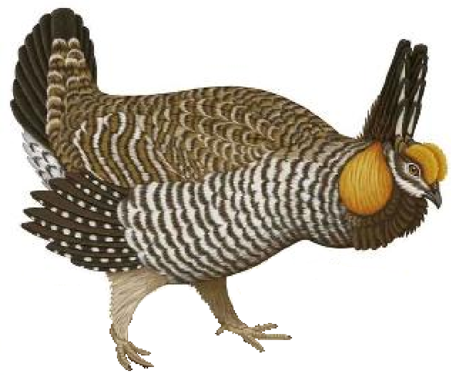
MANAGEMENT OF PRAIRIE GROUSE IN SOUTH DAKOTA, 2022-2031

Sharp-tailed Grouse



Greater Prairie-Chicken

SOUTH DAKOTA DEPARTMENT OF GAME, FISH AND PARKS

PIERRE, SOUTH DAKOTA

WILDLIFE DIVISION REPORT *TO BE DETERMINED*

SEPTEMBER 2022

ACKNOWLEDGMENTS

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PUBLIC INVOLVEMENT

A draft South Dakota prairie grouse management plan was available for public comment *TO BE DETERMINED*

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LIST OF ACRONYMS

CRP	Conservation Reserve Program
FPNG	Fort Pierre National Grassland
GRNG	Grand River National Grassland
NRCS	Natural Resources Conservation Service
SD	South Dakota
SDGFP	South Dakota Department of Game, Fish and Parks
USFWS	United States Fish and Wildlife Service
CRI	Crowned Ridge I
CRII	Crowned Ridge II
PUC	Public Utilities Commission

INTRODUCTION

South Dakota (SD) is home to two species of true prairie grouse, the sharp-tailed grouse (*Tympanuchus phasianellus*) and greater prairie-chicken (*Tympanuchus cupido*, hereafter prairie-chicken). Prairie grouse are medium sized (16–18 in [41–46 cm] long, 1.3–2.2 pounds [0.6–1.0 kg]) round-bodied and short-legged game birds native to grasslands, steppe, and mixed-shrub habitats of North America. Their cryptic coloration functions as camouflage and allows the birds to blend into the grassland habitat, reducing detection from predators. The unique feathering of the legs and nostrils make them especially adapted to cold and snowy climates found in SD. The feathering of the legs and feet is more pronounced in sharp-tailed grouse, whereas the feet of prairie-chickens appear nearly featherless. Although most prominent in sharp-tailed grouse, an additional adaptation to winter weather in both species is the lateral pectinate scales on their feet which perform like snowshoes.

The primary differentiating feature between the two species of prairie grouse is the shape of the tail. Sharp-tailed grouse, like the name suggests, have tail feathers which come to a sharp point while tail feathers of prairie-chickens are gently rounded. The distinct dark barring over much of the body of a prairie-chicken also differs from the generally non-barred dark colored dorsal and light-colored ventral coloration of sharp-tailed grouse. The long pinnae, or ear feathers which are erected during male courtship displays, are absent on sharp-tailed grouse. Both species of male prairie grouse have colored external air sacs located on each side of the neck which are inflated during courtship. These air sacs are purple for sharp-tailed grouse and orange for prairie-chickens.

As their name suggests, prairie grouse are found primarily within landscapes dominated by grassland habitat. The unique behavior and habitat use of prairie grouse make them an exciting game bird and valued watchable wildlife species. Most prairie grouse hunting occurs on open grasslands with the aid of dogs, often pointing breeds. The explosive flush of prairie grouse attracts thousands of hunters to SD each year. In 2020, 6,876 hunters harvested 67,261 prairie grouse. South Dakota is one of the few states where both species of prairie grouse can be harvested under liberal hunting regulations. Hunting is authorized from the third Saturday of September through the first Sunday in January with a combined daily bag limit of three prairie grouse.

The unique lekking behavior of prairie grouse (described below) attracts numerous wildlife viewers each year. Several viewing blinds are annually available for public use on the Fort Pierre and Buffalo Gap National Grasslands (FPNG) as well as Custer State Park. The amazing sight and sound of the prairie grouse courtship display is an annual sign that spring is soon to arrive on the prairies. Prairie grouse are an indicator of a functioning prairie ecosystem which suggests landscape-level habitat exists for other prairie obligate species. Prairie grouse are considered "flagship" species for conservation of prairie habitat throughout their range and in SD.

The future of prairie grouse in SD is primarily dependent upon prairie habitat, thus many of the management topics discussed in this document are habitat related. Because important prairie grouse habitat intersects many ownership boundaries, management addresses issues related to both public and private land. Without a doubt, many prairie-dependent species, both game and nongame, will benefit from management actions that benefit prairie grouse and prairie habitat.

HISTORICAL INFORMATION AND CURRENT DISTRIBUTION

Prior to European settlement, SD's landscape was a rolling sea of mixed and tallgrass prairie which likely supported sharp-tailed grouse nearly statewide. Sharp-tailed grouse are considered a landscape species which requires substantial grassland habitat at a landscape level to persist (Hanowski 2000, Niemuth 2011, Runia et al. 2021). Mass conversion of grassland to cropland has reduced the distribution of sharp-tailed grouse particularly in southeastern SD. The current distribution of sharp-tailed grouse includes most western SD counties and about half of eastern counties (Figure 1). Although sharp-tailed grouse still occur in every county west of the Missouri River, conversion of prairie to cropland has undoubtedly reduced their abundance west river and statewide.

Prairie-chickens may have been native to portions of eastern and central SD in limited numbers prior to European settlement (summarized in Flake et al. 2010). While conversion of prairie to cropland strictly reduced the distribution and abundance of sharp-tailed grouse, prairie-chickens expanded in distribution and increased in abundance when portions of the landscape were converted to cropland. Prairie-chickens benefit greatly when waste grain from agricultural fields is available in northern states such as SD. As European settlement and associated agriculture marched north and west across the prairies, prairie-chicken populations exploded and "followed the plow" all the way to prairie Canada (Johnsgard and Wood 1968, Houston 2002). During the early 1900s prairie-chickens could be found nearly statewide in SD. It is likely that they benefited from the extirpation of bison which resulted in the associated temporary increase in vegetation height across the state. The distribution and abundance of prairie-chickens probably peaked at the turn of the 20th century (Johnsgard and Wood 1968). It became quite apparent that a landscape dominated by grasslands with interspersed cropland provided ideal habitat for prairie-chickens.

The range of prairie-chickens quickly declined as agriculture became too intense and cattle grazing reduced grass height over much of their newly acquired range. As prairie-chickens are also landscape species, their current distribution occurs where large tracts of native prairie remain, mostly in central SD (Figure 2). Prairie-chickens are thought to be limited within SD by lack of grassland habitat in the east and grass height in the west.

Although prairie grouse are primarily birds of the open prairies in SD, one exception is the Black Hills National Forest. Sharp-tailed grouse do occur in the Black Hills, primarily within herbaceous openings such as those created by wildfires or timber harvest. The Black Hills were historically less wooded and probably had greater amount of suitable habitat for sharp-tailed grouse.

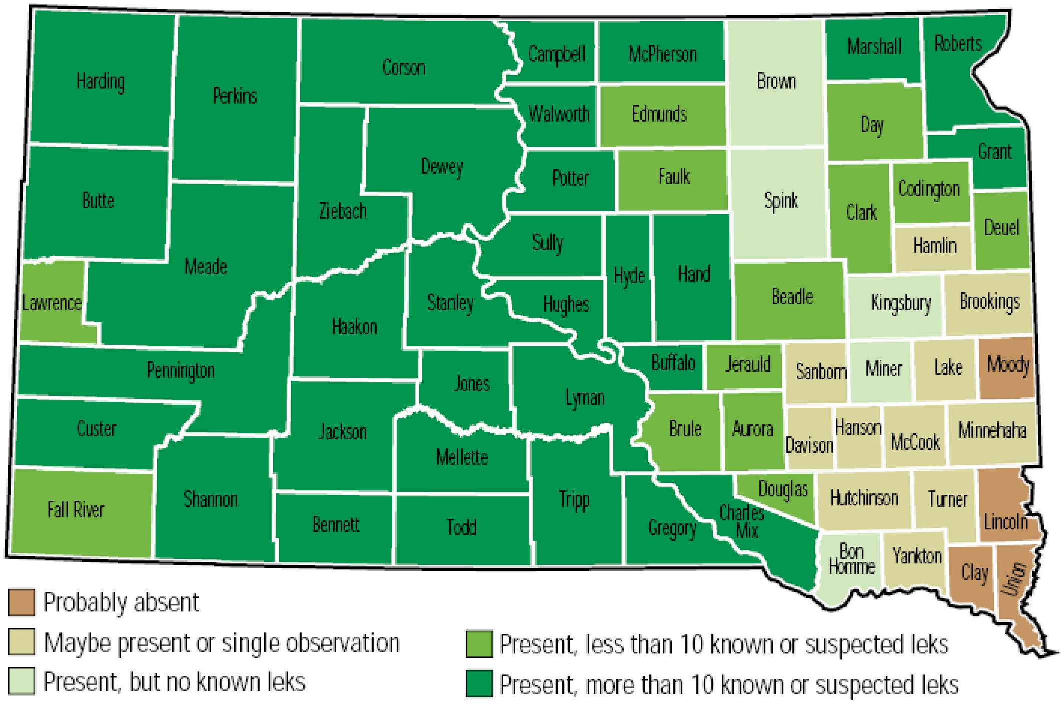

Figure 1. General distribution and abundance of sharp-tailed grouse in South Dakota (Flake et al. 2010).

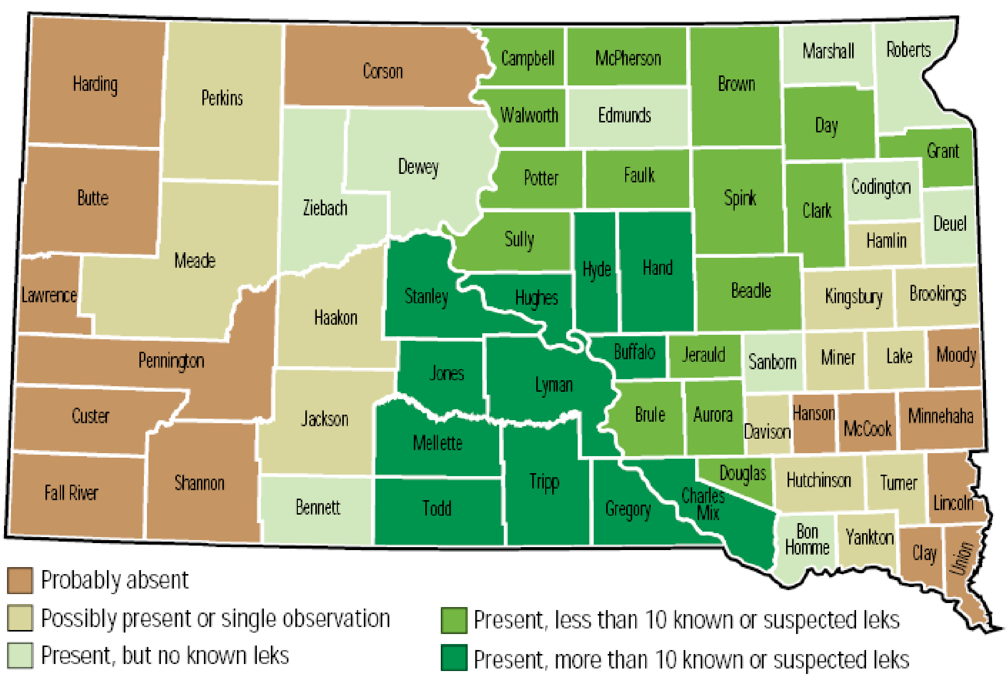

Figure 2. Distribution and general abundance of greater prairie-chickens in South Dakota (Flake et al. 2010).

PRAIRIE GROUSE ECOLOGY

Leks, also known as "dancing grounds" for sharp-tailed grouse and "booming grounds" for prairie-chickens, are located in areas of high breeding potential and typically exist within centers of large tracts of suitable prairie habitat (Merrill et al. 1999, Hanowski et al. 2000, Niemuth 2000). Leks are the focal point for reproductive ecology and behavior in prairie grouse. Prairie grouse leks are typically located on knolls or on a gentle rise, although prairie-chicken leks are commonly located on flat bottomlands such as a dry wetland. Males gather on leks primarily during spring to defend territories and attract females during the breeding season. While it is not unusual for hens to visit several leks during a single season, males typically attend one lek each year and likely return to the same lek year after year.

In SD, male prairie grouse begin defending territories on leks as early as late February with peak activity coinciding with peak hen attendance in early April. Sharp-tailed grouse display behavior involves rapid foot stomping, rapid tail vibrations (tail rattling), inflation of purple air sacs, and aggressive face-off behavior with other males. Prairie-chickens raise their pinnae and tail feathers while producing loud booming noises by inflating their orange external air sacs. Aggressive behavior between males is common, with some males even leaping several feet in the air during face-offs. The booming noise made by male prairie-chickens can be heard from several miles away during calm conditions.

Lekking activity can start well before daylight and last for several hours. Leks are attended during evening, although duration and display behavior is usually less intense. Male sharp-tailed grouse may also defend territories on leks during fall, although duration and intensity of display behavior is minimal. Lek attendance during fall is thought to be important in recruiting young males that did not establish a territory during the previous spring.

Hen prairie grouse may attend several leks before selecting a male for copulation. After breeding, hen prairie grouse will not visit a lek again unless her nest is destroyed. Most hen prairie grouse will initiate a nest within a few miles of the lek they visited for breeding, although some may nest 10 mi (16 km) away or farther. Nest initiation typically occurs within several days to a week after copulation.

Mean nest initiation date was April 22 during a 3-year study on the FPNG (Norton 2005). First nests of the year are usually located in residual grass or herbaceous vegetation, and sometimes under a small shrub such as western snowberry (*Symphoricarpos occidentalis*), as green up has yet to occur (Eng et al. 1988). First nest clutches typically contain 14 dull brown eggs (Norton 2005). Incubation begins before the last 1–2 eggs are laid and continues for 23 days. Nest success has been found to be higher when residual cover conceals the nest and the landscape consists of primarily intact grasslands (Frederickson 1995, McCarthy et al. 1998, Ryan et al. 1998, Powell et al. 2020). Mammalian predators are the primary cause of nest loss, although nest success of 80% has been documented on the ideal and intact habitat of the FPNG (Norton 2005). Hens may re-nest up to three times if previous nests are destroyed, but clutch size and egg size decreases with subsequent nesting attempts.

Although incubation begins before the last egg is laid, all eggs hatch concurrently after 23 days of incubation. Newly hatched chicks will remain in the nest bowl for about a day before the hen leads the brood to habitats containing plentiful insects, primarily areas with abundant forbs such as non-native sweet clover (*Melilotus spp.)* and other native wildflowers. By 10 days of age, young grouse are capable of short flights and by 8–10 weeks they resemble adults in size. Chick survival was found to be about 36% during a 3-year study on the FPNG (Norton 2005). Young-of-the-year grouse will remain in loose family groups well into the fall. Only female prairie grouse provide parental care for nests and young.

During spring and summer, adult prairie grouse spend a majority of their time in grasslands including grass and alfalfa hay fields. Habitat use and ecology is generally similar between species, although subtle differences have been noted (Norton 2005, Hiller et al. 2019, Powell et al. 2020). Their diet consists of plant material such as seeds, berries, and buds but can also include insects. During fall, prairie grouse form flocks which may contain both species and remain together through winter. Prairie grouse also utilize waste grain from agricultural fields, mostly during fall and winter. Waste grains from agricultural crops are used by sharp-tailed grouse, but are not necessary for winter survival; however, waste grains likely contribute to prairie-chicken survival and persistence in some landscapes. In SD, prairie-chickens commonly rely on waste grains during winter and commonly remain within 1–2 mi (1.6–3.2 km) of this food source during the entire winter. The interaction between agriculture and prairie-chicken distribution and abundance is described in detail in the historical information section.

Prairie grouse are well-adapted to survive severe winter weather in open grassland habitat. During winter, prairie grouse use low growing tree and shrub cover for shelter or simply roost in the snow. This unique behavior of snow roosting protects prairie grouse from harsh winds and blowing snow in open habitats. Sharp-tailed grouse will occasionally roost in trees during winter. As winter transitions to spring, large flocks of prairie grouse disperse across the landscape in preparation for the breeding season.

Prairie grouse have a wide range of natural predators, but populations are thought to be most influenced by habitat in the long term (Flake et al. 2010). Determining cause of mortality in adult prairie grouse can be difficult, even when birds are tracked as part of research projects. However, coyotes, red fox and a variety of raptors can predate adult prairie grouse. Annual adult survival is variable across space and time but generally averages around 50% (Flake et al. 2010, Runia and Solem 2015).

SURVEYS AND MONITORING

Traditional Lek Surveys

Lek counts are the most widely used method to survey prairie grouse throughout their range. Male attendance on leks is relatively stable throughout the breeding season while female attendance is highly variable and exhibits distinct peaks. Starting in the early 1950s, department staff annually searched established survey areas which were approximately 40 mi^2 (104 km^2) for prairie grouse leks and counted all males attending each lek (Figure 3). The number of males/area was tracked from year to year and was considered an index to the spring population

(Figure 4). The survey was largely discontinued after 2019 with future population monitoring likely to come from sample-based surveys (see next section).

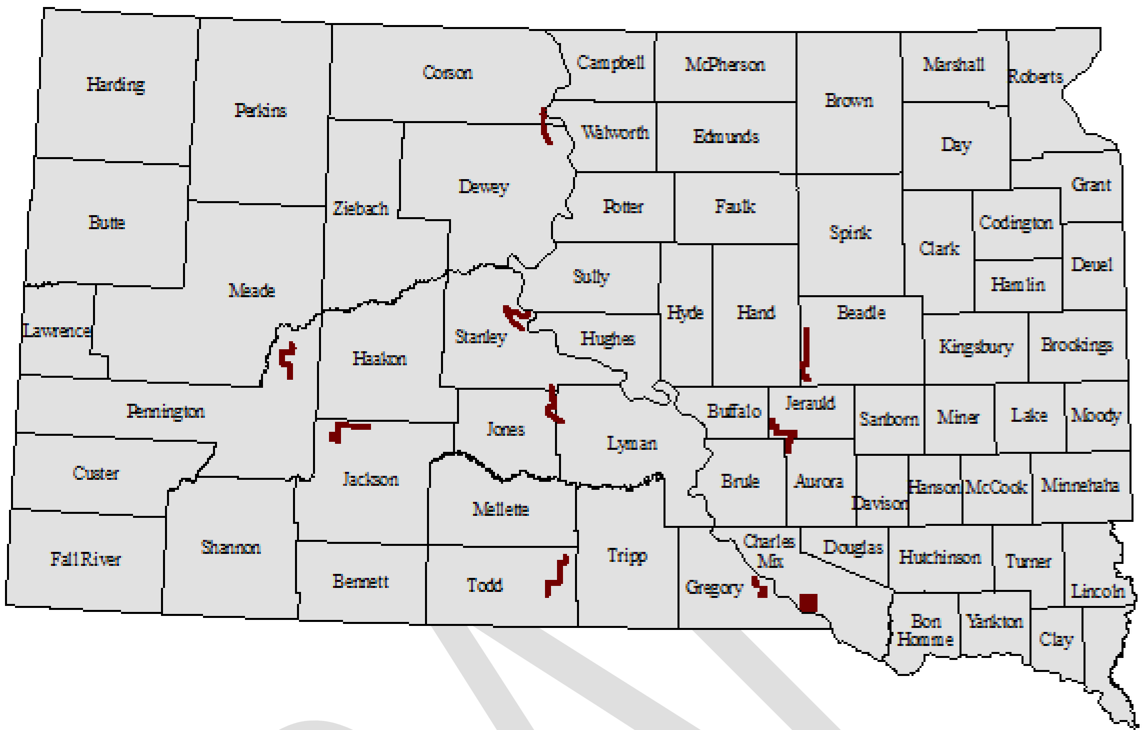

Figure 3. Prairie grouse traditional lek survey areas.

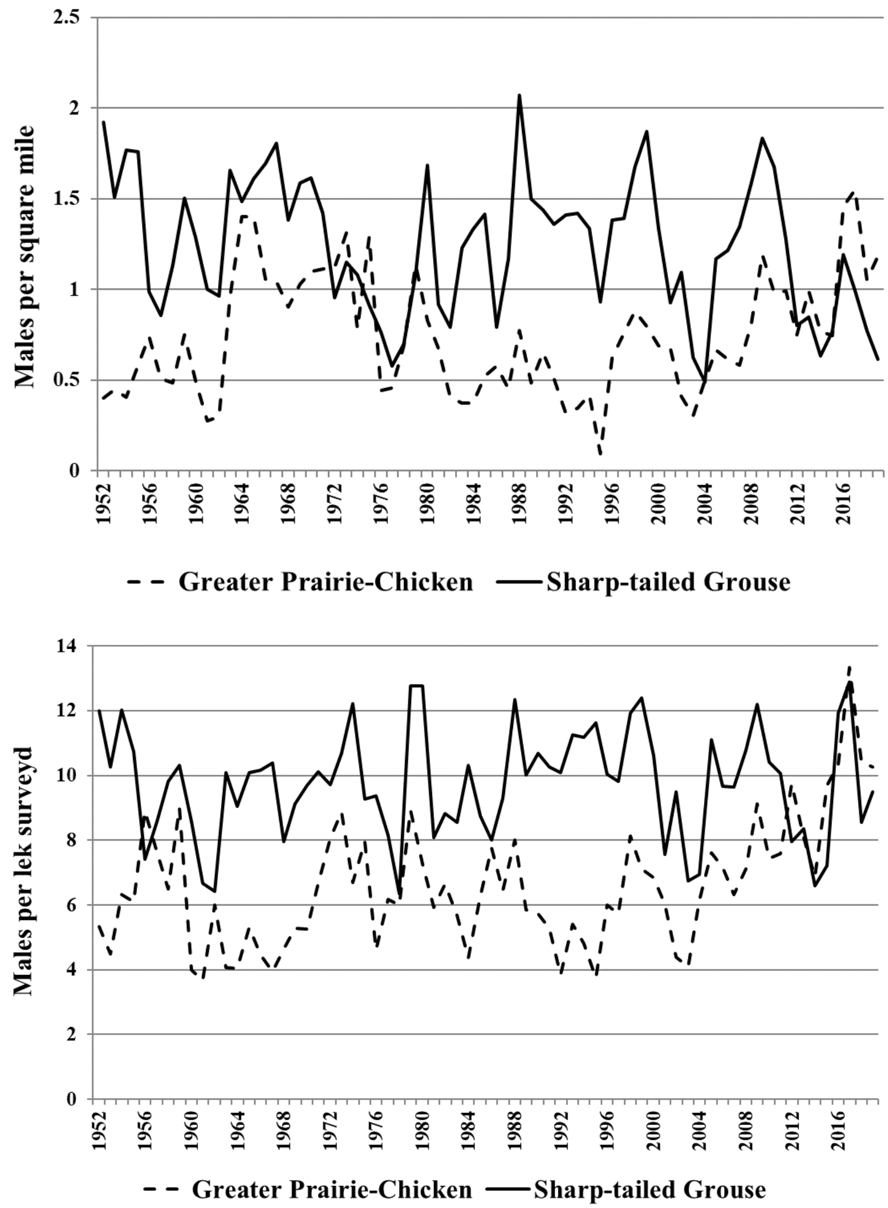

Figure 4. Results of prairie grouse traditional lek surveys 1952–2019.

Sample Based Surveys for Population Monitoring and Occurrence/Density Modeling

Data collection began in 2014 in SD to develop a spatially explicit habitat-based occurrence/density model for the Dakotas. SDGFP collaborated with North Dakota Department of Game and Fish to collect similar data between both states. Data were collected by determining presence or absence of prairie grouse leks on 1 mi² (2.56 km^2) sample units (Figure 5). Samples were spatially balanced and occurred along a gradient of landscape-level grassland availability. Each section was searched 2–3 times per year. If a lek(s) was present, the number of males was also counted. A total of 865 sections were searched between to two states. Models were developed to predict occurrence and density of prairie grouse based on landscape level habitat characteristics and climate variables (Runia et al. 2021).

As expected, prairie grouse were positively associated with grasslands including Conservation Reserve Program (CRP) and negatively associated with developed areas such as roads and dwellings (Figures 6 and 7). Spatially-explicit habitat-based occurrence and density maps were developed from the models (Figure 8). In addition to providing insight into broad-scale habitat selection, spatially explicit habitat models can be valuable tools for identifying and prioritizing areas for conservation treatments such as protection, restoration, or enhancement of habitat. Model-based estimates of the distribution and abundance of prairie grouse can also serve as a baseline for population monitoring. It is our intent to repeat this methodology periodically in the future, ideally in collaboration with adjacent states to conduct population monitoring across large portions of the species' range with similar methods.

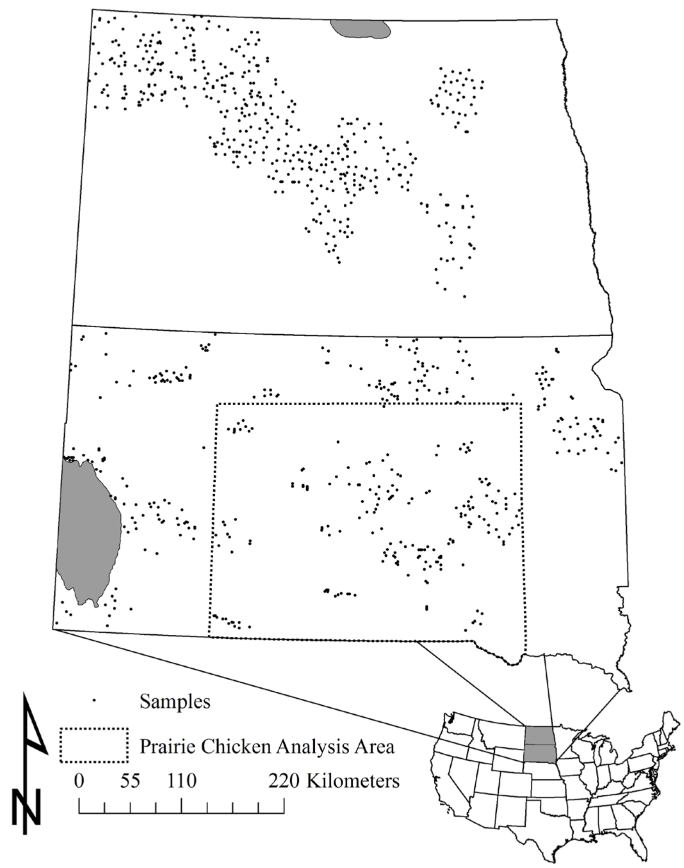

Figure 5. Areas surveyed for estimating occurrence and density of sharp-tailed grouse and greater prairie-chickens in South Dakota and North Dakota, USA, 2010–2016 (Runia et al. 2021). Samples were 1 mi^2 (2.56-km^2) Public Land Survey System sections.

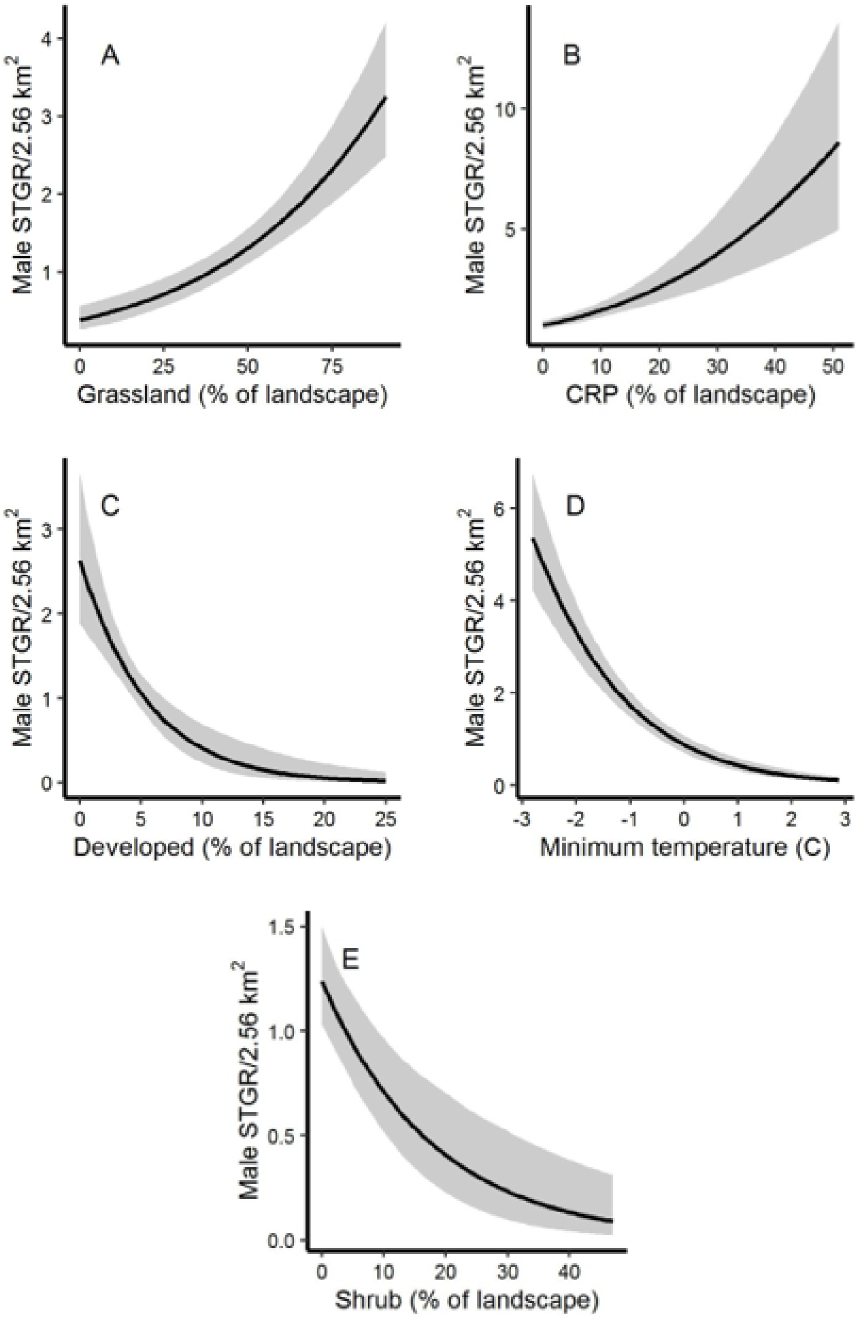

Figure 6. Predicted relative density of sharp-tailed grouse (STGR) as a function of % grassland (A), % CRP (Conservation Reserve Program) (B), % developed (C), average minimum temperature (D), and % shrub (E) in North and South Dakota, USA, 2010–2016 (Runia et al. 2021). All other continuous variables in the model were held at mean values. Predictions were reported for the dependent variable's range. Shaded areas represent 85% confidence limits. The percentages of landscape variables were calculated with a circle radius of 0.75 mi (1.2 km) centered on the sample unit.

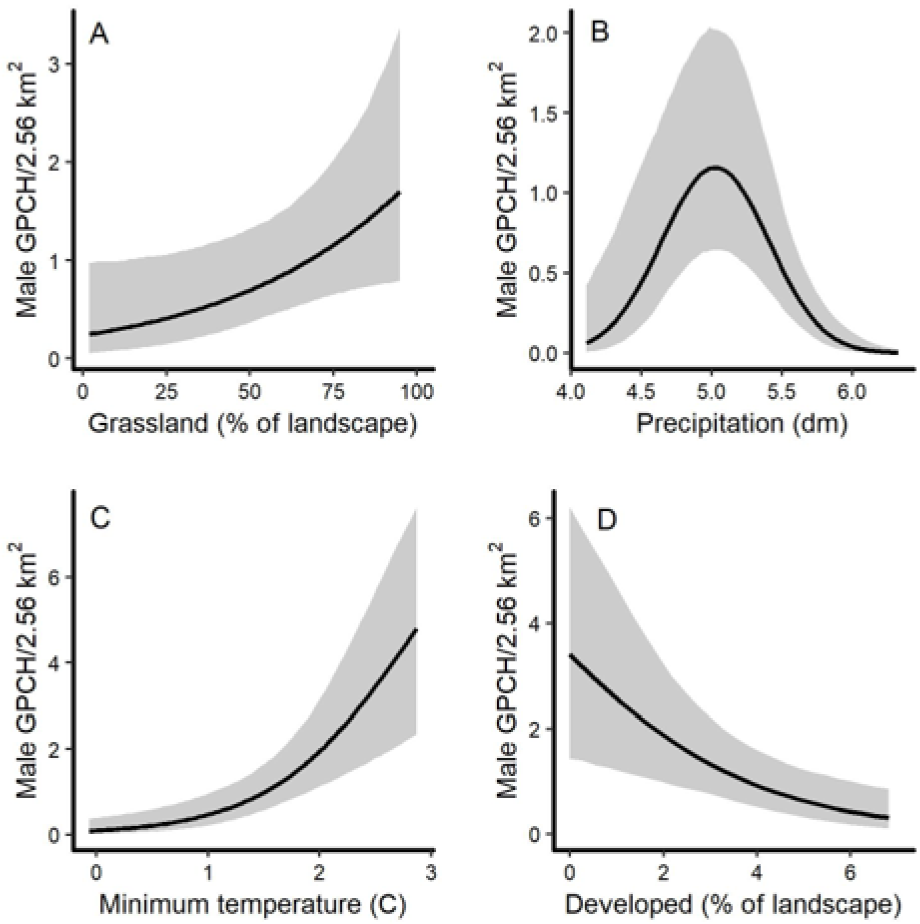

Figure 7. Predicted relative density of greater prairie-chicken (GPCH) as a function of % grassland (A), average precipitation (B), average minimum temperature (C), and % developed (D) in South Dakota, USA, 2014–2016 (Runia et al. 2021). All other continuous variables in the model were held at mean values. Predictions were reported for the dependent variable's range. Shaded areas represent 85% confidence limits. The percent of landscape variables were calculated with a circle radius of 0.75 mi (1.2 km) centered on the sample unit.

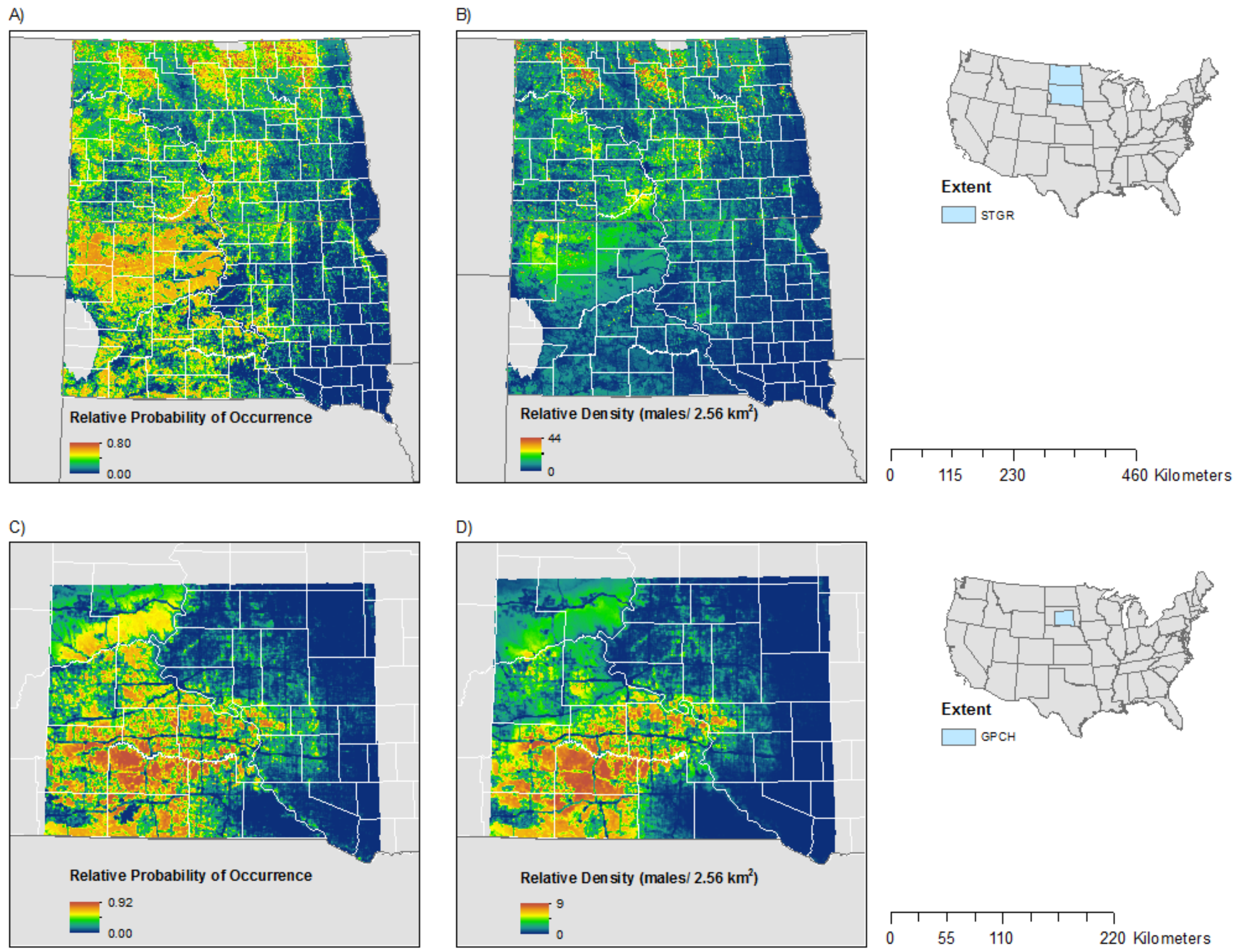

Figure 8. Maps of predicted probability of occurrence and relative density of sharp-tailed grouse (A and B) and greater prairie-chicken (C and D) in North and South Dakota, USA, 2010–2016 (Runia et al. 2021). Gray indicates areas outside the region of analysis.

Age Ratio Surveys

Wings from hunter-harvested prairie grouse are also collected during the first two weeks of the season at wing collection boxes located west of the Missouri River. (https://gfp.sd.gov/prairie-grouse/). Hunters are encouraged to place one wing from each harvested grouse in collection boxes. Each wing is identified to species (sharp-tailed grouse or greater prairie-chicken) and aged (adult or hatch year) to determine species harvest distribution and age ratios. The ratio of hatch year to adult grouse can be used to gauge production during that specific year (Figure 9). Biologists use these data to relate grouse production to weather variables to predict grouse production in future years. Prior to the hunting season the predictions are posted as prairie grouse hunting outlook document.

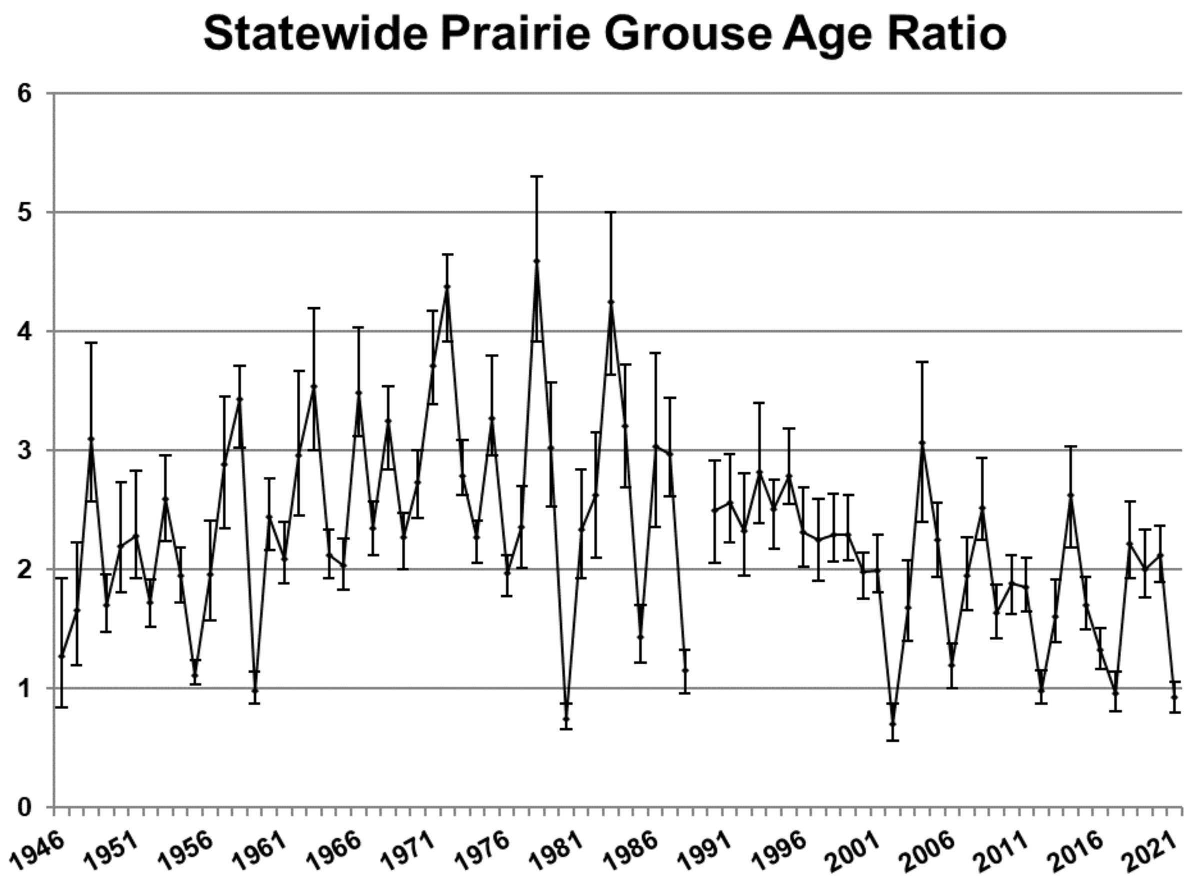

Figure 9. Statewide prairie grouse age ratio (± 95% confidence interval) from fall hunter-harvested sharp-tailed grouse and greater prairie-chickens 1946–2021.

PRAIRIE GROUSE RESEARCH

Rice and Carter (1982) investigated the relationship between grassland management practices and their subsequent influence on prairie grouse populations on the FPNG from 1974–1978. Specifically, they evaluated grazing regimes and resulting residual grass available to nesting grouse. Comparisons were made among rest-rotation, deferred-rotation, winter pasture, bull pasture, and wildlife areas. Prairie grouse production was compared among systems and related to available grass cover. Rest-rotation systems included a series of pastures in which one pasture was rested for an entire year. The pasture grazed last was rested the following year. The deferred-rotation systems consisted of a series of pastures, which were all rotationally grazed once during the growing season. The wildlife area was not grazed during the study. Bull pastures were stocked at very low density. The winter pasture was not grazed during the growing season.

The rest-rotation ungrazed pastures, winter pastures, and bull pastures yielded the most nests-broods/acre and possessed the highest amount of residual cover for nesting. Even when grazed rest-rotation pastures were included in analyses, rest-rotation pastures had more nest-broods/acre than deferred rotation pastures. The wildlife area study plots had among the highest amounts of residual grass, but much of the grass was produced on lowland sites which prairie grouse avoided for nesting.

The key finding of this study was that grazing systems that produced at least 900 lbs/acre (1010 kg/ha) of forage provided adequate residual cover for prairie grouse nesting and brood rearing. The authors recommended rest-rotation and winter grazing systems be used on the FPNG to boost local prairie grouse populations.

Fredrickson (1995) evaluated the success of a prairie-chicken reintroduction effort during 1985–1989. Prairie-chickens were captured on the FPNG and Lower Brule Indian Reservation and released in south-central McPherson County during 1986–1988. Birds were fitted with radio collars and tracked to determine survival, home range, and habitat use. The reintroduction effort was deemed unsuccessful as no prairie-chickens were observed in the release area for 5 years (1989–1993) following the last year of releases. Cause for the lack of success in the release area was attributed to habitat deficiencies, particularly during winter. Most of the released prairie-chickens traveled up to 20 mi (32 km) during winter to find adequate croplands for winter food that were adjacent to high quality grassland for roosting. Within the release area, adequate grass cover was lacking near available crop fields. Most of the migrating prairie-chickens were killed by predators before they could return to the release area after each winter.

Norton (2005, et al. 2010) estimated prairie-chicken and sharp-tailed grouse brood habitat use, nest success, and hen and brood survival on the FPNG during 2003–2005. Overall combined nest success was approximately 75%, which is one of the highest estimates ever recorded. Breeding season hen survival was approximately 82% during the 3-year study. Brood survival was also an astonishing 85% and chick survival was estimated at 36%. Prairie grouse broods avoided the use of smooth brome and selected for forb cover such as sweet clover. This study demonstrated how prairie grouse can exhibit very high reproductive potential in landscapes dominated by well-managed grasslands.

Kirschenmann (2008) studied the spatial ecology and harvest of prairie grouse on the FPNG during 2003–2005. Mean home range size for hens with broods was 455 ac (184 ha) for sharp-tailed grouse and 430 ac (174 ha) for prairie-chickens. Mean distance from lek of capture to nest sites was 1.23 mi (1.98 km) for prairie-chickens and 1.26 mi (2.03 km) for sharp-tailed grouse. Hens of both species selected pastures that were not grazed the previous year. Only 17 of 209 (8.1%) marked adult prairie grouse were reported as harvested by hunters during the 3-year study. Dog training had minimal impacts on prairie grouse behavior. Flushing distance was similar between areas open and closed to dog training. Results of this study indicate repeated flushes from dog training did not cause prairie grouse to exhibit more "wild" behavior during the hunting season.

Runia (2009) investigated how large-scale land use affects the distribution and abundance of prairie grouse in northeastern SD with an emphasis on the influence of CRP. Land use surrounding prairie grouse leks was compared to land use surrounding non-lek locations at several spatial scales. Landscapes surrounding prairie grouse leks contained higher proportions of pasture and CRP at several spatial scales. Spatially explicit habitat suitability models also were developed in a geographic information system to predict which landscapes are most likely to support prairie grouse leks. The most supported models were at the 1 mi (1.6 km) scale, similar to other studies (Merrill et al. 1999, Niemuth 2000). A similar study documented landscape level habitat characteristics associated with prairie-chicken leks on the extreme eastern fringe of their range (Orth 2012). Orth (2012) documented the need for a higher proportion of grassland on the landscape needed for lek locations, as well as the avoidance of trees and wetlands within ½ mi (0.8 km) of the lek location.

Runia and Solem (2015) collected baseline data on a pre-construction wind energy site in central SD. A control site (wind energy development not anticipated) with similar landscape characteristics was used as a comparison. Annual survival was 44% and nest success was 31%. Survival and nest success were similar between sharp-tailed grouse and prairie-chickens. Prairie grouse hens selected for nest sites within grassland dominated landscapes and avoided trees when considering only macro-scale habitat variables. This study demonstrated that prairie-chickens and sharp-tailed grouse select for and are most successful in tracts of unfragmented grasslands for reproduction. The study will be repeated if wind energy development occurs.

From 2009–2015, Geaumont and Graham (2015, 2020) studied the relationship between grassland habitat attributes and sharp-tailed grouse reproductive success on the Grand River National Grasslands (GRNG). Similar to past studies, they found sharp-tailed grouse selected for and were more successful using areas with taller grass for nesting and brood-rearing. Estimated overall nesting success with average habitat covariate values was 52%. Brood survival to 60 days was 84%. Brood survival was markedly lower within ~0.32 mi (500 m) of fences.

There are currently two ongoing research projects investigating the potential impacts of wind energy infrastructure on sharp-tailed grouse. One study is occurring at the Crowned Ridge I and II (CRI and CRII) project area in Grant, Deuel and Codington counties which was developed by NextEra Energy Resources, LLC. The project is tied to the Permit Condition No. 45 for CRI and thus funded by NextEra Energy Resources in collaboration with SDGFP. CRI began commercial operations in December 2019 and CRII began operation in December 2020. Sharp-tailed grouse were captured in spring 2020, 2021, and 2022 and marked with GPS transmitters to study their ecology in relation to the project. A full study description can be found at: https://puc.sd.gov/commission/dockets/electric/2019/el19-003/grousemig.pdf . The annual report from the first field season can be found at: https://puc.sd.gov/commission/dockets/electric/2019/EL19-003/Grouse012721.pdf .

A similar project began in the spring of 2021 at the future site of the Sweetland Wind Farm under development by Scout Clean Energy LLC in Hand County. At this site, a before-after control-impact study design is being implemented as grouse ecology data will be collected before and after turbine construction in and near the project site. This project is funded by Scout Clean Energy LLC, State Wildlife Grant, and SDGFP. The first field season was 2021 with construction of energy infrastructure planned for 2023. Five years of field research are currently planned.

HUNTING SEASON STRUCTURE AND AUTHORITY

Hunting is currently authorized from the third Saturday of September through the first Sunday in January (Administrative Rule 41:06:09:01) with a combined daily bag of three prairie grouse (Administrative Rule 41:06:09:03). The season and bag limit is set by the SDGFP commission on a 3-year cycle with the next cycle scheduled to occur in 2024.

The current hunting season structure is thought to have very little impact on the long-term population. Hunting mortality is thought to be mostly compensatory because prairie grouse are short-lived, have high reproductive potential, and are subject to a relatively low harvest rate. Only 2 out of 195 marked female prairie grouse were harvested by hunters during a 3-year study in Hyde and Hand counties (Runia and Solem 2015). Only 17 out of 209 marked adult prairie grouse were harvested during a 3-year study on the FPNG (Kirschenmann 2008). Geaumont (2015) marked 617 sharp-tailed grouse on the GRNG from 2009–2015. Only 10 birds were harvested for a 1.6% harvest rate. Hunter harvest would have very little, if any, impact on the population at these observed harvest rates (Powell et al. 2011). Prairie grouse harvest in 2020 was the highest since the early 2000s, yet spring lek counts on the FPNG were at record high levels the next spring of 2021 indicating little population impacts caused by hunting. The counties in and around the FPNG represent the highest hunter density and prairie grouse harvest in the state.

Prairie grouse hunting is most popular during the first few weeks of the season based on license sales and field staff observation. During the first few weeks of the season, prairie grouse are loosely scattered across the landscape in small coveys and family groups which is favorable for hunting. As the season progresses, flock sizes increase and hunting success generally declines sharply. Prairie grouse hunting pressure declines after the first few weeks in response to lower success and as hunters shift effort to other upland game such as pheasants. Some broods may not be fully grown if the season started earlier, and a later start date could sacrifice some of the most productive days of the season. An earlier start date could also make it more difficult to differentiate between prairie grouse and young pheasants. The current bag limit is thought to be socially and biologically acceptable. For these reasons, the SDGFP does not foresee any major recommended changes to the current hunting season structure, although the data suggests a more liberal season length, such as a structure aligned with the end of pheasant season would not be detrimental to the population. The SDGFP will continue to monitor the population, examine hunting statistics, and review public and SDGFP staff input when developing hunting season recommendations.

HUNTER & HARVEST TRENDS

Prairie grouse hunters and harvest have been estimated annually by analyzing responses from hunter surveys since 1945. Hunter and harvest numbers have been generally declining since 1975, although a sharp increase was observed in 2020 (Figure 10). An estimated 10,487 resident and 6,389 non-resident prairie grouse hunters harvested approximately 67,261 prairie grouse in

2020. Although harvest is a summation of both species of prairie grouse, prior to 2006, 60% of the bag was thought to be sharp-tailed grouse. Much of the prairie grouse harvest occurs in the central and western portion of the state (Figure 11). In 2006, hunters were asked specifically how many of each species of prairie grouse they harvested. Results from this survey revealed harvest was approximately 76% sharp-tailed grouse, 20% prairie-chickens, and 4% unknown. A supplemental survey in 2020 showed 29, 38, 24 and 9% of harvest occurred in September, October, November and December respectively.

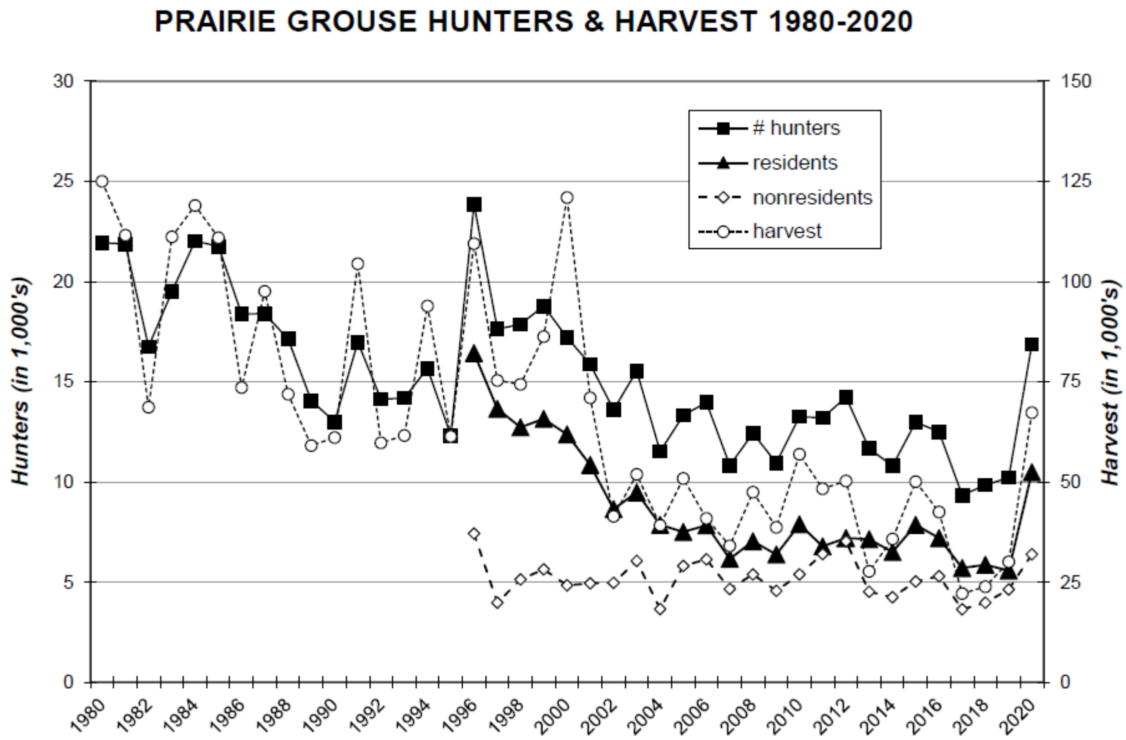

Figure 10. Prairie grouse hunters and harvest, 1980–2020.

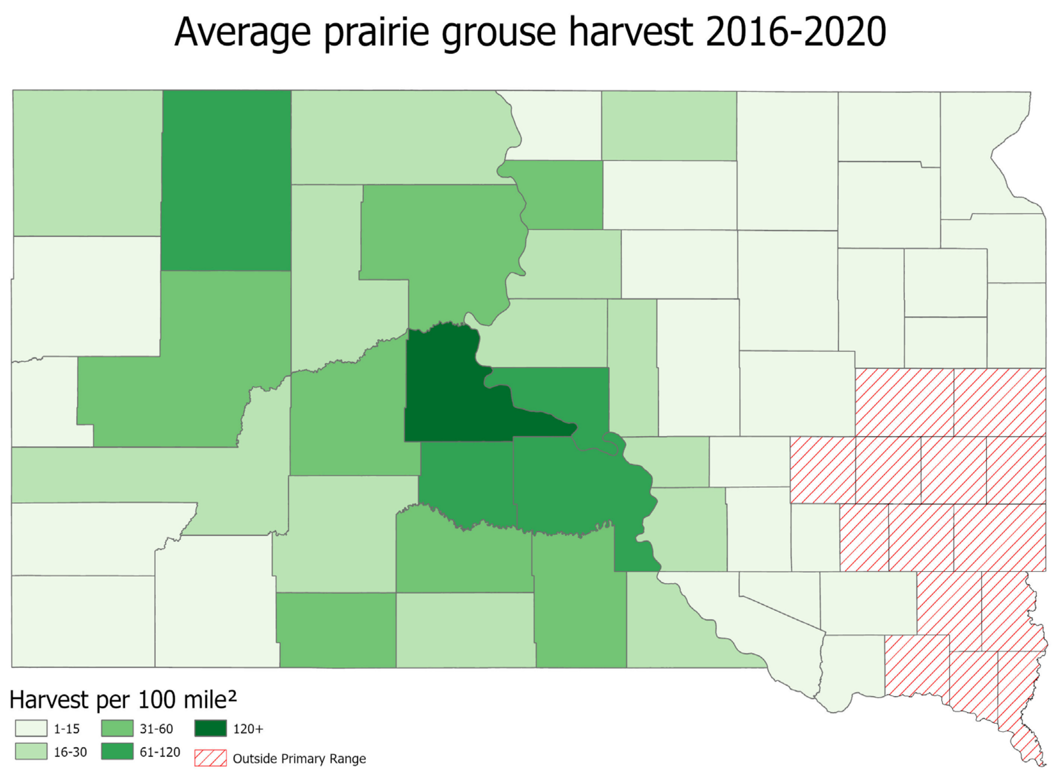

Figure 11. Average prairie grouse harvest/100 mi^2, 2016–2020.

HABITAT TRENDS

Prairie grouse require landscapes that contain a high percentage of grassland to persist (Merrill et al. 1999, Hanowski et al. 2000, Niemuth 2000). Since European settlement, grasslands have become one of the most imperiled ecosystems in the Great Plains primarily due to conversion to cropland (summarized in Samson et al. 2004). Range wide, severe loss of native grasslands has resulted in a decrease in abundance and distribution of prairie grouse (Johnsgard and Wood 1968) and these declines continue (Silvy and Hagen 2004). Sharp-tailed grouse were once found in 21 states, but habitat loss has reduced their range to portions of 11 states. Prairie grouse are prime examples of how large-scale land use changes can influence the distribution and abundance of landscape prairie obligates. Further conversion of grassland to cropland has been identified as a primary threat to prairie grouse throughout the northern Great Plains (Vodehnal and Haufler 2007).

South Dakota's landscape has changed substantially since European settlement in the late 1800s. Early settlers found the rich soils of eastern SD to be very productive for agricultural crops and quickly converted much of the grassland landscape to cropland. Conversion of grassland to cropland was more intense in the far eastern portion of the state because of higher annual precipitation. More recently, high commodity prices fueled by the ethanol industry and improvements in agricultural technology (e.g., improved crop genetics) have resulted in mass conversion of grassland to cropland in SD (U.S. GAO 2007). Total cropland in SD increased by nearly 1.5 million ac (0.6 million ha) in the last 40 years (USDA NASS 2021, Figure 12) as more land, primarily grasslands, have been converted to cropland.

During the 15-year period of 1982‒1997, 1.82 million ac (0.74 million ha) of grassland were converted to cropland in the U.S. (U.S. GAO 2007). A more recent study found 1.84 million ac (0.74 million ha) of grassland were lost, primarily to conversion to cropland, from 2006–2012 (Reitsma et al 2014). Wright and Wimberly (2013) estimated 450,000 ac (182,000 ha) of grassland were converted to corn or soybeans between 2006 and 2011. Grassland to cropland conversion continues at a rate of approximately 50,000 ac (20,000 ha) per year (Stubbs 2007) and the rate of conversion appears to be accelerating (Rashford et al. 2011). Using these statistics, it is reasonable to say that SD has lost an estimated 4.5 million ac (1.8 million ha) of grassland to cropland conversion since the early 1980s. Much of the recent conversions are occurring within the Missouri Coteau (Stubbs 2007, Stephens et al. 2008) which also represents the eastern fringe of the prairie grouse range in SD. This region contains vast grasslands that are vulnerable to future conversion (Stephens et al. 2008, Rashford et al. 2011).

Bauman et al. (2016) recently completed a fine-scale inventory of all undisturbed grasslands in eastern SD delineating remaining tracts of native sod grasslands, which are potentially important prairie grouse habitat on the fringe of their range. Overall, about 5.5 million ac (2.2 million ha) (24.2%) of the approximately 22.6 million ac (9.1 million ha) in eastern SD were designated as potentially undisturbed. Nearly 1.0 million ac (4.0 million ha) of the approximately 5.5 million ac (2.2 million ha) of undisturbed land (17.5%) had some level of permanent conservation protection status. In total, they identified 962,734 ac (389,604 ha) of undisturbed habitat that is protected from future conversion, representing only 4.3% of eastern SD's total land base. While all grasslands represent prairie grouse habitat, undisturbed grasslands are particularly important, especially when the diverse native plant community still persists.

While grasslands are being converted to cropland at alarming rates, there is interest by landowners to keep land in grassland in perpetuity. In fact, as of August 2021, 450 landowners representing 87,000 ac (35,000 ha) were on the waiting list to enroll their land in a perpetual grassland easement through the Unites States Fish and Wildlife Service (USFWS; Boyd Schulz, personal communication). Recent funding allows for approximately 45,000 ac (18,000 ha) of enrollment annually and 1.12 million ac (451,000 ha) are currently protected by grassland easements in SD.

Conversion of grassland to cropland has been substantial, but the CRP authorized under the 1985 Farm Bill has returned some cropland to grassland (Figure 13). Through this program, landowners receive an annual rental payment to convert eligible cropland to perennial cover (mostly grass) for 10 to 15-year contracts. As of 1 October 2021, SD had 912,000 ac (369,000 ha) of CRP, excluding acres enrolled in Grassland CRP practices. As much as 1.77 million ac (0.72 million ha) of CRP has been enrolled at one time in SD which occurred in 1995. Although CRP can benefit prairie grouse (Rodgers and Hoffman 2005, Runia et al. 2021), it represents a short-term solution to a long-term habitat loss problem.

In addition to declines in grassland habitat quantity, invasive plant species have also reduced grassland habitat quality across SD. Non-native grasses such smooth brome (*Bromus inermis*), Kentucky bluegrass (*Poa pratensis*), and crested wheatgrass (*Agropyron cristatum)* compete with native grasses and provide lower quality habitat than native plant communities. Moreover, invasive weeds such as Canada thistle (*Cirsium arvense*) and leafy spurge (*Euphorbia esula*) can be difficult to control and can become dominant if not managed. Fire suppression also has allowed encroachment of woody species such as eastern red cedar (*Juniperus virginiana*) into otherwise open grasslands, thereby reducing or even eliminating prairie grouse habitat. Loss of grasslands to invasive eastern red cedar along the Missouri River breaks and in similar landscapes along its larger western tributary rivers (e.g. White River and Cheyenne River) has gotten the attention of both the ranching community and wildlife managers.

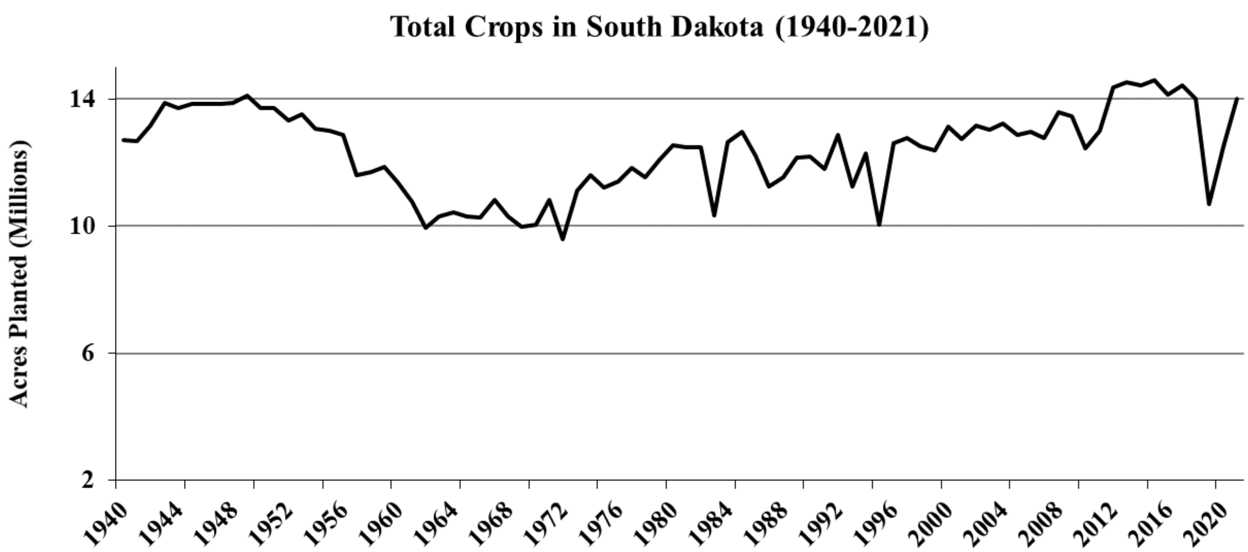

Figure 12. Total cropland in South Dakota 1940–2021 (USDA NASS 2021).

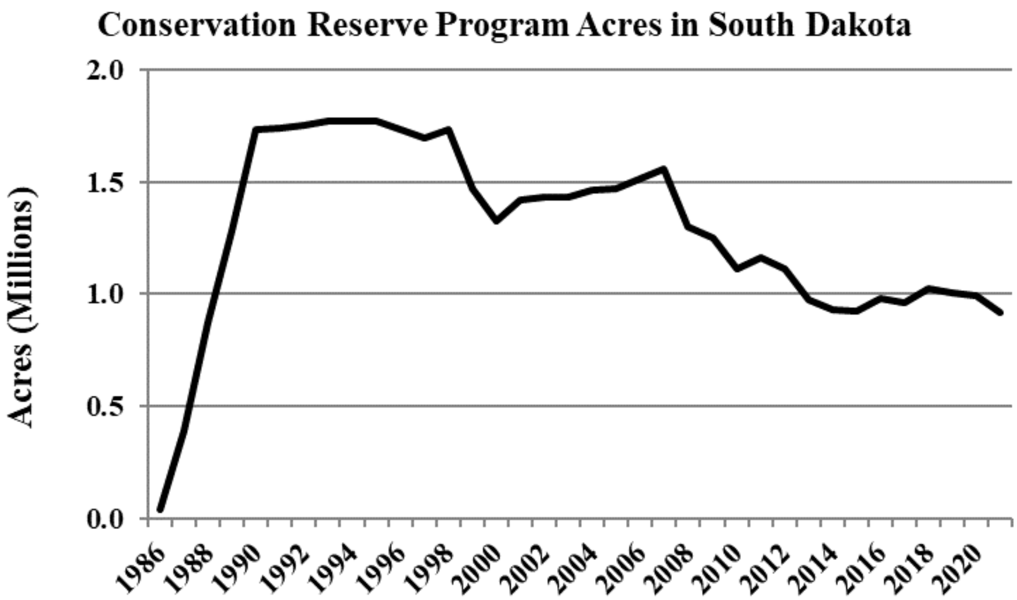

Figure 13. Total Conservation Reserve Program (CRP) acres in South Dakota 1985–2021. Note, lands enrolled in the Grasslands CRP practice are not included.

PRIORITY HABITAT AREAS

A system of tiered Priority Habitat Areas has been developed to delineate landscape level habitat for sharp-tailed grouse and greater prairie-chickens in SD. The system is based on the spatially-explicit habitat-based models published by Runia et al. (2021). As previously described in the *Surveys and monitoring* section, prairie grouse density models and associated maps/GIS layers were developed based on landscape-level habitat characteristics. We post-processed the species-specific continuous density layers into a system of categorical tiers. We selected density thresholds to categorize habitat as Tier 1 (highest quality), Tier 2, Tier 3 and Low-Quality habitat. We selected lower density thresholds for areas east of the Missouri River (east river) because prairie grouse habitat is less abundant and more isolated than areas west of the Missouri River (west river).

The 73,922 mi^2 (191,459 km^2) analysis area for sharp-tailed grouse was the state of SD excluding the Black Hills National Forest. For sharp-tailed grouse, the Tier 1 Priority Area was estimated to support about 20% of the population for east and west river (Figure 14). The Tier 1 priority area only encompasses 3.7% of east river and 6.6% of west river. The Tier 2 Priority Area was estimated to support an additional 20% of the population for east and 30% for west river (Figure 14). The Tier 2 Priority Area only encompasses 5.0% of east river and 14.9% of west river. Overall, 18.7% of east river and 56.3% of west river were categorized as Tier 1, 2, or 3 which is estimated to encompass about 64% and 87% of the population respectively.

The prairie-chicken analysis area was a 32,971 mi^2 (85,395 km^2) region of central SD. For prairie-chickens, the Tier 1 Priority Area was estimated to support about 22% of the population for east river and 28% for west river (Figure 15). The Tier 1 Priority Area only encompasses 1.9% of the east river and 6.6% of the west river analysis area. The Tier 2 priority area was estimated to support an additional 24% of the population for east river and 20% for west river (Figure 15). The Tier 2 Priority Area only encompasses 5.8% of the east river and 21.4% of the west river analysis area. Overall, 11.2% of the east river and 51.5% of the west river analysis area were categorized as Tier 1, 2, or 3 habitat which is estimated to encompass about 67% and 86% of the population respectively.

The Priority Areas will serve as an important tool for many aspects of prairie grouse habitat management. Tier 1 areas are generally indicative of favorable intact landscapes where maintaining landscape level habitat characteristics should be a priority (e.g., grassland easements). Tier 1 areas would also be prime candidates for local scale habitat assessments and appropriate treatments such as managed grazing or measures to prevent tree encroachment into grasslands. Tier 2 and Tier 3 areas will generally represent areas with more landscape level habitat improvement opportunities such as grassland restorations, reduction of developed areas, and removal of encroaching trees in grasslands. However, because both species models have climate variables, some Tier 2 and Tier 3 areas could have similar landscape conditions as Tier 1. Because of this, managers should conduct local assessments to determine appropriate habitat treatments.

The Priority Areas could provide a rapid way to assess habitat suitability during environmental review processes for many types of potential proposed projects. Environmental review processes for prairie grouse have traditionally relied heavily upon existing opportunistic lek data or pre-construction lek surveys. There may be advantages to integrating static priority areas for mitigation considerations versus relying on dynamic, incomplete or poor-quality biological data.

It should also be understood that not all designated priority areas will always be occupied by prairie grouse. All habitat suitability models are imperfect, and occupancy of all wildlife species can be by dynamic through space and time based on local conditions, connectivity to other suitable habitat, or unknown reasons. Although the priority areas are static maps based on the best available information, occupancy of specific priority areas is likely dynamic.

Sharp-tailed Grouse Priority Habitat Area Thresholds

	Cumulative % of Analysis Area					
	Statewide		East River		West River	
Density	Landscape	Abundance	Landscape	Abundance	Landscape	Abundance
0	100.0		100.0		100.0	
1	67.4	100.0	48.5	100.0	84.6	100.0%
2	38.3	81.3	18.7	63.5	56.3	87.3
3	22.3	60.6	8.7	39.1	34.8	67.9
4	13.0	42.7	3.7	21.0	21.5	49.9
5	7.4	28.3	1.4	9.7	12.9	34.6
6	3.7	16.3	0.5	4.1	6.6	20.4
7	1.7	8.5	0.2	1.6	3.1	10.8
8-26	0.6	3.8	0.1	0.7	1.2	4.9

Priority Habitat Category Tier 1 Tier 2 Tier 3

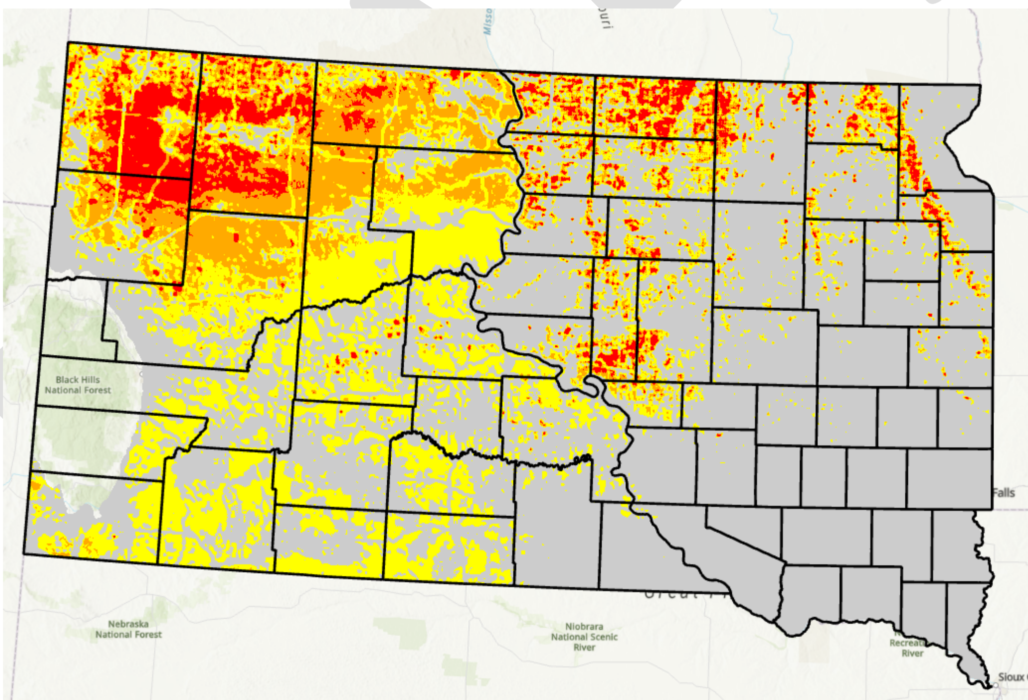

Figure 14. Sharp-tailed grouse priority habitat threshold table and associated map derived from Runia et al. (2021). Areas not categorized as Tier 1, Tier 2 or Tier 3 are considered Low-Quality habitat. Gray areas indicate the analysis area. Note, not all Priority Areas may be visible at the displayed scale.

Greater Prairie-chicken Priority Habitat Area Thresholds						
	Cumulative % of Analysis Area					
	Statewide		East River		West River	
Density	**Landscape**	**Abundance**	**Landscape**	**Abundance**	**Landscape**	**Abundance**
0	100.0		100.0		100.0	
1	57.2	100.0	29.1	100.0	82.3	100.0
2	39.9	91.1	11.2	66.5	65.5	94.7
3	29.9	80.8	5.8	46.1	51.5	86.0
4	21.9	68.4	3.2	31.7	38.6	73.9
5	15.6	55.5	1.9	22.0	27.9	60.5
6	11.8	45.7	1.1	14.8	21.4	50.3
7	8.6	35.9	0.7	10.1	15.7	39.7
8	5.7	25.4	0.4	6.3	10.5	28.3
9	2.7	13.1	0.1	2.1	5.1	14.7
10-26	0.6	3.3	0.0	0.1	1.2	3.8

Priority Habitat Category Tier 1 Tier 2 Tier 3

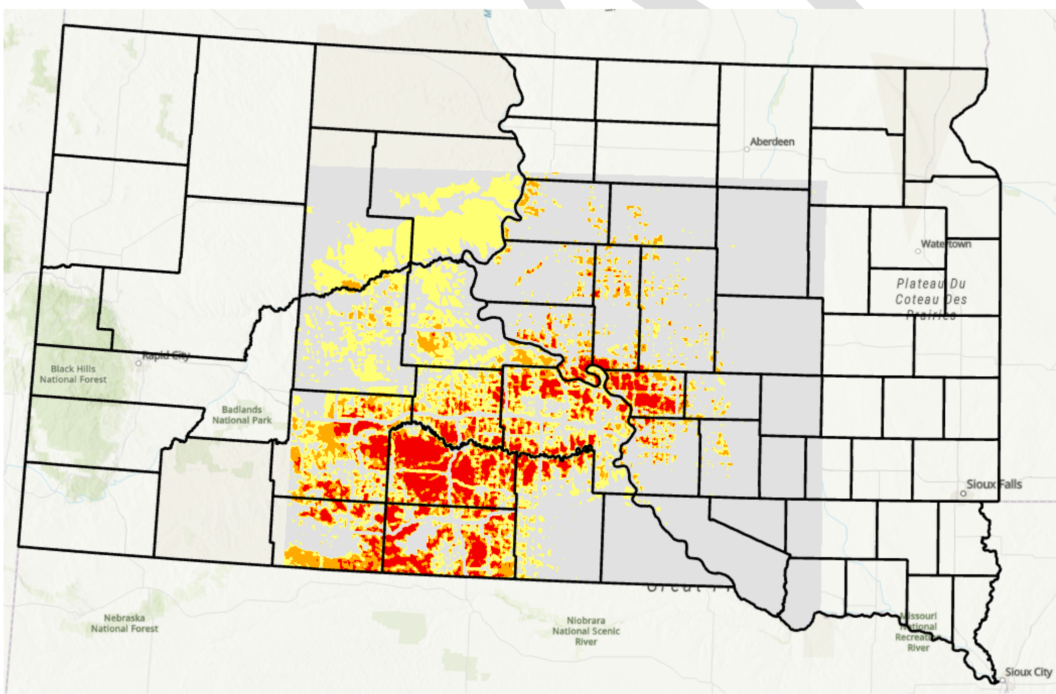

Figure 15. Greater prairie-chicken priority habitat threshold table and associated map derived from Runia et al. (2021). Areas not categorized as Tier 1, Tier 2 or Tier 3 are considered Low-Quality habitat. Gray areas indicate the analysis area. Note, not all Priority Areas may be visible at the displayed scale.

ISSUES, CHALLENGES, AND OPPORTUNITIES

Loss of grassland habitat, primarily through conversion to cropland, is currently and will continue to be the primary threat to prairie grouse in SD. History has demonstrated how prairie grouse population declines are linked to landscape level land use changes. Because SD's landscape changes are driven by many factors, it will be challenging to slow these habitat trends. With challenges also come opportunities, and many opportunities do exist to maintain, manage, and restore prairie grouse habitat on private and public land in SD.

Habitat delivery and advocacy - Partnership-based programs and initiatives which promote sound stewardship of grasslands on private lands are essential to management of prairie grouse habitat. The partnerships among SDGFP, USFWS, Ducks Unlimited, Pheasants Forever, Bird Conservatory of the Rockies, American Bird Conservancy, and the Natural Resources Conservation Service (NRCS) to station biologists in NRCS service centers and USFWS offices has been a successful way to expedite delivery of grassland conservation programs. In addition to partnership positions, SDGFP has 12 private lands habitat biologists stationed across the state to deliver grassland conservation practices. Partnership positions and the SDGFP private lands habitat program will be continually monitored to improve efficiencies and capacity.

SDGFP promotes and advocates for local, state, and national policies which would be favorable to prairie grouse habitat. Federal policies, particularly Farm Bill provisions, can have significant influences on land use decisions. Participation in a variety of technical committees, working groups, joint ventures, advisory boards, and associations will assure prairie grouse habitat needs are included in decision making processes. Habitat advocacy efforts include communication and participation among the following entities:

- South Dakota NRCS technical committee and subcommittees
- South Dakota Second Century Habitat Fund Board
- Prairie Pothole Joint Venture
- Northern Great Plains Joint Venture
- South Dakota Grassland Coalition
- South Dakota State University Extension
- South Dakota Governor's Office
- State and National delegation
- Midwest Association of Fish and Wildlife Agencies
- Western Association of Fish and Wildlife Agencies
- Association of Fish and Wildlife Agencies

It will remain critical to sustain working relationships with other public land management agencies, such as U.S. Department of Agriculture Forest Service, U.S. Bureau of Land Management and SD School and Public Lands, to foster similar land use goals which benefit prairie grouse and other prairie obligate species. SDGFP will continue to engage with the tribes on wide range of wildlife issues.

The department maintains the Habitat Pays website (http://habitat.sd.gov/) which includes many resources for landowners interested in grassland conservation programs, workshops, range tours, and grazing classes. The department also supports the SD Grassland Coalition (sdgrass.org) and their vision of promoting good stewardship of grasslands through sustainable and profitable management.

Grazing management – Most of the prairie grouse grassland habitat in SD is used for livestock grazing. Prairie grouse rely on residual vegetation to conceal nest sites especially during the egg-laying and early incubation periods (Vodehnal et al. 2020). As spring green up occurs, growing vegetation provides supplemental cover to nest sites. Prairie grouse rely on residual and growing vegetation as concealment and thermoregulation cover for broods. Grasslands are used year-round for roosting, hiding, protection from the elements, and food. The presence of diverse forbs/wildflowers within grasslands benefit prairie grouse by producing food items such as seeds and berries. Forbs also produce healthy insect populations which are a key food item, especially for chicks. Grazing regimes can influence vegetation structure and diversity through space and time.

In general, grazing regimes which avoid overgrazing and encourage diversity in vegetation composition, especially native grasses and forbs, and provide adequate structure most of the time are compatible with prairie grouse habitat needs. Overgrazing is the continued heavy grazing which exceeds the recovery capacity of the plant community and creates a deteriorated range (Society for Range Management 1998).

Grasslands which provide 8-12 in (20-30 cm) of vertical cover within 20 ft (6 m) of the nest bowl are generally optimal for most prairie grouse nesting needs (Milligan et al. 2020). Consistent with those findings, Geaumont and Graham (2015) found sharp-tailed grouse selected nest sites with 8-10 in (20-25 cm) of vertical cover at a much higher rate than shorter cover at the GRNG. In the same study, nest success was also markedly lower when less than 8 in (20 cm) of visual cover was used. Although vegetation measurements were not recorded at nest sites, Norton (2005) observed extremely high (72-80%) nest survival for prairie grouse on the FPNG. The high success occurred in a large intact grassland where 10-24% of the area was rested from grazing annually. Grazing pressure on utilized parcels is carefully managed to assure overgrazing does not occur. Powell et al. (2020) observed optimal prairie-chicken nest success with standing dead vegetation height of approximately 8-18 in (20-45 cm) in Nebraska.

Brood-rearing hens using grazing lands have been found to select sites with less litter and bare ground and tended to use areas near drainages (Geaumont and Graham 2020). Brood survival was extraordinary on the FPNG where broods used grass and forb-dominated vegetation with a visual obstruction reading (VOR) of 10-15 in (26-37 cm), although smooth brome grass was avoided (Norton et al. 2010). Brood survival was similarly high on the GRNG where brood survival was highest when VOR was about 4-6 in (10-15 cm) and max grass height was about 24-39 in (60-100 cm) (Geaumont and Graham 2020). Brood survival was also markedly lower within about ½ mile (800 m) of fences, possibly due to increased use of those areas by raptors or mesopredators (Geaumont and Graham 2020).

Where prairie grouse habitat is a consideration, managers should strive to meet optimal vegetation structure levels and strive for plant species diversity (grass <u>and</u> forbs) when and where possible within ecological site and local constraints. In general, rotational grazing that includes rest is an effective practice to improve prairie grouse habitat on grazing lands but may not be necessary in all situations. Exotic grasses such as smooth brome and Kentucky bluegrass commonly become dominant on native and non-native grazing lands in SD, especially the eastern half of the state, resulting in loss of species diversity or desired vegetation structure. Battling aggressive exotic cool-season grasses may require management actions that sacrifice prairie grouse habitat in the short term. For example, periodic prescribed fire, heavy grazing, or a combination thereof during April – June (and/or during fall growing season) may be necessary to shift plant communities from exotic cool season grasses to more diverse native assemblages. Such practices are likely to result in immediate sub-optimal vegetation structure for nesting and brood-rearing grouse but with a long-term habitat improvement goal. Other management actions such as seeding desirable species or chemical application could be appropriate in some circumstances and may also have some short-term detrimental impacts to habitat.

Managers have a challenging task of balancing the need for optimal vegetation structure and diversity while concurrently considering long-term goals of improving species diversity and composition. Our recommendations are deliberately broad as it is imperative that producers, managers, and resource professionals work in tandem to meet short- and long-term goals for both prairie grouse habitat and rangeland health/livestock production for each unique operation. The potential negative impact of fences on brood survival does present a management conundrum as fences are a near necessity for managed grazing. Managers should consider all options to distribute grazing pressure through space and time including temporary electric fences or water availability. It may be advantageous to manage with the largest paddock possible while still being able to meet management objectives.

Cropland retirement programs – Grasslands established through cropland retirement programs such as CRP have benefited prairie grouse populations, but vegetation composition and structure does influence the response (Rodgers and Hoffman 2005). Greater prairie-chickens exhibited population increases and range expansion in response to CRP in most areas of their range, except in some eastern areas where vegetation appeared to grow too tall. Sharp-tailed grouse exhibited widespread population increases and range expansion across the Great Plains in response to CRP. Sharp-tailed grouse occurrence and density was positively associated with CRP in a habitat model for the Dakotas (Runia et al. 2021).

We recommend cropland retirement programs to provide habitat for prairie grouse with some important considerations. Targeted enrollment in landscapes already containing adequate or near adequate amounts of grass to support prairie grouse would be the most efficient use of resources. The Priority Habitat Areas could serve as a tool to direct cropland retirement programs to the most appropriate locations. Managers should also be cognizant of the expected vegetation structure of planted grasses for the given ecological site. Particularly in the eastern 1/3 of state, many CRP stands will exceed 39 in (100 cm) which is likely above the preferred range for prairie grouse. We recommend diverse seed mixes of grasses and forbs that are expected to generally achieve maximum heights of 39 in (100 cm) for new plantings. We generally recommend native species, although some judiciously selected exotic species may be appropriate for some applications. Similar as described in the grazing section, we encourage periodic management of grass stands that encourage species diversity and promotes favorable vegetation structure. Management that maintains forb abundance through time is preferred.

General grassland habitat best practices – Retention of existing grasslands is a management priority. There are also best practices to improve/maintain value of existing grasslands as prairie grouse habitat. The following general best practices are expected to improve the value of grasslands as prairie grouse habitat, especially in priority habitat areas and other occupied habitat.

- Delay haying until after August 1.
- Use spot spraying herbicide application in lieu of field-level applications to control noxious weeds.
- Control woody species encroachment into grasslands (e.g. eastern red cedar, Siberian Elm).
- Avoid establishing trees within and directly adjacent to existing grasslands, especially large tracts of native prairie.
- Remove abandoned buildings which could harbor mammalian nest predators, especially in priority habitat areas.

Wind energy development - South Dakota has been identified as one of the top geographic locations for wind energy development within the United States. According to the U.S. Department of Energy, SD's resource potential for wind energy includes vast areas with wind power classifications of good to superb (Figure 16). As of December 1, 2021, SD had 25 operational wind energy projects capable of generating 2,895 MW of power from 1,383 turbines (SD Public Utilities Commission [PUC] 2021). Many of SD's large intact grasslands occur in areas of high wind potential such as the Missouri Coteau, Prairie Coteau, and vast areas of western SD.

Specifically, 75, 79, and 70% of Tier 1, Tier 2, and Tier 3 sharp-tailed grouse priority habitat areas have wind power classifications of good or higher respectively. In comparison, only 55% of areas outside of the priority habitat areas have wind power classifications of good or higher. For prairie-chickens, 65, 66, and 69% of Tier 1, Tier 2, and Tier 3 priority habitat areas have wind power classifications of good or higher respectively. In comparison, only 61% of areas outside of the priority habitat areas have wind power classifications of good or higher.

Wind energy development has generally occurred in sharp-tailed grouse priority habitat areas at a similar rate as low quality habitat areas. Tier 1 habitat encompasses 5% of the analysis area but included 7% of the wind turbines in the analysis area. Cumulatively, 33% of wind turbines in the sharp-tailed grouse analysis area were sited within the 38% of the landscape classified as Tier 1, 2, or 3 habitats. Development has not occurred in prairie-chicken Tier 1 habitat. Cumulatively, 14% of wind turbines in the prairie-chicken analysis area were sited within the 32% of the landscape classified as Tier 1, 2, or 3 habitats.

The impacts of wind energy on greater prairie-chickens are generally equivocal and the impacts on plains sharp-tailed grouse have not been studied. A single study on Columbian sharp-tailed grouse did not detect an influence of wind energy development on nest site selection or nest survival, but other aspects of ecology have not been studied (Proett et al. 2019). Greater prairie-chicken lek persistence was ~ 0.5 for leks < 0.62 mi (1 km) from a turbine, ~ 0.9 for leks 1.86 mi (3 km) from a turbine, and > 0.95 for leks ≥ 3.73 mi (6 km) from a turbine during the 3-year post-construction period for a study in Kansas (Winder et al. 2015a). The rate of lek abandonment was 3× higher for leks < 4.97 mi (8 km) from a turbine compared to leks ≥ 4.97 mi (8 km) from a turbine (22% vs 8%) supporting the USFWS's 4.97-mi (8 km) buffer zone for wind energy development (Manville 2004). The increased rate of lek abandonment within 4.97 mi (8 km) of wind turbines is concerning because female prairie-chicken activity centers are nearly always centered within 3.1 mi (5 km) of active leks (Winder et al. 2015b). Although previous research found female greater prairie-chickens avoid turbines in their space use and movements, turbines did not negatively affect nest-site selection, nest survival, or adult survival (Winder et al. 2013, McNew et al. 2014, Winder et al. 2014). Harrison et al. (2017) found little evidence of an effect of a small wind energy facility (36 turbines) on nest site selection and nest success of greater prairie-chickens in an intact grassland. At the same study site, Smith et al. (2017) found distance to turbine did not influence greater prairie-chicken survival but did influence distribution of some predators.

For projects 100 MW or larger, wind energy developers must consult with the SDGFP for an environmental review as part of the PUC permitting process. The SDGFP may also be consulted for an environmental review if the project has a federal nexus which initiates the National Environmental Policy Act process.

Other development - There is also evidence that other forms of development within occupied habitat could have a negative impact on prairie grouse. Greater prairie-chickens were found to avoid power lines by 330 ft (100 m) in Oklahoma (Pruett et al. 2009). A habitat-based greater prairie-chicken lek site model revealed a weak avoidance effect of roads at a 3.1-mi (5 km) scale in Kansas (Gregory et al. 2011). A similar modeling effort in Minnesota suggests road density at a 2-mile (3.2 km) scale was a negative predictor of lek presence (USFWS HAPET 2010). Significantly more roads occurred within 1,640 and 3,280 ft (500 and 1,000 m) of inactive sharp-tailed grouse leks when compared to active leks in Minnesota (Hanowski et al. 2000). Developed areas such as roads and building sites were a negative predictor of greater prairie-chicken and sharp-tailed grouse occurrence and density in the Dakotas (Runia et al. 2021). Research investigating the effects of oil and gas development is limited for prairie grouse. Energy development may alter predator dynamics increasing nest success for sharp-tailed grouse in areas of high development but reducing nest success for areas adjacent to development (Burr et al. 2017).

Surveys – Independent of population monitoring, prairie grouse surveys are often conducted by the private sector during the planning/permitting phase of planned development (e.g., energy development and associated infrastructure). Documenting lek sites within project areas is usually the objective of these surveys. However, for the results to be useful for avoidance measures or for policy makers issuing permits, the results should ideally represent a census of lek sites.

We recommend rigorous ground-based surveys by trained observers similar to those used by Runia et al. (2021) in SD. Trained observers should look and listen for prairie grouse lekking activity during favorable conditions and assume an effective search radius of 1/4 mi (400 m) from the observer. Roads can be used as a vantage point, but areas > 1/4 mi (400 m) should be searched by foot from the ground which will commonly require landowner permission. Searches should occur during a period of expected optimal male lekking activity to maximize detection. Specifically, searches should occur March 25-April 30 from 30 minutes before sunrise to 1.5 hours after sunrise with light winds < 12 mi/hr (19 km/hr) and no precipitation. We recommend that all areas of the project area be searched at least twice (different days) since lek sites could be temporarily unattended due to random events (e.g., flushed by raptor or mammalian predator). If a lek is located, a count of the number of males should be conducted from a clear vantage using a spotting scope or binoculars. Data collected for research purposes may benefit from multiple counts of males within the season.

In addition to documenting lek locations and attendance, it is imperative that all survey effort is documented. Data indicating absence of leks is just as important as presence data, but only if survey effort was adequate and documented. Survey documentation should include when, where and how surveys occurred as well as associated weather conditions.

Prairie grouse leks can be located from aircraft, but poor detection rates preclude the data from being interpreted as a census (McDonald et al. 2012). Aerial surveys could be a useful tool for rapidly searching high quality habitat for leks. However, we still recommend that areas > 1/2 mi (800 m) from leks located from the air be surveyed from the ground using the previously described methodology. If only aerial surveys are used, we recommend 3 repeated surveys to increase detection of leks. We speculate that aerial surveys may be more useful for detecting sharp-tailed grouse leks since they commonly occur on elevated areas of the landscape in short vegetation. However, greater prairie-chicken leks in SD are commonly observed in lower areas near wetlands with taller vegetation and at times are even difficult to visually detect from the ground. We suspect detection of greater prairie-chicken leks from the air could be prohibitively low. Therefore, we do not consider aerial only surveys as an *adequate survey* unless permission for conducting ground surveys is denied.

Although lek sites can be somewhat static features, and results of lek surveys are potentially useful for planning and mitigation purposes, leks can also be dynamic features. Lek sites can and do occur in different locations among years, and new leks can colonize while others can go extinct. These natural phenomena can represent a challenge, particularly if the objective of surveys is to avoid development near lek sites. Avoiding areas of favorable habitat, especially grasslands (e.g., priority habitats described above), may ultimately be more achievable than avoiding dynamic lek locations.

For the purpose of avoidance and minimization measures, an *adequate survey* would adhere to the described protocol and occur for at least 2 consecutive years. Survey results will be valid for 2 years after completion (e.g., survey conducted in year 1 and year 2 would be valid for year 3 and year 4). Aerial only surveys would not be considered an *adequate survey* without a ground-based follow-up survey. A *lek* would be defined as a group of ≥2 displaying male grouse in one or more years.

Avoidance, minimization and mitigation recommendations for development – We have integrated the system of tiered Priority Habitat Areas and outcomes of pre-construction lek surveys into a mitigation framework (Table 1). The approach categorizes individual components (e.g., distance of road or transmission line, number of wind turbines) of planned permanent above-ground development based on an avoidance rating scale (very good [A], good [B], fair [C], poor [D] and very poor [F]). We first and foremost recommend avoiding priority areas for development, with a stronger emphasis on higher level priority habitat areas (e.g., very good rating). We further recommend pre-development lek surveys and avoiding development within 1 mi (1.6 km) of lek sites as a way to minimize impacts to prairie grouse, especially when development is planned in priority areas. If all priority areas are avoided (true avoidance), pre-development surveys are less critical. Developers should consult with the Environmental Review Senior Biologist for guidance on implementation of this plan for their specific project.

Table 1. Avoidance mitigation recommendations for development.

Development location	**Avoid development within 1 mile of lek**	**Avoidance rating**
Tier 1, 2 and 3 priority areas are avoided	Yes	**Very good - A**
	No or no adequate survey	**Good - B**
Tier 1 and 2 priority areas are avoided	Yes	**Good - B**
	No or no adequate survey	**Fair - C**
Tier 1 priority areas are avoided	Yes	**Fair - C**
	No or no adequate survey	**Poor - D**
Development in Tier 1 priority area	Yes	**Poor - D**
	No or no adequate survey	**Very poor - F**

Public access – Many public hunting opportunities exist for prairie grouse in SD. In addition to publicly owned land, hunting opportunities exist on walk-in areas where the department has leased the hunting rights from private landowners. The department has recently added staff to help create relationships with landowners to increase hunting access as well as improve and increased access to public lands. The department will continue to enroll both working grasslands (e.g., grazing lands) and CRP grassland into the walk-in area program in areas where prairie grouse occur. The department will continue to provide a printed hunting atlas, online map, and maps compatible with smart phones and GPS units to help hunters navigate to public hunting lands in the state.

Dog training - The SDGFP occasionally receives comments of concern about the effect of dog training on prairie grouse hunting opportunity. Dog training on wild game birds is allowed from August 1 through the Friday preceding the third Saturday in September. See the SDGFP

Hunting Handbook for all restrictions. Research in SD has shown dog training has very little influence on prairie grouse behavior or survival and is not expected to detrimentally impact hunting opportunity or the population (Kirschenmann 2008). However, a study in Manitoba did show reduced chick survival from repeated flushes by dog trainers (Hicks 1992). In the Manitoba study, dog training was allowed after August 1, but some broods were less than three weeks old at that time. The SDGFP will continue to consider public comments, staff input and emerging research when considering changes to dog training rules.

Outreach - There are also opportunities to further inform the public about prairie grouse behavior, habitat needs and trends, and hunting/viewing opportunities. The SDGFP has many media available to further inform the public about prairie grouse and encourage them to participate in hunting or viewing opportunities. The SDGFP's published "Grouse of Plains and Mountains" book is an excellent resource for information related to all grouse species in SD and is available for purchase on the department's website. With increased public awareness of the challenges facing prairie grouse, more interest in the preservation of these great birds and their habitats may occur.

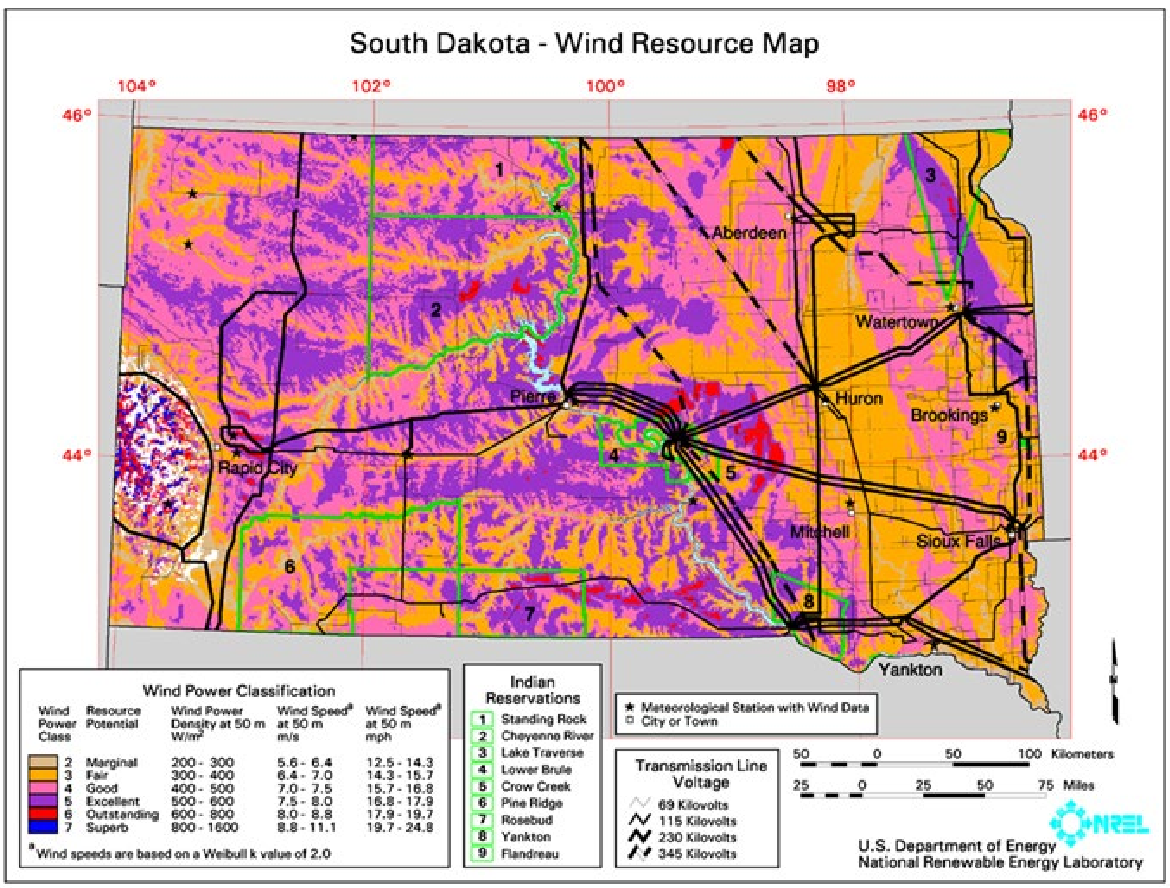

Figure 16. Wind energy classification classes for South Dakota (U.S. Department of Energy 2010).

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