USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Rocky Mountain Region / Black Hills National Forest June 2022

Black Hills National Forest

Draft Forest Assessments:

Rangeland Management

U.S. Forest Service rangeland management specialist and grazing permittees discuss pasture rotation, range projects, and travel management restrictions on a Black Hills National Forest livestock allotment.

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Chapter 1. Introduction

Livestock grazing has been, and continues to be, an important use on the Black Hills National Forest. Several ranching operations in the area still rely on public lands (national forests and grasslands, state lands, Bureau of Land Management lands) for livestock grazing. Supporting these ranching operations helps ensure the maintenance of open spaces and reduces the issues associated with the wildland-urban interface. Maintaining the sustainability of ecological resources is therefore important for continuing the social, cultural, and economic benefits for local communities.

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 achieve big game population levels (elk, deer, bighorn sheep) that 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.

Forest Service rangeland management specialists and range technicians work with grazing permittees to achieve proper use of the forage resource and maintain harmony with other resources and uses. The current forest plan for the Black Hills National Forest identifies allowable forage use by livestock and wild herbivores by grazing system and identified condition in guideline 2505.

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.

Key Issues for Rangeland Management on the Black Hills

This assessment considers multiple uses related to range, and follows direction outlined in FSH 1909.12 Land Management Planning Handbook, Chapter 10 – The Assessment: Section 13.32 – Assessing Multiple Uses for Range Resources.

This assessment identifies and evaluates the following:

- current grazing and trends in numbers,
- rangeland condition and trends,
- effects of uses on ecological integrity and species diversity,
- contributions of livestock grazing to social, cultural, and ecological sustainability, and
- potential need for plan changes to respond to rangeland management issues.

Use of Best Available Science

Information sources used for this assessment include data from agency-wide databases including the Natural Resource Manager (Infra database) 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 Forest Service rangeland management specialists, range technicians, and botanists, informed by the Region 2 Rangeland Analysis and Management Training Guide (USDA Forest Service 1996a).

Chapter 2. Current Status

Grazing Allotment Status and Acreage Information

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.

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 that 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 1. 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 1. 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 1). 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 this 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 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 2.

Table 2. 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

Rangeland Vegetation

The composition of the rangeland vegetation on the Black Hills National Forest is described in the *Non-forested Ecosystems* portion of the *Terrestrial Ecosystems* assessment.

Livestock Grazing Management

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 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 NFS 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 and willows, and water diverted for irrigation in some locations... Hay was gathered from natural grasses. Nearly all of these early homesteads have been abandoned, consolidated, 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.

Some sparse, eroded areas were of increasing concern to Forest Service officials, aggravated by sustained high levels of livestock use. During the1930s Dust Bowl Era, the resultant loss of soils on the plains was noted by the Forest Service. Concerned that 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 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.

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

> *“Meanwhile, sometime in the 1930s the carrying capacity for grazing land was reached. As many applicants for grazing allotments were turned away as were accepted, so the grazing resource, which had seemed nearly endless a couple of decades before had finally reached an official saturation point.*
>
> *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. Grass and forb species were in poor condition on many areas of the Forest and deciduous vegetation, like willows, berry bushes and aspen had been damaged by overgrazing. Big game species, especially deer, were impacted. Grazing permit cuts began again in 1951. Programs were implemented in the 1950s to improve range conditions, including rotational grazing systems, ground spraying of brush, and aerial spraying of weeds. These programs met with some success and were undertaken cooperatively between the Forest Service and permittees.”*

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 improved 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 an effort to conduct and update site-specific analyses on all grazing allotments in compliance with the National Environmental Policy Act. That effort resulted in adjusting the levels of use and changing management on the allotments through evaluation of long-term monitoring data, range improvement efforts, and overall improved grazing management practices.

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 that 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 that are intended to meet standards and guidelines and are expected to help achieve the desired conditions in a timely manner.

Adjustments to livestock grazing timing, intensity, duration, and frequency continues 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, which help to 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 3. These structures continue to help to improve management on the allotments by providing management flexibility.

Table 3. 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 4). 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 4) 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. 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 4. 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

Chapter 3. Sustainability

Environmental Sustainability

Range condition is generally considered to be the status of the range 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).*

Allotment-specific objectives are identified in allotment management plans 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 that used most often for riparian conditions is the multiple indicators monitoring protocol (Burton et al. 2011). 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 currently used to monitor conditions on the Black Hills National Forest are listed in table 5.

Table 5. 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	44
Proper Functioning Condition (Riparian)	20

Monitoring protocol	Number of study sites
Photo Point	352
Other protocols used infrequently[1]	69
Total	902

1 Includes Rooted Nested Frequency, ECODATA, Sample Point, Cover by Life Form protocols.

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 6). This current assessment used professional and technical knowledge of the planning area, and an analysis of the long-term monitoring data.

Table 6. Forestwide summary of rangeland condition

	1995	2021
Percent of acres meeting or moving toward forest plan objectives (satisfactory)	79%	71%
Percent of acres not moving toward forest plan objectives (unsatisfactory)	4%	22%
Percent 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 indicates nuances. Since 1995 all the active grazing allotments on the Black Hills National Forest have undergone site-specific project planning and as discussed previously, the overall grazing management has improved, resulting in an increase in satisfactory acres, ultimately resulting in 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 national forest. This increase is a direct result of both the previously described intentional seeding of non-native cool season grasses, and an increase in (non-native) noxious weeds. Because the desired conditions for an allotment 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 range condition. As noted previously 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 is continuing 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 stipulated by the Multiple-Use Sustained-Yield Act of 1960, National Forest System lands, including the Black Hill National Forest, allow for multiple uses. Some of these other uses may adversely impact rangeland vegetation. Impacts can be direct (such as off-road vehicle use denuding the 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 range condition in 2021 have a non-native plant component that significantly exceeds what was identified in the desired conditions for the allotment. During the site-specific planning efforts, the non-native cool season grasses (timothy, *Phleum pratense;* smooth brome, *Bromus inermis;* 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 that 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 reached the threshold to eliminate native diversity. It is those areas, where potential to increase native plant diversity 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. This spread is not unique to South Dakota; it has also been observed and documented in adjacent states.

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.

Healthy, productive wildlife communities are an element of rangeland health. 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. 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.’

Ecological Integrity and Species Diversity

Effects from unmanaged livestock grazing can result in adverse effects on ecological integrity and species diversity. The sheer numbers of unregulated livestock use (cattle, horse, sheep, and other domestic animals) prior to establishment of the Black Hills National Forest (see table 4 for reference) no doubt contributed to these impacts. However, grazing is not necessarily a primary driver of vegetation change, and even when grazing has been one of the causes of vegetation change, removing or curtailing grazing will not always result in a return to historical conditions. As discussed previously, the most important

concern regarding ecological integrity and species diversity is the increase noted in non-native invasive plants.

The Forest Service intentionally seeded areas with non-native cool season grasses in the past, effectively converting primary grazing areas to non-native plant communities. For example, numerous meadows were planted with timothy and/or smooth brome (forage species) and managed as hay grounds (Graves 1899, MacIntosh 1928). These non-native species were intentionally seeded because of their ability to germinate, survive, and reproduce under poor soil conditions and altered hydrologic states. Their presence is recognized and included when developing desired condition during site-specific allotment planning. However, in many places across the national forest, they have increased beyond what was identified as desirable to the point where their continued expansion is detrimental to native heterogeneity and resilient landscapes.

Over the past several years, Forest Service personnel and permittees have diligently 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 that 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.

Economic and Social Sustainability of Rangeland Management

Livestock grazing use has remained constant since 1983 (table 4). The Black Hills National Forest has supported 124,000-128,000 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 301states: “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.

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).

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. Droughts that affected huge 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 level 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 Southwestern United States, 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.
5. The Southwest and Desert Southwest rangeland ecoregions are expected to be the most vulnerable as present patterns of drought continue and possibly intensify in the future. Drying

may be particularly pervasive in the Southwest United States, northern Mexico, and in the Interior West.

Additionally, the expected increase in carbon dioxide over the coming decades is expected to enhance the production of cool season (C_3) grasses over warm season (C_4) 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 (the Dust Bowl in the 1930s, the mid-1950s drought, 1988, 2002, 2012). Current efforts associated with the dry years of the early 21st 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 Plan Changes to Respond to Rangeland Management Issues

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 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 to 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)).
- 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 3 separate towns). Additional direction for managing prairie dogs would help in areas where expanding prairie dog towns are preventing allotments from moving toward desired conditions.
- 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.
- 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 the drivers that are completely unrelated to livestock grazing management.
- Consider editing objective 301 so that it considers the potential future variability in forage production expected from climate change.
- Consider as needed updating 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.

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