in future precipitation and increased variability in year-to-year moisture availability and precipitation. Future variability in moisture availability from year to year may result in increased variability in annual herbaceous forage and browse production compared to the present.

The lower elevation ecotones for ponderosa pine in the Black Hills may also be vulnerable to vegetation type conversion to grasslands, especially following disturbances that remove seed bearing trees. While Black Hills ponderosa pine is well north of the southern range limits of the species, suggesting low vulnerability to shifts in species distribution, the elevation profile of the Black Hills implies limitations on upslope range shifts as temperatures increase and life-zones move upward.

One study using a global vegetation model parameterized for the Black Hills indicates that ecotonal areas between prairies and woodlands are projected to experience increased fire frequencies under anticipated 21st century climate conditions. This investigation found that ponderosa pine would continue to persist in these areas in the face of increased fire frequency due to thick bark of older trees and other adaptations that confer resistance to surface fire if large, thick-bark adult pine persist (King et al. 2013). However, this would only be true if the trees were already a size that would facilitate survival after a fire and ponderosa pine may persist as woodlands rather than forests. This study's conclusions countered the findings of climate envelope modelling, which projected a loss of ponderosa pine in the Black Hills region (Rehfeldt et al. 2006). Mechanistic models like that used by King and others (2013) are generally viewed as more robust than climate envelope modelling (Iverson and McKenzie 2013).

As discussed above, studies conducted across the West indicate that wildfire will become more widespread because of climate change. Grassland and shrubland species associated with ponderosa pine may persist with some species shift to non-native, invasive grasses. Ponderosa pine has structural traits (e.g., thick sloughing bark, self-pruning lower limbs) that confer relatively high resistance to fire (Stevens et al. 2020), and their persistence may help maintain some favorable associated plant communities that also contain forage and browse species.

The effects of drier conditions on post-fire regeneration are another well-documented climate change vulnerability for ponderosa pine forests, particularly following high severity fires that burn large areas. Such high severity fires may facilitate conversion to grasslands and shrublands. Limited numbers of seed trees in these areas and climate-driven drought conditions make it difficult for trees to establish (Stevens-Rumann et al. 2018). Studies examining the effects of the Jasper fire, which burned more than 80,000 acres in 2000, suggest limited pine regeneration in areas that burned at high severities (Lentile et al. 2005,

Keyser et al. 2008). One study that examined several fires, including the Jasper fire, indicated that climatic stress was one of three factors most strongly associated with post-fire regeneration patterns, along with burn severity and elevation (Korb et al. 2019), thus allowing grasslands and shrublands to persist without pine regeneration.

## **Other Forest Users**

As mandated by the Multiple-Use Sustained-Yield Act of 1960, National Forest System lands, including the Black Hill National Forest, are managed for multiple uses. Some of these uses may degrade grassland and shrubland vegetation. Impacts can be direct, such as off-road/trail vehicle use denuding the native vegetation, or indirect, such as gates being left open and making it impossible to control grazing and rest periods. Recreation on the Black Hills National Forest is expected to continue to increase. As the number of visitors increases, the magnitude of the impacts from that use is expected to increase. Opportunities to minimize the effects from this particular stressor include management actions such as installing user-friendly gates or UTV cattleguards, and public education regarding the users' role in ensuring that permitted livestock stay where they are supposed to be (i.e., the importance of closing gates).

## **Key Ecosystem Characteristics and Ecological Integrity of the Ecosystem**

The Black Hills National Forest grasslands are a group of diverse plant communities occurring on numerous soil types. They include areas with predominantly native grass and forb species, areas that are a diverse mix of native and some non-native invasive grasses, and other areas dominated by non-native grasses and noxious weeds. While the grasslands Forestwide have variable plant communities, they all provide habitat, forage, browse for numerous wildlife species, and other ecosystem services such as watershed protection and pollination opportunities. The ecological integrity (discussed further below) is variable but generally moderate.

One sub-aspect of grasslands ecosystems is the significance of montane grasslands. Per Marriott (2012): *“Due to limited global distribution, rarity of native stands, significant habitat loss in the past, continued habitat loss, and low level of protection afforded remaining stands, Black Hills montane grassland vegetation is ranked G1S1 [rare at Global and State level due to rarity of native stands] in South Dakota and Wyoming, “critically imperiled” on a global and local basis.”*

The predominant upland shrublands on the forest are mountain mahogany (*Cercocarpus montanus*) shrublands, located on the western and southwestern portions of the Black Hills National Forest. A large swath of the mountain mahogany shrublands are within the Fanny/Boles Research Natural Area. They generally reflect stable moderate ecological integrity and are subject to occasional fires of low severity. They provide a unique plant community, habitat, and browse forage for wildlife and protect soils and watersheds.

## **Ecological Integrity and Species Diversity**

Ecological integrity of grasslands is perhaps best described in terms of range condition. Range condition is generally considered to be the status of the rangeland plant community compared to some benchmark typically associated with a theoretical climax or historical plant community (Ruyle and Dyess 2010, USDA Forest Service 1996a). The current forest plan for the Black Hills National Forest states:

*A rangeland is considered to be in satisfactory condition when the desired condition is being met or short-term objectives are being achieved (vegetation management status) to move the rangeland toward the desired condition (trend). Unsatisfactory condition is when the desired condition is not*

*being met and short-term objectives are not being achieved (vegetation management status) to move the rangeland toward the desired condition (trend). (USDA Forest Service 1997).*

Site-specific objectives are identified during project-level planning and include desired conditions for vegetation, cover, and soils in upland and riparian areas. For the past 20 years the protocol used most often to determine upland conditions is the cover-frequency protocol (USDA Forest Service 1996a), while the multiple indicators monitoring protocol (Burton et al. 2011) has been used most often in riparian areas (please see the *Aquatics, Riparian and Groundwater-Dependent Ecosystems* assessment for further information regarding riparian areas). However, other protocols identified in the Rangeland Analysis and Management Training Guide (USDA Forest Service 1996a) are also used. The types and number of long-term monitoring studies used to monitor conditions on the Black Hills National Forest are listed in table 2.

**Table 2. Number of long-term monitoring studies on the Black Hills National Forest**

[Source: District GIS records]

Monitoring Protocol	Number of Study Sites
Cover Frequency	313
Ocular Plant Composition	79
Multiple Indicators Monitoring (Riparian)	25
Paced Transect (Historical)	44
Proper Functioning Condition (Riparian)	20
Photo Point	352
Other protocols used infrequently <sup>1</sup>	69
Total	902

<sup>1</sup> Includes Rooted Nested Frequency, ECODATA, Sample Point, Cover by Life Form protocols.

Long-term monitoring studies help identify changes in the plant communities, which determines if the site-specific conditions are moving toward desired conditions. They are generally permanently marked to enable repetitive reading and considered ‘long-term’ because changes in plant communities occur slowly, over many years. Each study is reread on an established schedule, and many have historical data back to the 1950s. The monitoring protocol has varied over the years so while direct comparison may not be available prior to the 2000s, species composition generalities can be determined from historical data. The two protocols listed in table 2 that may not be permanently marked are ocular plant composition and paced transect. Paced transects are not currently common on the Black Hills National Forest; however, data from the historic studies may be used to determine the historic plant communities in some areas. Ocular plant composition studies may occur at permanently marked long-term monitoring sites, or they may be used elsewhere when more data regarding plant communities is needed for a broader picture of the vegetation.

What is not included in Table 2 is the short-term monitoring that occurs yearly. Short-term monitoring includes utilization (including visual obstruction readings, i.e., Robel pole), and compliance checks. Short-term monitoring helps ensure that management reflects the proposed grazing management on a unit. Short-term monitoring is not used to determine if a site is moving toward a desired plant community, but does inform grazing permit compliance and may indicate a need for management changes.

The final environmental impact statement for the current forest plan noted that 79 percent of the rangeland Forestwide was in satisfactory condition in 1995 (USDA Forest Service 1996b). An assessment of the rangeland vegetation data currently indicates that 71 percent of the rangeland Forestwide is in satisfactory condition (table 3). This current assessment is based on professional and technical knowledge

of the planning area, and an analysis of the long-term monitoring data collected using the protocols identified in table 2.

**Table 3. Forestwide summary of rangeland condition**

	1995	2021
Percentage of acres meeting or moving toward forest plan objectives (satisfactory)	79%	71%
Percentage of acres not moving toward forest plan objectives (unsatisfactory)	4%	22%
Percentage of acres with undetermined status	17%	5%

At first glance the trend for rangeland condition Forestwide appears to be fairly stable (or slightly downward); however, a deeper look at the data reveals important nuances. Since 1995 all the active grazing allotments on the Black Hills National Forest have undergone site-specific project planning and the overall grazing management has improved, resulting in meeting, or moving toward, desired condition in more areas, an increase in acres rated as satisfactory, and ultimately more sustainable conditions. Concurrently, there has been a substantial increase in both the establishment and spread of non-native, invasive plants on portions of the forest. As noted previously, this increase is a direct result of both the intentional seeding of non-native cool season grasses (described further under the *Historical Use* section), and an increase in (non-native) noxious weeds. Because the desired conditions always include a diverse native plant community, those areas that have experienced a substantial increase in non-native, invasive plants cannot be considered ‘satisfactory,’ even though the driver for that rating is not livestock grazing management. In general, the reasons for an area to be in unsatisfactory condition fall into three broad categories:

1. **Livestock grazing management** – This is the category most people think of when they hear the term ‘unsatisfactory range condition.’ However, on the Black Hills National Forest, this is not the most common reason for unsatisfactory rangeland condition. As described further under the *Current Management* with the adaptive management component of the allotment management plans, livestock grazing management is continuously being adjusted for current conditions. There are areas where additional structural range improvements are still needed and are awaiting adequate funding, and other areas where grazing management continues to be adjusted. But overall, livestock grazing management has improved since 1995 as controlled grazing management practices have been implemented, allowing for adjustments to the timing, intensity, duration, and frequency of livestock grazing.
2. **Other forest uses** – As noted under system drivers and stressors, other uses of the forest may adversely impact rangeland vegetation. Impacts can be direct, such as denuded native vegetation or indirect such as gates being left open and making it impossible to control grazing and rest periods. It may be an increased prairie dog population that needs reduction in size and scope, or soil disturbance from timber activities; any of these can result in impacts to the rangeland vegetation that are unrelated to livestock grazing management yet prevent the area from moving toward desired conditions.
3. **Increased non-native, invasive plants** – A majority (94 percent) of the areas identified as unsatisfactory rangeland condition in 2021 have a non-native plant component that significantly exceeds what was identified in the desired conditions for the area. During the site-specific planning efforts, the non-native cool season grasses (timothy, smooth brome, and Kentucky bluegrass, *Poa pratensis*) were often identified as part of the desired conditions; however, in some areas these non-native cool season grasses have continued to spread and are now present in

percentages beyond what was identified as desired, resulting in unacceptable losses of native plant diversity. Because desired conditions must be attainable, it is likely some areas will need to be re-evaluated and ultimately managed as areas lacking native plant diversity (i.e., intentionally managed for a non-native plant community). However, there are also areas where non-native grasses are increasing but have not yet reached the threshold to eliminate native diversity. It is those areas, where potential to increase native plant diversity still exists, that have been identified as unsatisfactory range condition in 2021.

This undesirable non-native plant component also includes legally designated noxious weeds. Despite ongoing treatment, noxious weeds have aggressively expanded across the Black Hills and surrounding area. Under the Black Hills National Forest Noxious Weed Management Plan (USDA Forest Service 2003), targeted grazing is an available tool to use for noxious weed control. However, the opportunity to use domestic sheep for targeted grazing is limited because disease transmission from domestic sheep to bighorn sheep has been raised as a concern by South Dakota Game, Fish, and Parks. The current noxious weed management plan does not include aerial application of herbicide as an available tool, effectively precluding the use of new drone technology for herbicide application.

As discussed above, range condition is assessed by comparing the existing plant community to what has been identified as desired conditions on a particular site. The same methodology can be used to estimate a broad category of ecosystem integrity for the grasslands and shrublands and to predict future ecosystem integrity under current management. A summary of the ecological integrity for grasslands and shrublands is displayed in table 4; additional details are in earlier sections of this document. Key factors for the moderate and low/moderate ratings are:

- Since 1995 all the active grazing allotments on the Black Hills National Forest have undergone site-specific project planning and the overall grazing management has improved, resulting in meeting, or moving toward, desired condition in more areas, an increase in acres rated as satisfactory, and ultimately more sustainable conditions.
- However, there has also been an increase in acres invaded by non-native, invasive grasses such as Kentucky bluegrass, timothy, and smooth brome on portions of the grasslands. Climate change may favor these grasses and other invasive noxious weeds. While these non-native plants produce forage for grazing animals and help protect the watershed by producing effective ground cover, they pose a risk to native plant diversity. A continuation of current forest plan direction could result in a loss of ecosystem integrity in some grasslands as the invasive plants increase.
- Ponderosa pine is a prolific regenerative species. High intensity fires and climate change may lead to areas devoid of or sparsely stocked with pine and would be expected to promote short- and long-term grassland and shrubland expansion.
- Forest structure across the landscape has been simplified and is not as diverse as the historical structure. This change in forest structure also has likely led to a loss in the diversity and biomass of understory grasses and shrubs.

**Table 4. Summary of terrestrial ecosystem integrity and trends**

Ecosystem	Current Ecosystem Integrity	Likely Future Ecosystem Integrity with Current Forest Plan Direction
Grasslands	Moderate	Low/Moderate
Shrublands	Moderate	Moderate

## Chapter 3. Ecosystem Services

Ecosystem services are defined by the planning rule as benefits people obtain from ecosystems (36 CFR 219.19). Humans benefit from and depend on non-forested ecosystems such as grasslands and shrublands in a variety of ways. They provide vegetative and litter cover to help regulate water quality and quantity, stabilize and develop soil profiles, and support carbon sequestration. Plant species also provide pollination opportunities for native insects and bees from managed hives. Grassland watersheds typically support another terrestrial ecosystem: riparian, which in turn may support favorable stream and creek flows. These flows in turn provide fish habitat for native species, and for introduced catchable species.

Both grassland and shrubland ecosystems are often vital year-round in supporting a variety of wildlife species including small mammals (e.g., pine martens and tree squirrels), big game (e.g., elk, mule deer, and whitetail deer), and watchable wildlife (e.g., raptors and songbirds). Recreational opportunities are present for viewing wildlife, hiking, dispersed camping, and for using designated motorized trails and roads with a variety of vehicles. Big game, predator, prairie dog, and upland bird hunting opportunities are present as well. Many plants within grasslands are of cultural and tribal importance; tribal members may seasonally collect plants for medicinal and spiritual uses. Some grassland locations have religious meaning to Native Americans. Grasslands and shrublands also exhibit beautiful scenery and offer opportunities for solitude and spirituality.

Livestock grazing has been, and continues to be, an important use of the Black Hills National Forest. Several of the ranching operations in the area rely on public lands (e.g., national forests and grasslands, state, and Bureau of Land Management lands) for livestock grazing. Supporting these ranching operations helps ensure the maintenance of open spaces and reduces the number of issues associated with the wildland-urban interface. As described further in the *Forest Assessments: Socioeconomics* document, the County comprehensive plans from the area emphasize the importance of protecting the rural character and natural amenities that characterize the communities in the area (Crook County 2014, Custer County 2009, Lawrence County 2020, Meade County 2010, Pennington County 2020). Maintaining the sustainability of ecological resources is therefore important for continuing the social, cultural, and economic benefits for local communities.

Ecosystems with moderate to high ecological integrity that are resilient to future disturbances and climate change will continue to provide the ecosystem services that have been historically provided by the Black Hills National Forest. Continued production of ecosystem services may be more difficult and less certain if ecosystems have reduced or low ecological integrity or experience large-scale disturbances.

### Permitted Livestock Grazing

Rangelands are defined as all lands producing or capable of producing native forage for grazing and browsing animals and lands that have been revegetated naturally or artificially to provide a forage cover that is managed like native vegetation. Rangelands include all grasslands, shrublands, and forested lands that can, continually or periodically (naturally or through management), support an understory of herbaceous or shrubby vegetation that is forage for grazing or browsing animals.

Generally speaking, grasslands are considered primary range whereas shrublands and forested ecosystems are typically secondary range. Primary range is preferred by livestock and big game based on forage availability and nearby water sources. Secondary range also provides forage and browsing opportunities but is generally farther from water sources, provides less total forage, and is in steeper terrain. Secondary range may provide better hiding, security, and thermal cover for big game animals. The term transitory is used to convey the short-term changes in available forage associated with plant succession; it is used here to address grazing and browsing opportunities often available due to changes in the forested ecosystems. As forested ecosystems develop and mature, they often develop denser canopies that restrict sunlight and

understory growth and provide less forage and browse production; conversely, as canopies are opened, the understory produces more forage and browse.

The current forest plan defines an allotment (as it pertains to range management) as a designated area of land available for livestock grazing upon which a specified number and kind of livestock may be grazed under a range allotment management plan. It is the basic land unit used to facilitate management of the range resource on National Forest System lands.

Suitable rangelands are those lands where the economic and environmental consequences, and alternative uses foregone, have been analyzed to determine they are appropriate for livestock grazing management (36 CFR 219.3). The current forest plan identifies 1,037,598 acres of the Black Hills National Forest as suitable for grazing, all of which is managed on 136 active cattle allotments. The number of allotments, status, and National Forest System acres by ranger district are listed in table 5. Note that the acres displayed were summarized by allotment and do not differentiate between suitable and unsuitable acres (which is why the number of total acres differs from the number of total suitable acres referred to previously).

**Table 5. Number of grazing allotments, National Forest System acres, and status, by ranger district**

[Source: GIS, INFRA database]

Ranger District	Active Allotments (acres)	Vacant Allotments (acres)	Closed Allotments (acres)	Total Allotments (acres)
Bearlodge	33 (185,420)	0 (0)	0 (0)	33 (185,420)
Hell Canyon	45 (430,395)	1 (1,492)	1 (12,097)	47 (443,984)
Mystic	30 (279,535)	0 (0)	0 (0)	30 (279,535)
Northern Hills	28 (267,535)	4 (22,743)	1 (15,842)	33 (306,120)
Total	136	5	2	143

There are five vacant and two closed grazing allotments on the Black Hills National Forest (table 5). Efforts are currently underway to restock one of the vacant allotments, through the allotment management planning process. Restocking the other four vacant allotments is not considered feasible at this time. They would require extensive resources not readily available, and the increased grazing capacity from the investment would be very small. They lack water, fencing, and access, and have human encroachment.

There are 420 grazing permits on the Black Hills National Forest, including term grazing permits, term grazing permits with on/off provisions, term private land permits, temporary grazing, or livestock use permits (may include crossing permits, breeding animal permits, vegetation manipulation permits). Term grazing permits are the most common grazing permit. They are issued for a 10-year period, and the permit holder may have preference for renewal. Temporary grazing permits are issued for no more than one year and there is no preference for renewal. All permits on the Black Hills National Forest are for cattle grazing. Those 420 grazing permits are held by 193 different permittees. The number of grazing permittees by ranger district for the 2021 grazing season is listed in table 6.

**Table 6. Number of grazing permittees by ranger district, 2021 grazing season**

[Source: INFRA permits report 2021]

Bearlodge Ranger District	Hell Canyon Ranger District	Mystic Ranger District	Northern Hills Ranger District	Total
51	79	30	33	193

## Historical Use

Livestock grazing in the Black Hills area was unregulated from the late 1870s to 1905, when efforts to control grazing began with the establishment of national forests.

The following history of grazing (in *italics*) for the Black Hills is excerpted from “Historic and Contemporary Use and Occupation of the Black Hills” (USDA Forest Service 1994), which was compiled during the 1997 forest plan revision process. This excerpt is repeated here to provide insight on the nature and intensity of historical grazing impacts in the Black Hills and provides a social perspective for the vegetative range conditions found in the Black Hills today:

*“With the 1870s gold rush, needs for meat, vegetables, dairy products and fodder for people and animals moving into the Hills heightened. Over the next two decades, industries grew out of cattle and sheep production, both within and outside of the Hills (Cassells et al. 1984). By 1888, as many as 600,000 cattle were concentrated in the Black Hills region. Estimates from 1903 placed cattle at 300,000 head, sheep at 100,000, and horses at 7,000 head (Cassells 1984). Plains ranchers also brought cattle into the Hills in the summer in search of grazing lands. Livestock numbers for this era are phenomenal given the number of cattle allowed today. Currently 23,000 head of cattle (28,344 head in 2021) graze on the Black Hills National Forest lands.*

*Like other parts of the West, “range wars” erupted between sheep and cattle interests. Although Belle Fourche and Rapid City supported a thriving wool industry with warehouses used as hubs for wool exports, cattlemen lobbied hard to drive sheep from the Hills. After holding public meetings, (Gifford) Pinchot opted to close the Forest to sheep. He did so in large part to protect the Forest’s timber reserves, which were being degraded by sheep that often destroy pine saplings. Sheep were again allowed on the Forest in 1916, “probably because the price of wool was up, and the price of beef was down” (Geores 1993). Sheep grazing on Forest System lands in the Black Hills has occurred since, but not to the scale it had early this century and late last century. (Today there is no domestic sheep grazing on the National Forest System lands).*

*Homesteading ceased for a time in the Black Hills as a result of the creation of the Black Hills Forest Reserve in 1898. Those homesteads already established in the Hills were allowed to stay on... The Forest Homestead Act of 1906 dissolved the 1898 moratorium on homesteading on Forest Reserves. Homesteaders again arrived in the Hills. Since many of the lower elevation areas had already been homesteaded, a number of people tried to homestead in the higher valleys and draws within the Black Hills. The usual pattern was to claim a homestead along a stream bottom, which included a long strip of land along the stream. This process, along with those who filed mining claims, scattered parcels of private land in the public lands of the Black Hills National Forest... In some instances, small grains were produced on meadows that were cleared of rocks. Hay was gathered from natural grasses. Nearly all of these early homesteads have since been abandoned or subdivided. Because of the climate, successful homesteading above about 6,000 feet proved virtually impossible (Cassells et al.1984).”*

The newly established Forest Service immediately started livestock grazing management with issuance of permits and charging grazing fees on these newly acquired reserves. Permit holders were authorized to turn out cattle in the spring (approximately early/mid-May after snow melted off and grass growth

initiated) and gather in the fall (October/November). Sheep were either herded across portions of the national forest or allowed to use higher elevation areas. Livestock often concentrated in preferred areas, typically valley bottoms and narrow drainages, often resulting in overuse of these areas.

Another excerpt in *italics* from “Historic and Contemporary Use and Occupation of the Black Hills” (USDA Forest Service 1994) further explains:

*“By the early 1940s, some rangelands on the Forest were severely overgrazed. As a result, the Forest Service reduced the number of grazing permits to allow the land to recuperate. Programs were implemented in the 1950s to improve range conditions, including rotational grazing system and aerial spraying of weeds. These programs met with some success and were undertaken cooperatively between the Forest Service and permittees.”*

Some sparse, eroded areas were of increasing concern to Forest Service officials, aggravated by sustained high levels of livestock use. During the 1930s Dust Bowl Era, the resultant loss of soils on the plains was noted by the Forest Service. Concerned such soil erosion would spread to or start on National Forest System lands, they shared non-native grass seed mixtures with permittees to reseed bare and thin areas. These non-native, cool season perennial grass species served as stabilizers of soil and provided ground cover. Non-native grasses dominate in many areas of the national forest today as a direct result of those early seeding practices.

The length of the period of use is an additional indicator of how much grazing use the area received. During the early 1900s the period of use was seven to eight months (April or May until November). From the 1930s to 1950 the period of use decreased to six months (May thru October). After 1950 the period of use was decreased to approximately four and one-half to five months (June to October).

In addition to reducing the number of cattle and the period of use, implementing grazing systems that supported growing season rest in the 1950s and 1960s helped to improve conditions. Implementing planned rest periods as part of improved range management required more structural range improvements. Fences, spring developments, wells, pipelines, water storage tanks, water tanks, and handling facilities were constructed to achieve improved livestock distribution and timing of grazing use.

## **Current Management**

Livestock grazing management has continued to improve across the Black Hills National Forest since 1995, with the implementation of controlled grazing practices that allow for adjustments to the timing, intensity, duration, and frequency of livestock grazing. During the late 1990s to mid-2000s there was Forestwide effort to conduct and update site-specific analyses on all grazing allotments in compliance with the National Environmental Policy Act. That effort, informed through evaluation of long-term monitoring data, resulted in adjusting the levels of use and changing grazing management on the allotments.

The decision documents produced as a result of those site-specific analyses incorporated an adaptive management component into the allotment management. Adaptive management can be defined as a way to remain flexible to cope with changing conditions and annual climatic fluctuations. It is an approach to ecosystem restoration that recognizes uncertainties, embraces multiple problem-solving strategies, and allows for adjustments to be made along the way. If monitoring shows desired conditions, or progress toward desired conditions, are not being met, then one or more of the adaptive management actions may be utilized. This allows the Forest Service to work with grazing permittees to implement actions intended to meet standards and guidelines and ultimately help achieve the desired conditions in a timely manner.

Adjustments to livestock grazing timing, intensity, duration, and frequency continue today, with annual adjustments to fit the resource needs on each allotment. Forest Service staff meet with grazing permittees annually to develop annual operating instructions and address any site-specific concerns. In recent years,

annual operating instructions for some allotments have been tailored to use livestock as a vegetation management tool to manage herbaceous fuels, achieve desired impact on forage, and reduce infestations of noxious weeds.

The construction of new structural range improvements continues today as a cost-share between the permittees and the Forest Service. The current number of structural range improvements is listed in table 7. These structures continue to help improve management on the allotments by providing management flexibility.

**Table 7. Structural range improvements by ranger district**

[Source INFRA database, GIS]

Ranger District	Fences (miles)	Water Storage	Water Developments	Pipelines	Cattleguards	Total
Bearlodge	174	258	101	9	81	449
Hell Canyon	708	1,080	266	84	216	2,354
Mystic	429	657	214	25	300	1,625
Northern Hills	295	108	147	5	117	672
Total	1,606	2,103	728	124	714	5,275

### Trend in Livestock Use

While there are fluctuations in response to yearly conditions, the level of livestock use across the Black Hills National Forest has remained fairly constant since implementation of the 1983 forest plan (table 8). The record of decision for the 1983 forest plan noted that livestock grazing would be “maintained at current levels” (USDA Forest Service 1983). The accompanying forest plan identified the level of grazing use as 128,000 animal unit months, with a prediction that use would remain at that level into the future. Likewise, the current forest plan states that livestock use will be up to 127 million pounds of forage per year or approximately 128,000 animal unit months (objective 301a). The numbers for 1888 and 1903 (table 8) are from *Historic and Contemporary Use and Occupation of the Black Hills* (USDA Forest Service 1994) and are included to illustrate use prior to the establishment of the national forest (please note the estimates for 1888 and 1903 were for the general area, not just the national forest lands). The data for 2021 are from the INFRA database and are included to show recent permitted use, which fluctuates yearly but has remained below 128,000 animal unit months.

**Table 8. Livestock grazing use**

Year	Estimated Cattle	Estimated Sheep	Estimated Horses	Animal Unit Months
1888	600,000	unknown	unknown	unknown
1903	300,000	100,000	7,000	unknown
1983	23,940	300	0	128,000
1995	24,000	0	0	up to 128,000
2021	24,375	0	0	115,440

## Wildlife

Healthy, productive wildlife communities are another ecosystem service provided by healthy rangelands. Rangelands provide forage for both domestic livestock and wildlife populations, and rangeland managers consider use levels by both when applying adaptive management and adjusting annual grazing. Management in terms of timing, intensity, duration, frequency, and distribution has been adjusted in many areas of the Black Hills National Forest to maintain or enhance overall rangeland conditions.

The Forest Service actively cooperates with State agencies to balance the forage demands of a desired big game population and livestock with the production potential of the National Forest System lands and precipitation variability. The current forest plan objective 301 states: *‘Produce and make available up to 233 million pounds of forage for livestock and wildlife use each year (weather permitting). This total production is further allocated with up to 127 million pounds or approximately 128,000 animal unit months for livestock. Wildlife use is allocated up to 106 million pounds of forage each year or approximate population levels of 70,000 deer and 4,500 elk or other combinations that use the same amount of forage.’* A recommendation received during the public input period was to revise the forest plan to remove the estimated pounds of forage produced (because it comes with a degree of error), as well as the species-specific allocations of forage; that has been identified in this document as a potential need for change.

Over the past several years, Forest Service staff and permittees have worked with State agencies to coordinate beneficial range improvement projects for both livestock and wildlife. For example, grazing can improve forage quality by removing coarse grasses and allowing for nutrient-rich regrowth; water developments aid in wildlife distribution; and it has been informally noted that areas not grazed by permitted livestock do not receive the level of use by big game as grazed areas receive each season. As stated in Vavra (2005), managed livestock grazing programs have potential to maintain or improve wildlife habitat diversity and quality. It is difficult to generalize the impact of livestock grazing on wildlife Forestwide because of the uniqueness of each grazing situation and varying habitat requirements of different wildlife species.

As the land management agency, the Forest Service manages the forage resource and wildlife habitat, but does not control the wildlife numbers. The State agencies are responsible for managing the wildlife populations. The management plans for wildlife are available on the agency websites:

- [South Dakota Game, Fish, and Parks wildlife and fisheries management plans](#)
- [Wyoming Game and Fish Department habitat plans](#)

## Fuels Reduction

Many of the public comments received on the draft document noted that there was no mention of the role livestock grazing plays in the reduction of fine fuels. While the effects of livestock grazing on the fuel load is more appropriately addressed in the effects analysis to be conducted during the next phase of the revision process, it is noted here that the current forest plan acknowledges the use of livestock grazing as a tool for reducing hazardous fuels. The current forest plan states, even in areas designated unsuitable to grazing, *livestock may occasionally be used as a tool to achieve management objectives, such as noxious weed control, hazard reduction of fine fuels, pre-planting treatment and maintenance of grass/shrub health, etc.*

The use of livestock grazing to reduce fine fuels is supported by Davies and others (2022), who note that grazing can alter fuel characteristics by reducing fuel continuity, height, and amount, and can also increase fuel moisture by decreasing dead plant materials, particularly prior years' growth of annual and perennial grasses. Moderate grazing can also reduce litter buildup and ultimately be used to alter plant communities, which may in turn alter fuel characteristics.

## Economic and Social Sustainability of Rangeland Management

Livestock grazing use on the forest has remained constant since 1983 (table 8). The Black Hills National Forest has supported up to 128,000 animal unit months of forage use by livestock, which is within range of the stated goal and objective of supporting the livestock community. However, there has been a tendency for the number of permittees per allotment to be reduced, often resulting in one permittee per allotment as consolidation occurs over time. In 1983, the final environmental impact statement developed for the forest plan states that there were 303 permittees on the Black Hills National Forest; in 2021, there were 193.

For information on the economic and social sustainability of rangeland management, please see the *Issues in the Broader Landscape* section below, and the *Benefits to People: Multiple Uses, Ecosystem Services, and Socioeconomic Sustainability* assessment.

## Chapter 4. Current Forest Plan and its Context within the Broader Landscape

### Existing Forest Plan Management Direction

The current forest plan direction for rangelands is to provide livestock forage commensurate with the needs of the resources and in harmony with plan direction. The Forest Service actively cooperates with State wildlife agencies to achieve big game population levels that are compatible with existing uses and consistent with forage resource requirements and availability. Forest plan objective 301 states: “*Produce and make available up to 233 million pounds of forage for livestock and wildlife use each year (weather permitting) ...*” The objective states livestock use will be up to 127 million pounds of forage per year or approximately 128,000 animal unit months, and wildlife use will be up to 106 million pounds of forage each year or approximate population levels of 70,000 deer and 4,500 elk or other combinations that use the same amount of forage. As noted previously, comments received on the draft of this document recommend revising objective 301 to remove the reference to pounds of forage produced (because of the inherent degree of error introduced when trying to project yearly forage production) as well as the species-specific allocations.

The current forest plan sets allowable forage use by rangeland condition and grazing system. The terms “satisfactory” or “unsatisfactory” rangeland condition are used to describe whether areas are meeting specific forest plan and allotment management plan objectives. Allotment-specific objectives are identified during site-specific planning for each allotment.

The current plan contains direction related to livestock management and associated range improvements, both structural (i.e., fences and water developments) and nonstructural (i.e., seeding and burning).

Objective 205 of the current forest plans states to manage for 122,000 acres or prairie grassland and 3,600 acres of meadow, and, specific to Management Area 5.1A, to remove pine encroachment in grasslands and shrublands.

Additional current plan direction is detailed in appendix B.

## Issues in the Broader Landscape

Livestock ranching operations manage millions of acres of rangelands in the United States. These operations produce food and are increasingly important for providing ecosystem services as more rangelands are permanently converted to development. As noted previously, county comprehensive plans in the Black Hills area note the importance of supporting ranching operations and maintaining open spaces.

Droughts affecting extensive areas of the Central and Western United States can trigger undesirable ecological changes in rangelands, reduce livestock production and provision of ecosystem services, and threaten ranching livelihoods (USDA Forest Service 2016).

In September 2016, General Technical Report WO-94, *Future of America's Forest and Rangelands* was published. This report provides a snapshot of current forest and rangeland conditions and trends, identifies drivers of change, and projects conditions 50 years into the future. The report contains information regarding the sustainability of rangelands and five impact areas: 1) rangeland productivity by examining the potential effects of climate change, 2) the flux and storage of soil organic carbon on rangelands, 3) the vulnerability of livestock in the United States that depend on rangeland forage for all or part of their life cycle, 4) quantifying the status and trends of degradation on rangelands, and 5) examining the present and ongoing drought situation to understand conditions that have led to relatively low cattle inventories in the United States (USDA Forest Service 2016).

The analysis concludes:

1. The Interior West and Eastern Prairie rangeland ecoregions exhibit the greatest amount of warming. Some subsections in the Interior West experience significant increases in temperature, the average often exceeding 4 degrees Celsius (39.2 degrees Fahrenheit) by the end of the 50-year projection period.
2. Net primary productivity (the rate of assimilation of carbon dioxide through photosynthesis [taking in carbon dioxide equals the creation of plant material]) over the next 50 years is estimated to increase or stay stable in the Interior West ecoregion among other ecoregions, but decline in the Southwest and Desert Southwest.
3. The vulnerability of cattle operations to climate change is projected to be higher in the Southwest, while the northern portion of the Great Plains ecoregion exhibits less vulnerability. Diversifying livestock operations and maintaining flexibility in herd sizes and stocking rates (i.e., adaptive management) will be important strategies in adapting to climate change.
4. About 7 percent of U.S. rangelands exhibit significant decreases in productive potential. Other monitoring strategies are needed to augment the degradation assessment at the national scale versus at the local scale.

Additionally, the expected increase in carbon dioxide over the coming decades is expected to enhance the production of cool season (C<sub>3</sub>) grasses over warm season (C<sub>4</sub>) grasses (Morgan et al. 2008). This could exacerbate the spread of non-native cool season grasses the Black Hills is already experiencing.

Livestock managers have historically dealt with drought conditions. Current efforts associated with the dry years of the early 21<sup>st</sup> century validate the use of adaptive management to increase resiliency of rangeland vegetation and for sustainability of rural communities and economies. Adaptive management provides sufficient capacity for flexibility with predicted long-term droughts that are more intense and severe, as well as “flash” droughts like the one experienced across a wide swath of the United States in 2013. The key for livestock managers is the ability to increase flexibility in management to adapt to increasing weather variability associated with a changing climate (Derner 2015).

## Chapter 5. Potential Need for Forest Plan Changes

The Black Hills National Forest may need plan revisions to provide better direction for management of ecosystems to achieve a desired outcome based upon best available science. The focus should be on managing to maintain resiliency to provide for ecosystem services and buffer anticipated impacts from climate change. Thus, the overarching need for change is a need for more management flexibility to respond to variable resource or climatic conditions.

- As noted throughout this document an increase in non-native cool season perennial grasses is a concern, and that concern will likely be exacerbated in the future as predicted climatic conditions are expected to favor these species. The current forest plan prescribes proper use levels of less than 50 percent on areas defined as unsatisfactory (guideline 2505). This guideline is contrary to what is now known for managing rangelands with a large non-native cool season grass component. Managing to reduce the levels of non-native cool season grasses and move these sites toward satisfactory conditions will likely require early season, time-controlled intensive grazing, followed by rest periods timed to favor native species (multiple citations summarized in DeKeyser (2014)). It will also be necessary to ensure the forest continues to provide needed forage and that management actions taken to restore native plant communities do not result in a decrease of available forage.
- The current forest plan has an objective for the management of prairie dogs (objective 237: manage for 200 to 300 acres of prairie dog towns across the forest in at least three separate towns). Additional direction for managing prairie dogs would help in areas where expanding prairie dog towns are preventing portions of some allotments from moving toward desired conditions.
- Consider editing the current forest plan definition of satisfactory and unsatisfactory range conditions to include ‘as influenced by livestock grazing management.’ Or editing the definition to acknowledge some drivers that affect rangeland condition are completely unrelated to livestock grazing management.
- Consider editing objective 301 so it considers the potential future variability in forage production expected from climate change, including removing any forage allocation language. As noted by commentors on the draft assessment, a forage production estimate comes with a degree of error and there is a high likelihood it will change throughout the life of the plan.
- Consider, as needed, updating structural range improvement guidelines with other resource objectives. Examples include fence construction designed for elk passage by including a top cable, new or reconstructed water developments that provide access to safe bat usage, and cattleguards designed for off-highway vehicles. Allow for new technologies as they are developed.
- Consider formally incorporating current management direction that would promote the protection and management of high-quality Black Hills montane grasslands. These unique plant communities are considered critically imperiled both globally and locally.
- Consider desired conditions for a variety of rangeland health indicators: the degree to which the integrity of soil, vegetation, water, and the ecological processes of the rangeland ecosystem is balanced and sustained. Integrity is defined as maintenance of the composition, structure, and functional attributes characteristic of a particular locale, including normal variability.
- Focus management actions to mitigate the impacts of known ecosystem stressors (e.g., high intensity wildfires, non-native invasive plant species, and insect outbreaks) in the Black Hills National Forest and to prevent drivers from becoming stressors.
- Allow and provide direction for ecologically sound uses of prescribed fire and wildfire in grasslands and shrublands, while remaining fully aware of the implications and mitigations needed to protect wildland-urban interface developments. In cover types heavily impacted by fire suppression, the revised forest plan should promote continued restoration and/or resiliency treatments.

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- Consider adding additional direction to reduce the impacts to rangeland and livestock grazing management from recreation uses on the forest.
- Consider adding standards and guidelines to help reduce noxious weed spread, such as requiring equipment/recreation vehicle cleaning and public education regarding the public's role as a vector for noxious weeds.
- Consider re-evaluating the suitability of grazing the four vacant allotments where restocking is considered infeasible and consider officially closing them.

## Appendix A: Black Hills Community Types

Black Hills community types are described below as they were in the Black Hills Phase II Amendment Final Environmental Impact Statement (USDA Forest Service 2005).

### Black Hills Plant Community Types

Marriott and Faber-Langendoen (2000) identified four ecological groups and six community types of the most prevalent upland grasslands and upland shrublands within the Black Hills National Forest (table 9). Detailed environmental and vegetation descriptions of plant associations are provided in Marriott and Faber-Langendoen (2000).

**Table 9. Grassland and shrubland ecological groups and plant community types**

Ecological Group	Community Type
Dry Plains Shrublands (Generally greater than 50% cover)	Mountain Mahogany/Sideoats Grama
Dry Mixedgrass Prairies	Little Bluestem/Grama/Thread-leaf Sedge Needle and Thread/Blue Grama
Mesic Mixedgrass Prairies	Western Wheatgrass/Green Needlegrass Western Wheatgrass/Needle and Thread
Black Hills Montane Grasslands	Prairie Dropseed – Richardson’s Needlegrass – Timber Oatgrass

#### Dry Plains and Shrublands

The primary community type in the dry plains and shrublands group in the Black Hills National Forest is mountain mahogany (*Cercocarpus montanus*)/sideoats grama (*Bouteloua curtipendula*) shrubland. It is best developed east of Newcastle, Wyoming, and occurs on low-elevation, limestone-derived soils. Total vegetative cover is generally greater than 50 percent; herbaceous stratum is relatively sparse generally ranging from 10 to 25 percent (Marriott and Faber-Langendoen 2000).

#### Dry Mixedgrass Prairies

The most common dry mixedgrass prairie community type in the Black Hills is the Northern Great Plains little bluestem (*Schizachyrium scoparium*) prairie, dominated by little bluestem, blue grama (*Bouteloua gracilis*), and sideoats grama and often threadleaf sedge (*Carex filifolia*). It occurs throughout the Black Hills but stands at higher elevations tend to be reduced in size. The other dry mixedgrass prairie type, needle-and-thread (*Hesperostipa comata*) – blue grama mixedgrass prairie, is restricted to the lower elevations (Marriott and Faber-Langendoen 2000).

#### Mesic Mixedgrass Prairies

Mesic mixedgrass prairies are most extensive in the Red Valley and much of the Hogback Rim. Two associations are currently recognized for the Black Hills: western wheatgrass (*Pascoyrum smithii*) – green needlegrass (*Nassella viridula*) and western wheatgrass – needle-and-thread mixedgrass prairies. Stands can be difficult to classify due to shared dominants among both mesic and dry mixed-grass types. Species distribution typically is patchy, with local dominance variable (Marriott and Faber-Langendoen 2000).

## **Black Hills Montane Grasslands**

Black Hills Montane Grasslands are endemic to the Black Hills (i.e., this plant association does not occur anywhere else outside of the area), occurring at higher elevations on the Limestone Plateau and adjacent Central Core (Marriott and Faber-Langendoen 2000). Comprehensive surveys and ranking of Black Hills Montane Grasslands (Marriott 2000, Marriot 2012) have identified high-ranking examples on the southern Limestone Plateau and adjacent Central Core, and on Warren Peaks in the Bear Lodge Mountains). These highest-ranking examples exhibit the following three native species: *Sporobolus heterolepis* – *Achnatherum richardsonii* – *Danthonia intermedia* (prairie dropseed – Richardson’s needlegrass – timber oatgrass) (Marriot 2012).

## Appendix B: Key Plan Direction

Key plan direction described in this appendix includes the overarching objective of maintaining or moving toward satisfactory range conditions. The *Other Direction* and *Forest Plan Direction* sections include forest plan goals and objectives that relate to successful permitted livestock grazing practices and use. The following is a comprehensive listing of known direction from the current forest plan and other sources.

### Other Direction

On August 24, 2000, an internal memo from the forest supervisor to all district rangers and zone engineers directed careful consideration of high-quality montane grasslands before commencing ground-disturbing actions. The following specific activities were covered: logging, skidding, road construction or relocation (reconstruction of an existing prism is allowed), prescribed burning, large recreational group events, and ground-disturbing heavy maintenance or reconstruction of range improvements. Permitted livestock grazing under issued, active permits may proceed. Particular emphasis is placed on the following eight high ecological integrity sites (Overall Rank A or B): Gillette Canyon Upper, Smith Draw, Lemming Draw Upper, Redbird Canyon South, West Hell Canyon Upper, Gillette Canyon Headwaters, Redbird Canyon at Sixmile, and Lemming Draw Lower (Marriott et. al. 1999, Marriott 2012).

### Forest Plan Direction

#### Forest Plan Goals and Objectives Relating to Livestock Grazing

**Goal 1:** Protect basic soil, air, water, and cave resources.

- Objective 102. Use a qualitative survey which emphasizes riparian condition, such as the Proper Functioning Condition methodology, to refine the preliminary watershed health assessments (FP-FEIS, Appendix J) within the next planning period. This survey would focus first on Class III watersheds and could be supplemented with additional qualitative methods (such as MIM – Multiple Indicator Monitoring), as needed, for the design of watershed improvements. Class I watersheds do not need to be surveyed unless information becomes available which suggests there was an error in classification.
- Objective 103. Maintain or improve long-term stream health. Achieve and maintain the integrity of aquatic ecosystems to provide stream-channel stability and aquatic habitats for water quality in accordance with state standards.
- Objective 104. Maintain or enhance watershed conditions to foster favorable soil relationships and water quality.
  - Achieve and maintain stable stream beds and banks, diverse riparian vegetation, and effective ground cover that control runoff and erosion.

**Goal 2:** Provide for a variety of life through management of biologically diverse ecosystems.

- Objective 205. Manage for 122,000 acres of prairie grassland and 3,600 acres of meadow during the life of the Plan. Restored acres will not be considered suitable for timber production.
- Objective 213. Maintain or enhance existing riparian area biodiversity, physical structure, and size.
- Objective 216. Manage to conserve or enhance the integrity of the following important botanical areas:

- Objective 222. Complete the following habitat projects each year during the plan period as funding allows: Range -- 30 structural and 600 acres of nonstructural improvements.
- Objective 240-HAB. Manage and/or install structures to provide water for livestock and to protect the aquatic, shoreline and upland vegetation around ponds or water catchments containing leopard frogs.

**Goal 3:** Provide for sustained commodity uses in an environmentally acceptable manner.

- Objective 301. Produce on a sustained basis and make available up to 233 million pounds of forage for livestock and wildlife use each year (weather permitting). The location and amount of forage produced under the forest canopy will vary with the density of the overstory. This may necessitate changes in where and how both livestock and wildlife grazing take place on a local basis over the rotation of a stand of timber.
  - a. Livestock use will be up to 127 million pounds of forage per year or approximately 128,000 AUMs.
  - b. Wildlife use will be up to 106 million pounds of forage per year or approximate population levels of 70,000 deer and 4,500 elk or other combinations that use the same amount of forage.
- Objective 302: Maintain rangelands in satisfactory range condition.
  - a. Management of rangelands determined to be neither meeting nor moving toward satisfactory rangeland condition in an acceptable timeframe, shall cause actions designed to move toward satisfactory rangeland condition within a stated timeframe to be implemented.
  - b. In the absence of a site-specific planning process and an Allotment Management Plan, management direction for ongoing rangeland management activities on active allotments needed to address rangeland conditions and trends and species viability will be incorporated into the grazing permits through the AOI.

**Goal 7:** Emphasize cooperation with individuals, organizations, and other agencies while coordinating planning and project implementation.

- Objective 701. Continue to cooperate with interested parties and organizations in the development of plans and projects.
- Objective 702. Encourage cost sharing as part of cooperative efforts.
- Objective 707. Allow military construction and tactical training exercises, consistent with resource protection, standards and guidelines, and safety of other Forest users.

**Goal 9:** Provide high-quality customer service.

- Objective 901. Provide customers the kind and quality of services they reasonably want.
- Objective 903. Respond to information needs of the public.

## **Forestwide Standards and Guidelines Relating to Livestock Grazing**

### **Physical Elements: Riparian Areas, Water Influence Zones, Caves, and Wetlands**

- 1301. In the water influence zone next to perennial and intermittent streams, lakes, and wetlands, allow only those actions that maintain or improve long-term stream health and riparian ecosystem condition. STANDARD. (Regional WCP Handbook Standard 3)
- 1304. As opportunities arise, and need dictates, relocate or implement mitigation measures for roads, trails, watering tanks, ponds, water catchments, and similar facilities currently located within the Water Influence Zone. STANDARD

- 1401. For caves that have been determined significant or that have not been evaluated for significance [as per 36 CFR 290.3 (c) or (d), manage to protect or enhance biological, cultural, ecological, hydrological, and physical characteristics with the following actions:
- Avoid ground disturbance within 100 feet of an opening of a natural cave (also see standard 3207). **STANDARD**
- b. Take measures to prevent human-caused changes in cave ecosystem, water sediment, nutrient, chemical, airflow, humidity, or temperature regimes. **GUIDELINE**
- 2107. Conifer encroachment on areas that have formed over grass, meadow, or hardwood vegetation may be treated (e.g., to conserve habitat for threatened, endangered, and sensitive species, management indicator species and species of local concern, maintain forage base, and landscape diversity.) Consider soils that formed under grass or meadow plant communities and other factors in determining extent of pine encroachment removal. **GUIDELINE**
- Locate new livestock/wildlife water sites (e.g., drinking structures) outside of hardwood communities, except when no other option is available. **STANDARD**

**Biological Elements – Flora: Range – General**

- 2503. Developed recreation sites will be closed or restricted to grazing through use of fencing, as opportunities permit. However, grazing may be used as a management tool in these areas. Recreational livestock will normally be fed in designated areas. **GUIDELINE**
- 2504. The site-specific rangeland analysis necessary for preparation of allotment management plans shall document selected desired conditions and evaluate whether the designated area is at, moving toward, or moving away from, the desired conditions. **GUIDELINE**
  - a. Satisfactory range conditions occur when the existing conditions are at, or progressing toward the desired conditions identified through the project planning process.
  - b. When trends toward satisfactory range conditions are not achieved within 5 years by changes in grazing systems, allowable use or residual guidelines, more restrictive use or residual guidelines, changes to the grazing system shall be adopted, or cattle use be removed or relocated for a period of time.

**Range – Proper Use or Residual Levels – Riparian/Uplands**

- 2505. Livestock and wild herbivore allowable forage use or residual levels on rangelands by grazing system and range condition are as follows:

**Proper Allowable Use Guidelines**  
(Percent Utilization by Weight Each Year)

Season of Use	Satisfactory Condition	Unsatisfactory Condition
Continuous Use Spring/Summer	0-45%	0-40%
Continuous Use Fall/Winter	55-60%	0-55%
Deferred Rotation	0-50%	0-45%
Rest Rotation	0-55%	0-50%

**Residual Levels for Wetlands and Riparian Areas**

Residual levels (or remaining height of key plant species) can be prescribed for riparian areas in the AMP or the annual letter of operating instructions (AOI) to the livestock permittee. Residual levels will be based upon specific objectives for the location in question and will consider season of use and range conditions. **STANDARD**

### Allowable Use and/or Residual Levels

c. Utilization of willow, shrubs, woody vines or young deciduous trees (such as aspen, birch and oak) in any year by livestock or wildlife is limited to browsing only 40 percent of the total individual leaders produced in that year (not to be confused with 40 percent use on each and every leader produced).

d. Remove livestock from the grazing unit or allotment when further utilization on key areas in that year will exceed proper allowable use or prescribed residual level in the Forest Plan, AMP, or AOI for either grass and forbs or shrubs.

e. No authorized utilization will be allowed by domestic livestock on known occurrences of willow emphasis species (e.g., *Salix candida*, *Salix serissima*, *Salix lucida*).

f. Implement additional measures to assure avoidance of livestock use on *Carex alopecoidea*. Restrict livestock use of all or portions of 5 of the largest geographically spaced occurrences at site numbers: CAAL8-19, CAAL8-20, CAAL8-22, CAAL8-30, and CAAL8-31. STANDARD

- 2506. Develop site-specific vegetation utilization or residual guidelines during rangeland planning, and document them in allotment management plans (AMPs). In the absence of updated planning, the utilization guidelines as shown or residual guidelines documented in the AOI will apply. GUIDELINE
- 2507. Allow use of forage by livestock and wildlife in fenced riparian pastures so long as it meets the objectives of maintaining, enhancing, or conserving the riparian ecosystem and emphasis species persistence. STANDARD

### Biological Environment – Fauna: Endangered, Threatened or Sensitive Species – Protection and Management

- 3103. Manage known sensitive species and species of local concern snail colonies to:
  - c. Avoid burning, heavy grazing, off-highway vehicles (OHVs), heavy equipment and other activities that may compact soils or alter vegetation composition and ground cover. STANDARD
- 3104. Do not develop springs or seeps as water facilities where sensitive species or species of local concern exist unless development mitigates an existing risk. STANDARD
- 3111. From April 1 through August 15, minimize additional human-caused noise and disruption beyond that occurring at the time of nest initiation (e.g., road traffic, timber harvest, construction activities such as new range improvement projects) within one-half mile of all active goshawk nests until the nest has failed or fledglings have dispersed. STANDARD
- 3125. Prescribe burn no more than 60 percent of any contiguous grassland area at a time and burn in early spring or fall. STANDARD

### General Wildlife and Fish Direction

- 3202. Structures, such as fences and roads will be designed and built so that they do not create unnecessary or unreasonable barriers or hazards for wildlife and people. GUIDELINE
- 3207. Where caves or abandoned mines serve as nurseries or hibernacula for bats, vegetative changes within 500 feet of the opening are allowed only if needed to maintain bat habitat or if topography or other features protect the openings from disturbance. STANDARD
- 3212. Manage for high quality riparian communities.
  - a. Provide stable stream banks. GUIDELINE

- b. Retain woody vegetation along streams and lakes to provide shading for aquatic life and terrestrial species. GUIDELINE

### **Fuels – Prescribed Fire**

- 4103. Utilize prescribed fire though planned and natural ignitions to achieve management objectives for each management area (as shown in the *Fire Management Direction Summary Table* on pages II-42 through II-44 in the Black Hills National Forest Land and Resource Management Plan).  
STANDARD
- 4105. When feasible and appropriate use broadcast burning to dispose of slash to return the inorganic chemicals in the foliage and small woody material to the soil, to reduce fire hazard, and to provide a seed bed for natural regeneration. GUIDELINE (Amended Regional Guide Silviculture Guideline)
- 4107. Defer Prescribed burned areas from livestock grazing for a portion or all of the following growing season to ensure regrowth of forage species. GUIDELINE

### **Noxious Weeds – General**

- 4301. For all proposed projects or activities, determine the risk of noxious weed introduction or spread, and implement appropriate mitigation measures and treatment. STANDARD

### **Heritage Resources – General**

- 6101. Consider long-term Forest management needs in determining appropriate use of mitigation of effects to, or avoidance of, heritage resources during project planning. GUIDELINE

### **Forest Plan Management Area Standards and Guidelines relating to grazing within the Mystic Range EIS Project**

- 3.1 – Botanical Areas
  - 3.1-2501. Allow livestock grazing if it does not conflict with the values for which the botanical area was designated. STANDARD
  - 3.1-2502. Allow new improvements only when they are necessary to maintain, restore or enhance the values for which the botanical area was designated. GUIDELINE
  - 3.1-2503. Restrict access of domestic livestock to protect the R2 sensitive and species of local concern plant occurrences in designated botanical areas. STANDARD
- 4.1 – Limited Motorized Use and Forest Product Emphasis
  - 4.1-2501. Prepare livestock management strategies in the allotment management plan that will be compatible with recreation objectives. GUIDELINE
  - 4.1-2502. Locate or design structural improvements to meet Scenery Integrity Objectives. GUIDELINE
- 4.2B – Peter Norbeck Scenic Byway
  - 4.2B-2501. Livestock management strategies in allotment management plan should meet the recreational objectives for the management area. GUIDELINE
- 5.4 - Big Game Winter Range Emphasis
  - 5.4-204. Improve forage on range areas.
  - 5.4 -2501. Design livestock management strategies including distribution and stocking rates to be compatible with big-game habitat objective. STANDARD

5.4 -2502. Feature big-game use of forage increases, which result from the vegetative improvements, while also allowing for livestock increases. Follow Forestwide proper allowable use guidelines or residual levels documented in AMPs or AOIs for combined use by wildlife and livestock. GUIDELINE

- 5.4A – Norbeck Wildlife Preserve

5.4A-2501. Existing livestock grazing may continue; permits may be reissued to existing or new permittees. Do not permit any increase in livestock numbers (animal months) STANDARD

5.4A-2502. Take advantage of opportunities to transfer forage use from livestock to wildlife. GUIDELINE

5.4A-2503. Prevent habitat degradation adjacent to water sources. (See Appendix E of the Black Hills National Forest Land and Resource Management Plan.) GUIDELINE

5.4A-2505. Livestock grazing may be used intermittently as a management tool (even in areas designated unsuitable for livestock grazing) to improve habitat conditions, e.g., to control noxious weeds. GUIDELINE

- 8.2 – Developed Recreation Complexes

8.2-2501. Livestock management strategies in allotment management plan should meet the recreational objectives for the management area. GUIDELINE

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