# SOUTH DAKOTA WHITE-TAILED DEER AND MULE DEER MANAGEMENT PLAN, 2017-2023

SOUTH DAKOTA
Game, Fish & Parks

SOUTH DAKOTA DEPARTMENT OF GAME, FISH AND PARKS
PIERRE, SOUTH DAKOTA

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This document is for general, strategic guidance for SDGFP and serves to identify what we strive to accomplish related to management of both mule deer and white-tailed deer populations. This plan will be utilized by Department staffs and Commission on an annual basis and will be formally evaluated at least every 6 years. Plan updates and changes, however, may occur more frequently as needed.

All text and data contained within this document are subject to revision for corrections, updates, and data analyses. Cover art was provided by Adam Oswald.

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ACEP | Agricultural Conservation Easement Program |
| ADC | Animal Damage Control |
| ADRDL | South Dakota State University Animal Disease Research and Diagnostic Laboratory |
| AHD | Adenovirus Hemorrhagic Disease |
| API | Application Program Interface |
| ARSD | South Dakota Administrative Rules Article |
| ASI | American Sheep Industry Association |
| AWWI | American Wind Wildlife Institute |
| BFM | South Dakota Bureau of Finance and Management |
| BHNF | Black Hills National Forest |
| BLM | Bureau of Land Management |
| BMPs | Best Management Practices |
| BT | Bluetongue |
| BVD | Bovine Viral Diarrhea |
| CEQ | Council on Environmental Quality |
| CFSPH | The Center for Food Security and Public Health |
| CHAP | Controlled Hunting Access Program |
| CI | Confidence Interval |
| CRD | Commission Recommendation and Development |
| CREP | Conservation Reserve Enhancement Program |
| CRP | Conservation Reserve Program |
| CSP | Conservation Stewardship Program |
| CSP | Custer State Park |
| CWD | Chronic Wasting Disease |
| DAU | Data Analysis Unit |
| DMAP | Deer Management Assistance Program |
| DOE | United States Department of Energy |
| EHD | Epizootic Hemorrhagic Disease |
| EIA | United States Energy Information Administration |
| EQUIP | Environmental Quality Incentives Program |
| FAIMS | Federal Aid Information Management System |
| FMH | Forage-maturation hypothesis |
| FPNG | Fort Pierre National Grasslands |
| FSA | Farm Service Agency |
| GHCN | Global Historical Climatology Network |
| GIS | Geographic Information System |
| GPAs | Game Production Areas |
| GPS | Global Positioning System |
| HD | Hemorrhagic Disease |
| IDW | Inverse Distance Weighted Interpolation |
| INTAMap | ProgramR Statistical package |
| IPMs | Integrated Population Models |
| IRRC | Interim Rules Research Committee |

| | |
|---|---|
| IWVC | Interstate Wildlife Violators Compact |
| Lambda (λ) | Rate of Population Change |
| LAUs | Limited Access Units |
| LM1, LM2 | Limited Statewide Season |
| LRC | Legislative Research Council |
| MD | Mule Deer |
| MDEQ | Montana Department of Environmental Quality |
| MDNR | Minnesota Department of Natural Resources |
| MDNR | Michigan Department of Natural Resources |
| MDWG | Mule Deer Working Group |
| MOUs | Memorandum of Understanding |
| MPB | Mountain Pine Beetle |
| MVUM | Motorized Vehicle Use Maps |
| MWFP | Mississippi Wildlife, Fisheries, and Parks |
| n | Sample Size |
| N | Population Size |
| NAS | National Academy of Science |
| NGO | Non-governmental Organizations |
| NIAID | National Institute of Allergy and Infectious Diseases |
| NOAA | National Oceanic and Atmospheric Administration |
| NPS | National Park Service |
| NRCS | National Resources Conservation Services |
| ODFW | Oregon Department of Fish and Wildlife |
| OST | Oglala Sioux Tribe |
| PGC | Pennsylvania Game Commission |
| PopR | Server-based Software Modeling Package |
| PR | Pittman-Robertson Act |
| ProgramR | Statistical Software Package |
| QDMA | Quality Deer Management Association |
| R3 | Recruitment, Retention and Reactivation |
| RMP | Resource Management Plan |
| SAH | Sportsman Against Hunger |
| SCWDS | Southeastern Cooperative Wildlife Disease Study |
| SDAIB | South Dakota Animal Industry Board |
| SDCL | South Dakota Codified Law |
| SDDOT | South Dakota Department of Transportation |
| SDDPS | South Dakota Department of Public Safety |
| SDFO | South Dakota Field Office |
| SDGFP | South Dakota Game, Fish and Parks |
| SDSPL | South Dakota Office of School and Public Lands |
| SOD | Stakeholder Opinion Database |
| SS | Structural Stages |
| SUGMP | South Unit General Management Plan |
| TB | Tuberculosis |
| TIPs | Turn In Poachers |
| UDNR | Utah Division of Wildlife Resources, Department of Natural Resources |

| | |
|---|---|
| USDA | United States Department of Agriculture |
| USFS | United States Forest Service |
| USFWS | United States Fish and Wildlife Service |
| WAFWA | Western Association of Fish and Wildlife Agencies |
| WDNR | Wisconsin Department of Natural Resources |
| WGFD | Wyoming Game and Fish Department |
| WIA | Walk in Area |
| WPAs | Waterfowl Production Areas |
| WPP | Wildlife Partners Program |
| WRDTF | West River Deer Task Force |
| WRIWG | West River Issues Working Group |
| WSI | Winter Severity Index |
| WT | White-tailed Deer |

**EXECUTIVE SUMMARY**

South Dakota's diverse landscapes of grassland, cropland, and timbered areas are home to white-tailed deer (*Odocoileous virginianus*) across the entire state and mule deer (*Odocoileous hemionus*) primarily adjacent to and west of the Missouri River breaks. Both species of deer were nearly extirpated due to unregulated harvest and market hunting by the turn of the 20th century. Legislation created in the 1900s and hunting seasons established by the South Dakota Department of Game, Fish, and Parks (SDGFP) Commission allowed deer populations to recover from historic lows. Deer hunting seasons have occurred regularly since the 1950s, with deer hunters harvesting approximately 95,000 deer during the recent record year of 2010.

Deer hunting is a popular and much awaited outdoor activity for many sportsmen and women in South Dakota. Within South Dakota, approximately 61,000 residents (7.5% of the resident population) and 6,850 non-residents hunted deer in 2015, with peak deer hunter participation occurring in 2010 when 81,478 residents and non-residents pursued deer. Hunting remains the number one tool for managing deer populations across South Dakota and harvest strategies are intended to ensure the well-being of the species and its habitat while maintaining populations at levels compatible with human activity and land use.

The SDGFP manages wildlife and associated habitats for their sustained and equitable use, and the benefit, welfare and enjoyment of the citizens of this state and its visitors. South Dakota's deer resources demand prudent and increasingly intensive management to accommodate numerous and varied public demands and growing impacts from people. This plan provides important historical background and significant biological information for the formulation of sound deer management. Current deer survey methods and management tools are presented, along with a thorough discussion of objectives and strategies to guide management of this important resource into the future. This plan is intended to guide managers and biologists over the next six years, but should be considered a working document that will be amended as new biological and social data provide opportunities to improve management of deer resources in South Dakota. Furthermore, this plan will aid in the decision-making process of SDGFP staff and SDGFP Commission, and serves to inform and educate the sportsmen and women, landowners, and other publics of South Dakota to whom it will ultimately benefit.

Current statewide models estimate 2016 preseason populations of approximately 425,000 [95% Confidence Interval (CI): 320,000 – 530,000] white-tailed deer and 115,000 (95% CI: 80,000 – 150,000) mule deer. Based on habitat and social tolerances, white-tailed deer and mule deer management units will be managed to increase, maintain, or decrease populations. Within the Black Hills data analysis unit, SDGFP has estimated white-tailed deer abundance for multiple years and therefore was able to define a pre-season abundance objective of 70,000 (65,000-75,000) white-tailed deer. All management unit objectives will be based on annual collection and evaluation of white-tailed deer and mule deer biological data, habitat resources, weather data, private land depredation issues, and substantial input from a wide variety of publics with an interest in deer management in South Dakota. SDGFP will adopt harvest strategies that will progressively allow the white-tailed deer and mule deer population to reach these population objectives.

Many complex issues arise during the management of deer, their habitats, depredation to private property, and hunting opportunities. While not an exclusive list, the following topics, in no particular order, were discussed amongst SDGFP staff and the deer stakeholder group during plan development and include: habitat loss; antlerless deer harvest management; hunter access to public and private lands; distribution and allocation of hunting opportunity; landowner preference; deer depredation; hunting regulations; social tolerance of deer and deer hunters; and nonresident deer hunting opportunities. These challenges and opportunities serve as the foundation for the objectives and strategies outlined in the plan and will be addressed to ensure this plan is successfully implemented.

The SDGFP will manage white-tailed deer and mule deer populations and habitats by fostering partnerships and stewardship, and applying biological and social sciences. To achieve these population goals in balance with social and biological considerations, the following objectives have been identified: 1) Maintain, manage, establish and protect white-tailed deer and mule deer habitat throughout the Black Hills and prairie deer management units of South Dakota; 2) Manage white-tailed deer and mule deer populations by conducting scientifically based biological surveys within South Dakota; 3) Manage white-tailed deer and mule deer populations in the state for both maximum and quality recreational hunting opportunities, considering all social and biological inputs; 4) Cooperatively work with private landowners to resolve white-tailed deer and mule deer depredation to growing crops, stored-feed supplies, trees, and private property; 5) Monitor and evaluate risk and impact of disease in wild white-tailed deer and mule deer herds in South Dakota; 6) Provide the public with access to private and public land for quality white-tailed deer and mule deer hunting opportunities; 7) Engage the public on and evaluate white-tailed deer and mule deer research and management needs; 8) Promote public, landowner, and conservation agency awareness of white-tailed deer and mule deer management needs and challenges; and 9) Cooperatively work with municipalities and other agencies in South Dakota to manage urban deer and deer vehicle collisions. Time-specific and measurable strategies have been identified to ensure these objectives are delivered and achieved.

Involving the public in the development of the *"South Dakota White-tailed Deer and Mule Deer Management Plan, 2017-2023"* has been a high priority of SDGFP. Multiple avenues for public involvement and outreach were used in order to engage the public at various stages of plan development and to ensure opportunities for participation were accessible to all citizens. In 2016, SDGFP conducted a public opinion survey of landowners and hunters to collect and evaluate opinions from these publics on numerous topics related to deer management. Another important technique used by SDGFP to formally gather public opinion on deer management was to develop a South Dakota Deer Stakeholder Group, which included representation from the general public, deer hunters, private landowners, agricultural interests, commercial hunting interests, and conservation organizations. In March of 2017, SDGFP made the first draft plan available to the public for 30-day review and comment. Due to the overwhelming response, the SDGFP Commission extended the public comment period to May 5, 2017. Approximately 250 comments were formally received via email, letter, or public testimony.

Numerous opinions and suggestions from the public have been received related to license allocation, lottery draw process, late season antlerless deer hunts, nonresident archery licenses, nonresident license fees, season structures, landowner preference, landowner-own-land licenses, mandatory harvest survey, and several others. These opinions and suggestions were carefully considered in identifying the management plan objectives and strategies. As with many topics pertaining to deer management, opinions vary greatly on each issue identified, and potential solutions needed, if any. Many of the public suggestions would require changes to South Dakota Administrative Rules, which is under the authority of the SDGFP Commission. Implementing suggested changes would therefore require following the rule promulgation process outlined in state statute. SDGFP is mandated to follow this process, which ensures the public has sufficient opportunity for input. Making administrative rule changes in the deer plan would not only be a violation of this statute-mandated process, but it would limit the ability of the SDGFP Commission and the public to implement changes. A summary of all public comments and recommended changes offered by the public will be presented to the SDGFP Commission for consideration later in 2017. The Commission will consider all public comments and incorporate such changes as deemed warranted through the administrative rule making process found at http://gfp.sd.gov/agency/commission/default.aspx.

The "*South Dakota White-tailed Deer and Mule Deer Management Plan, 2017-2023*" will serve as the guiding document for decision making and implementation of actions to ensure deer populations and their habitats are managed appropriately, addressing both biological and social tolerances, while considering the needs of all stakeholders. SDGFP will work closely with private landowners, public land managers, and sportsmen and women to overcome the challenges and capitalize on opportunities regarding the future management of deer in South Dakota.

## INTRODUCTION

White-tailed deer (*Odocoileous virginianus*) and mule deer (*Odocoileous hemionus*) were indigenous to almost all of South Dakota prior to the American expansion west (Bever 1957a). The Missouri River was the simplest mode of transportation for the earliest explorers to the Dakota Territory, and many of their observations indicate that both white-tailed and mule deer were abundant along the Missouri River and most of its significant tributaries prior to 1840 (Bever 1957a, Popowski 1962). Early exploration by Lewis and Clark first recorded observations of mule deer when Captain Merriweather Lewis killed two deer at the mouth of the White River in 1804. In 1817 Constantine Samuel Rafinesque officially named the mule deer in North America based on the descriptions of two deer in Lyman County, South Dakota from field notes later to be identified from Patrick Gass, a member of the Lewis and Clark Expedition, (Woodman 2013). The scientific name *hemionus* means "half-mule" and was appropriately given due to the similarity of mule deer ears to those of a mule. The scientific name *virginianus* was given to white-tailed deer due to the general area this deer was first described (near Virginia).

By the turn of the 20th century, most deer were extirpated due to unregulated harvest and market hunting. Legislation created in the early 1900s essentially closed all deer hunting across South Dakota except in the Black Hills, and by the 1950s deer populations had recovered in most areas of the state and regulated hunting seasons were reopened (Richardson and Petersen 1974). Since 1949, South Dakota Department of Game, Fish, and Parks (SDGFP) has completed deer population surveys to assess and manage deer herds (Berner 1951).

White-tailed deer are presently the most abundant deer species in the state with over 400,000 currently found in all habitats across South Dakota. Mule deer are less abundant with approximately 100,000 restricted primarily to habitats adjacent to and west of the Missouri River. Considering deer populations are now found in every habitat across the state, deer management in South Dakota should be regarded as a wildlife management success story. Public demand for deer hunting opportunities is strong, with approximately 81,000 deer hunters purchasing over 203,000 deer tags and harvesting approximately 95,000 deer in the recent record year of 2010. Deer population levels are likely most affected by landowner tolerances, habitat availability, harvest rates, winter severity, drought, disease, and predation.

There is no question that deer are clearly the species of choice for the majority of hunters in the United States (US). In 2006, one of every 25 Americans greater than 16 years of age and eight of every 10 hunters hunted deer (USFWS 2011). In 2011, 10.9 million or 80% of the 13.7 million hunters in the US hunted deer (USFWS 2011). In South Dakota, deer hunting is critically important to residents as well, with deer license sales on average being three times greater than the combined license sales of all other big game licenses. SDGFP manages wildlife and associated habitats for their sustained and equitable use, and the benefit, welfare and enjoyment of the citizens of this state and its visitors. South Dakota's deer resources demand careful and increasingly intensive management to accommodate varied public demands and growing impacts from people. This plan provides important historical background and significant biological information for the formulation of sound deer management. Current deer survey methods and management tools are presented, along with a thorough discussion of objectives and strategies to guide management of this important resource into the future. This plan is intended to guide managers and biologists over the next six years, but should be considered a working document that will be amended as new biological and/or social data provide opportunities to improve management of deer resources in South Dakota. Furthermore, this plan will aid in the decision-making process of the SDGFP Commission, and serves to inform and educate the sportsmen and women, landowners, and other publics of South Dakota to whom it will ultimately benefit.

## HISTORICAL BACKGROUND

The passage of the Homestead Act in 1862 resulted in a massive influx of settlers into South Dakota and had a dramatic impact on mule deer and white-tailed deer populations. As settlers moved into the Dakota Territories, deer were harvested for food and clothing, but were also subject to increased market hunting for settlements and trade. Historical records suggest that both white-tailed and mule deer were nearly extirpated from the region east of the Missouri River in South Dakota between 1875 and 1880 (Jackson 1972). By 1900, records further suggest both deer species were nearly extirpated in the state west of the Missouri River (Bever 1957a). Despite unregulated harvest and market hunting, deer herds persisted in the Black Hills region but numbers were greatly reduced. In the mid-1870s Custer and Ludlow wrote that deer were abundant in the Black Hills region, but by 1880 prospectors, market hunters, and homesteaders devastated the deer herds (Bever 1957a).

The demise of deer herds did not go unnoticed, and in 1883 the Government of the Dakota Territory prohibited hunting from January 1 to September 1 which helped minimize market hunting and over harvest of deer populations (Popowski 1962). The SDGFP was created in 1909 as legislation was passed to instate the first Governor appointed conservation officer (Hipschman 1959). It was not, however, until the enactment of the “Buck Law” (1911 and 1921), that deer began to show a material increase (Bever 1957a). Bever (1957a) also noted that in 1925, the Buck Law was amended to close deer hunting in all counties within the state except those within the Black Hills, marking the first step towards rebuilding statewide deer populations.

Hipschman (1959) reported that even with protection, deer in the Black Hills struggled to increase with hard winters recorded in 1917-1920. By the early 1920s game counts estimated approximately 2,000 deer in the Black Hills. Deer populations in the state struggled to return to pre-settlement numbers until the late 1930s when deer populations were improving in the Black Hills. After above normal rainfall in 1940, the deer herd in the Black Hills was estimated at 15,000 deer (Hipschman 1959).

Hipschman (1959) noted that with the onset of World War II, all game species in South Dakota made a tremendous resurgence with above normal rainfall and land use changes. An example of the returning deer numbers was evident when the legislature opened two areas of the Black Hills to antlerless harvest in 1943. During this same season, a record number of 3,000 bucks was also harvested. The post-war era brought changes to SDGFP and in 1946, commission approval was granted to begin a wide-scale program of scientific research and management of game. Utilizing biologist knowledge and experience of conservation officers, improvements in game management techniques were implemented (Hipschman 1959). In the late 1940s, four counties were opened for deer hunting in the eastern part of South Dakota and 2,000 antlerless permits were issued in the Black Hills. The state had provided a legal harvest of over 20,000 animals in the 1948 season; the largest to that time (Hipschman 1959). Other evidence that deer populations had made a comeback in the Black Hills by the early 1950s was the depleted range conditions found by biologists. A drastic herd reduction was needed as surveys found that Black Hills deer ranges were being stripped of available forage and that deer were in danger of starvation. In response to these conditions, deer feeding was implemented by SDGFP in the northern Black Hills (Hipschman 1959). In 1953, despite much opposition, the SDGFP Commission authorized a season that allowed two deer per hunter and Hipschman (1959) reported that 31,000 hunters harvested more than 42,000 deer in the Black Hills.

Richardson and Petersen (1974) noted that limited reduction seasons were held in 1948 east of the Missouri River as white-tailed deer had reoccupied much of the available habitat and crop damage reports could not be ignored. By 1951, all East River counties were open for a 3-day "any deer" season. By 1969, there had been at least one mule deer harvested in each East River County, but the reoccupation of historical range would not occur due to the lack of suitable habitat east of the Missouri River (Richardson and Petersen 1974).

By 1965, Richardson and Petersen (1974) reported that both species of deer were reported in all West River counties and white-tailed deer were present in all riparian areas where suitable habitat occurred while mule deer occupied the more rugged habitat. Populations of both white-tailed deer and mule deer have returned to all historic ranges of South Dakota and management of these two important species by the SDGFP continues today.

## SEASON SETTING PROCESS

Managing wildlife populations within various social tolerances, hunter desires, and expectations of the general public is a challenging task. Deer hunting is a popular and much awaited outdoor activity for many sportsmen and women in South Dakota. This high demand for white-tailed and mule deer hunting opportunities amongst the numerous deer seasons requires careful consideration by SDGFP to provide the highest amount of hunting opportunity in the most fair and equitable manner in accordance with current deer population management objectives.

South Dakota Codified Law (SDCL) § 41–11–5 grants authority to the SDGFP Commission to establish hunting seasons for game species, including deer. Administrative Rules of South Dakota (ARSD) § 41:06 (Title: Hunting Seasons and Methods) specifies rules for the following: application for licenses; license forms and fees; possession, processing and transportation of game; hunting requirements and prohibited methods; archery restrictions; and specific deer season information such as open units, season dates, and license allocations. Administrative rules related to these topics can be found online at http://sdlegislature.gov/rules/DisplayRule.aspx?Rule=41:06. Administrative rule changes to set deer seasons are currently considered by the SDGFP Commission on an annual basis, but will be adjusted to a two-year cycle beginning with the implementation of this management plan for the 2017 deer hunting season. Currently, the Special Buck deer season and all hunting season dates are proposed in January and finalized in March, with all other deer season rules proposed in May and finalized in June.

The deer season setting process consists of primarily three components: 1) SDGFP recommendations; 2) SDGFP Commission action; and 3) post-SDGFP Commission action. These components are described in detail below.

**SDGFP Recommendations**

A variety of information and data are collected, reviewed, and used in the development of white-tailed and mule deer hunting season recommendations by SDGFP staffs. From a workload perspective, SDGFP staffs spend a significant amount of time on deer management and deer hunting seasons largely due to the high demand by both resident and nonresident hunters, the various deer hunting seasons and user groups (e.g., firearm, archery, muzzleloader), and the challenges of finding that balance between biological and social carrying capacities. The process for the development of deer hunting recommendations by SDGFP staffs includes the evaluation of three groups of information: biological data, harvest data, and social data (Figure 1).

As described in the *Deer Population Surveys* section of this plan, deer biological data are collected from aerial surveys, spotlight surveys, herd composition surveys, reproduction surveys, and survival monitoring. These data are used in an integrated population model to assist SDGFP in determining current population abundance and trends for white-tailed deer and mule deer across the state. Depending on the objectives of each biological survey, data are analyzed at the data analysis unit and/or the statewide level. Strong sample sizes and statistically valid estimates, along with long-term data trends are valuable to wildlife managers and allow for inferences that can be used to make adjustments to seasons (e.g., number of licenses, tag types, season length).

Harvest data, also described in the *Deer Population Surveys* section of this plan, provide useful information on hunter and license/tag success, harvest, number of days hunted, hunter satisfaction, and hunter comments. From a management unit perspective, harvest data are the largest and most long-term data set wildlife managers have to evaluate deer seasons. Trends in hunter/tag success rates are used as a qualitative way to assess deer population trends; however, success is affected by many factors other than deer population abundance so careful interpretation is warranted. Harvest success rates are used to estimate harvest of future license allocations, and hunter success and satisfaction ratings can be used to evaluate specific management objectives. Harvest estimates in conjunction with survival data are used in population reconstruction modeling to estimate abundance. Harvest estimates are considered an additive source of mortality in evaluations of future population trends. Hunter satisfaction is an important consideration when developing season recommendations. Though not a quantitative measurement, hunter comments are sorted by management unit and shared with SDGFP staffs for review. If hunters request a follow up on a question or desire an opportunity to discuss a topic with SDGFP staffs, every effort is made to follow up with these requests.

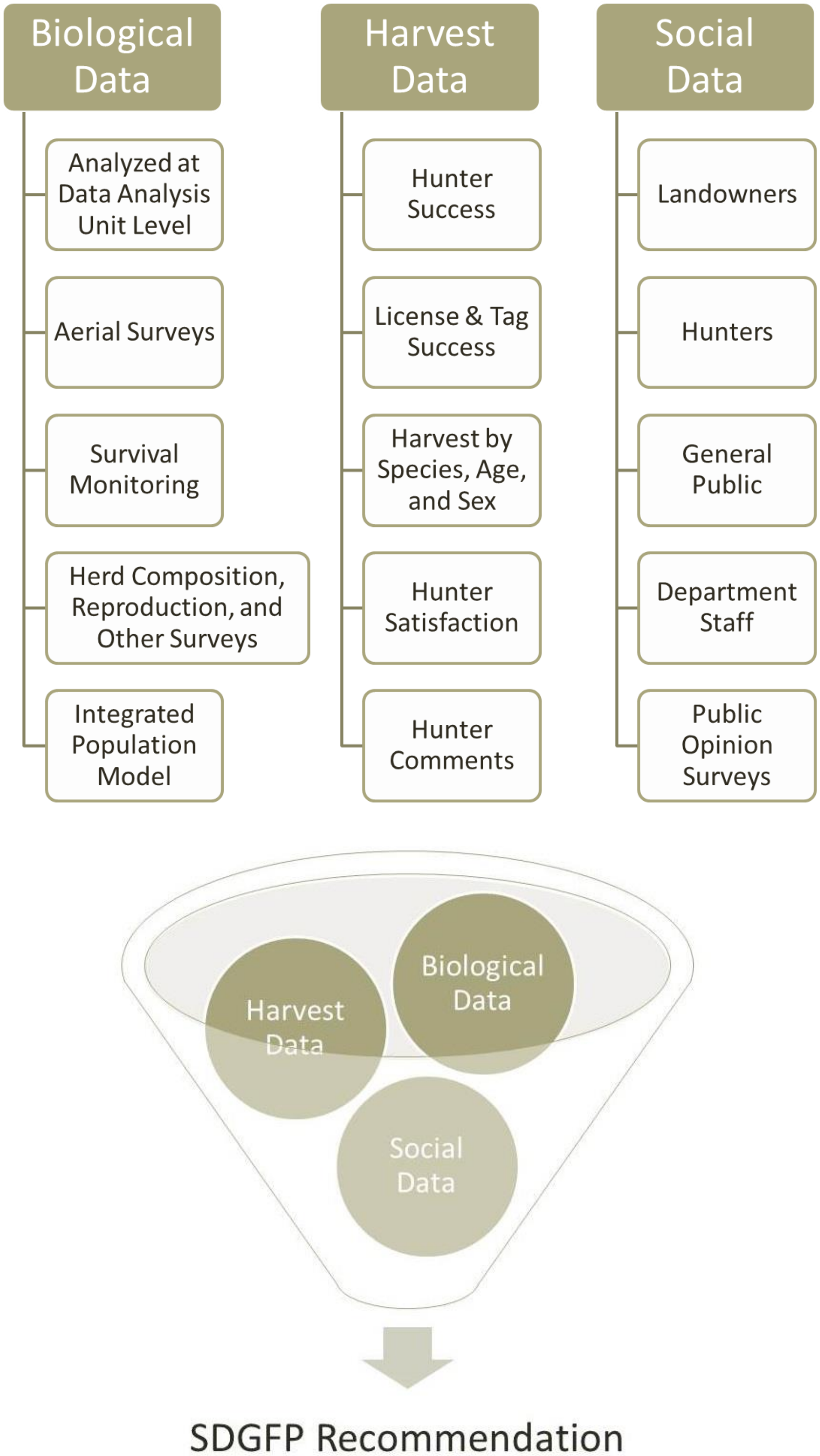



Figure 1. Simplistic model describing the process for the development of SDGFP deer hunting recommendations.

Social data, described in more detail in the *Citizen Involvement and Outreach* section, obtained from stakeholders (e.g., landowners, hunters, general public, non-governmental organizations) is used by SDGFP to determine deer population objectives. This input constructs a list of discussion topics for consideration in hunting season structures. SDGFP staffs that have conversations with stakeholders on deer management are now entering this information into a customized Stakeholder Opinion Database (SOD). SOD has been used by SDGFP staffs since 2015 and is a database used to store, organize, and produce reports on the feedback from stakeholders on wildlife species. Though still in its infancy, SOD has potential to assist wildlife managers in making decisions in the development of season recommendations and other wildlife management efforts.

One of the first and most important steps in the deer license recommendation process is to define a qualitative management objective (i.e., substantially decrease, slightly decrease, maintain current level, slightly increase, substantially increase). This process involves SDGFP staffs obtaining stakeholder's opinions regarding the status of deer populations within individual firearm deer hunting units throughout the year. Multiple sources of public opinion are used in formulating management objectives and include personal contacts with landowners and hunters, open houses, regional advisory meetings, hunter and landowner opinion surveys, hunter harvest surveys quantifying success and satisfaction ratings, and other submitted comments. Once the data are reviewed and summarized, internal staff meetings are then conducted at the regional level to discuss public input received regarding deer population abundance levels, deer depredation issues, landowner tolerance, hunter comments, and harvest results from the previous season. The end result is a defined qualitative management objective for each firearm management unit.

After a qualitative management unit objective is defined, a numerical value is assigned to that management unit (i.e., substantially decrease = 1, slightly decrease = 2, maintain current level = 3, slightly increase = 4, substantially increase = 5), which is used in defining a management objective at a larger Data Analysis Unit (DAU; see *Deer Population Surveys* section) level. The first step in the development of a DAU management objective is to determine how much weight each firearm unit objective contributes to the overall DAU objective. This step incorporates unit harvest proportions within a DAU to weight each unit objective appropriately because not all units within a DAU have equal harvest rates. Unit harvest proportions are calculated by taking the 10-year harvest average of white-tailed deer or mule deer within the defined management unit divided by the total 10-year harvest average for the entire DAU. The management unit objective is then multiplied by the 10-year average harvest proportion for that unit and the sum of the weighted values for all the units within the DAU then becomes the numerical DAU management objective. Tables 1 and 2 illustrate how management objectives in each DAU in 2016 were converted to a DAU management objectives based on the steps described above. The DAU objective is then assigned a lambda rate (i.e., rate of change to population abundance) objective based on pre-determined ranges that are realistic for most deer herds in South Dakota (Table 3). To quantify the objective lambda value, the DAU objective is entered into the following linear regression equation: 0.1456 (DAU Objective) + 0.5631 = Lambda Objective. For example, in 2016 the white-tailed deer objective for DAU 1 was 3.4 and the DAU lambda objective was calculated as 0.1456 (3.4) + 0.5631 = 1.06 lambda objective.

Table 1. Formulation of the 2016 white-tailed deer DAU management numerical objectives using 10-year average harvest proportions.

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DAU 1** | **Unit Data** | **20A** | **53A** | **53C** | **35A** | **35C** | **35L** | | | | | | | | |
| **Objective** | Harvest Proportions | 18.5% | 22.5% | 28.3% | 14.8% | 15.6% | 0.3% | | | | | | | | |
| **3.4** | Unit Objectives | 5 | 3 | 3 | 3 | 3 | 4 | | | | | | | | |
| | Weighted | 0.92 | 0.68 | 0.85 | 0.44 | 0.47 | 0.01 | | | | | | | | |
| **DAU 2** | **Unit Data** | **15A** | **15B** | **49A** | **49B** | | | | | | | | | | |
| **Objective** | Harvest Proportions | 30.4% | 26.0% | 22.1% | 21.5% | | | | | | | | | | |
| **2.4** | Unit Objectives | 2 | 2 | 3 | 3 | | | | | | | | | | |
| | Weighted | 0.61 | 0.52 | 0.66 | 0.64 | | | | | | | | | | |
| **DAU 4** | **Unit Data** | **02C** | **11A** | **11B** | **21A** | **21B** | **27A** | **27B** | **39A** | **39B** | **41A** | **50AB** | **65A** | **67A** | |
| **Objective** | Harvest Proportions | 4.1% | 4.6% | 6.6% | 9.9% | 5.7% | 3.0% | 10.6% | 6.9% | 5.8% | 12.5% | 24.4% | 1.1% | 4.9% | |
| **4.0** | Unit Objectives | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | |
| | Weighted | 0.16 | 0.19 | 0.26 | 0.39 | 0.23 | 0.12 | 0.42 | 0.27 | 0.23 | 0.50 | 0.98 | 0.04 | 0.24 | |
| **DAU 5** | **Unit Data** | **02A** | **24AB** | **31A** | **58AD** | **64A** | | | | | | | | | |
| **Objective** | Harvest Proportions | 17.5% | 23.5% | 21.5% | 14.7% | 22.8% | | | | | | | | | |
| **3.8** | Unit Objectives | 3 | 4 | 4 | 4 | 4 | | | | | | | | | |
| | Weighted | 0.53 | 0.94 | 0.86 | 0.59 | 0.91 | | | | | | | | | |
| **DAU 6** | **Unit Data** | **16A** | **33A** | **36A** | **38A** | **54A** | **59A** | **59B** | **63A** | | | | | | |
| **Objective** | Harvest Proportions | 11.6% | 20.5% | 6.6% | 14.5% | 17.5% | 7.6% | 9.1% | 12.6% | | | | | | |
| **3.3** | Unit Objectives | 4 | 3 | 3 | 3 | 3 | 4 | 3 | 4 | | | | | | |
| | Weighted | 0.47 | 0.62 | 0.20 | 0.44 | 0.52 | 0.30 | 0.27 | 0.50 | | | | | | |
| **DAU 7** | **Unit Data** | **30AB** | **45A** | **45B** | **45C** | **45D** | **60A** | | | | | | | | |
| **Objective** | Harvest Proportions | 39.4% | 14.8% | 6.1% | 0.8% | 1.8% | 37.1% | | | | | | | | |
| **3.4** | Unit Objectives | 3 | 3 | 4 | 3 | 4 | 4 | | | | | | | | |
| | Weighted | 1.18 | 0.44 | 0.24 | 0.02 | 0.07 | 1.49 | | | | | | | | |
| **DAU 8** | **Unit Data** | **04A** | **07A** | **08A** | **10A** | **12A** | **13A** | **14A** | **17A** | **25A** | **34A** | **37A** | **40A** | **51A** | **56A** |
| **Objective** | Harvest Proportions | 13.7% | 4.7% | 4.7% | 10.0% | 4.2% | 13.7% | 4.0% | 7.7% | 4.2% | 4.1% | 4.7% | 8.2% | 8.7% | 7.5% |
| **3.6** | Unit Objectives | 4 | 4 | 5 | 3 | 4 | 3 | 3 | 4 | 4 | 5 | 5 | 3 | 3 | 3 |
| | Weighted | 0.55 | 0.19 | 0.24 | 0.30 | 0.17 | 0.41 | 0.12 | 0.31 | 0.17 | 0.20 | 0.24 | 0.25 | 0.26 | 0.23 |
| **DAU 9** | **Unit Data** | **03A** | **26A** | **28A** | **47A** | **57A** | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Objective** | Harvest Proportions | 27.2% | 20.6% | 20.4% | 13.9% | 17.8% | | | | | |
| **3.6** | Unit Objectives | 4 | 3 | 3 | 4 | 4 | | | | | |
| | Weighted | 1.09 | 0.62 | 0.61 | 0.56 | 0.71 | | | | | |
| **DAU 10** | **Unit Data** | **05A** | **18A** | **22A** | **23A** | **29A** | **32A** | **48A** | **55A** | | |
| **Objective** | Harvest Proportions | 8.2% | 20.8% | 16.0% | 10.0% | 8.3% | 11.4% | 14.6% | 10.7% | | |
| **4.1** | Unit Objectives | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | | |
| | Weighted | 0.33 | 0.83 | 0.64 | 0.40 | 0.33 | 0.46 | 0.73 | 0.43 | | |
| **DAU 11** | **Unit Data** | **01A** | **06A** | **19A** | **42A** | **43A** | **44A** | **46A** | **52A** | **61A** | **62A** |
| **Objective** | Harvest Proportions | 13.1% | 12.6% | 6.5% | 18.0% | 10.6% | 4.8% | 10.6% | 8.4% | 7.0% | 8.3% |
| **4.0** | Unit Objectives | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | Weighted | 0.52 | 0.50 | 0.26 | 0.72 | 0.42 | 0.19 | 0.43 | 0.34 | 0.28 | 0.33 |

Table 2. Formulation of the 2016 mule deer DAU management numerical objectives using 10-year average harvest proportions.

| **DAU 1** | **Unit Data** | **20A** | **53A** | **53C** | **35A** | **35C** | **35L** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Objective** | Harvest Proportions | 9.4% | 18.0% | 24.0% | 27.8% | 19.1% | 1.8% | | | | | | | |
| **5.0** | Unit Objectives | 5 | 5 | 5 | 5 | 5 | 5 | | | | | | | |
| | Weighted | 0.47 | 0.90 | 1.20 | 1.39 | 0.95 | 0.09 | | | | | | | |
| **DAU 2** | **Unit Data** | **15A** | **15B** | **49A** | **49B** | | | | | | | | | |
| **Objective** | Harvest Proportions | 29.6% | 9.6% | 25.7% | 35.2% | | | | | | | | | |
| **5.0** | Unit Objectives | 5 | 5 | 5 | 5 | | | | | | | | | |
| | Weighted | 1.48 | 0.48 | 1.28 | 1.76 | | | | | | | | | |
| **DAU 4** | **Unit Data** | **02C** | **11A** | **11B** | **21A** | **21B** | **27A** | **27B** | **39A** | **39B** | **41A** | **50AB** | **65A** | **67A** |
| **Objective** | Harvest Proportions | 9.4% | 3.9% | 2.9% | 9.0% | 4.3% | 6.5% | 12.2% | 9.0% | 6.9% | 11.7% | 21.6% | 0.8% | 1.7% |
| **5.0** | Unit Objectives | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| | Weighted | 0.47 | 0.20 | 0.15 | 0.45 | 0.21 | 0.33 | 0.61 | 0.45 | 0.35 | 0.59 | 1.08 | 0.04 | 0.09 |
| **DAU 5** | **Unit Data** | **02A** | **24AB** | **31A** | **58AD** | **64A** | | | | | | | | |
| **Objective** | Harvest Proportions | 25.6% | 7.0% | 35.9% | 16.6% | 14.9% | | | | | | | | |
| **5.0** | Unit Objectives | 5 | 5 | 5 | 5 | 5 | | | | | | | | |
| | Weighted | 1.28 | 0.35 | 1.80 | 0.83 | 0.74 | | | | | | | | |
| **DAU 6** | **Unit Data** | **16A** | **33A** | **36A** | **38A** | **54A** | **59A** | **59B** | **63A** | | | | | |
| **Objective** | Harvest Proportions | 6.8% | 4.9% | 21.4% | 2.5% | 15.3% | 35.6% | 2.5% | 11.1% | | | | | |
| **4.6** | Unit Objectives | 4 | 4 | 5 | 4 | 4 | 5 | 4 | 4 | | | | | |
| | Weighted | 0.27 | 0.20 | 1.07 | 0.10 | 0.61 | 1.78 | 0.10 | 0.44 | | | | | |
| **DAU 7** | **Unit Data** | **30AB** | **45A** | **45B** | **45C** | **45D** | **60A** | | | | | | | |
| **Objective** | Harvest Proportions | 27.1% | 23.6% | 6.7% | 1.0% | 2.8% | 38.8% | | | | | | | |
| **5.0** | Unit Objectives | 5 | 5 | 5 | 5 | 5 | 5 | | | | | | | |
| | Weighted | 1.36 | 1.18 | 0.33 | 0.05 | 0.14 | 1.94 | | | | | | | |
| **DAU 8** | **Unit Data** | **04A** | **08A** | **10A** | **12A** | **13A** | **14A** | **17A** | **25A** | **34A** | **37A** | **40A** | **56A** | |
| **Objective** | Harvest Proportions | 2.6% | 0.5% | 0.4% | 3.0% | 49.2% | 10.4% | 27.9% | 0.3% | 0.9% | 0.3% | 2.9% | 1.5% | |
| **4.9** | Unit Objectives | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 4 | 5 | 5 | 5 | 5 | |
| | Weighted | 0.13 | 0.03 | 0.02 | 0.15 | 2.46 | 0.41 | 1.40 | 0.01 | 0.05 | 0.01 | 0.14 | 0.08 | |

Table 3. Categorical objective values based on qualitative objective.

| Qualitative Objective | Unit Objective | DAU Objective | Lambda Objective |
|---|---|---|---|
| Substantially decrease | 1 | 1.0 - 1.5 | 0.7 - 0.8 |
| Slightly decrease | 2 | 1.5 - 2.5 | 0.8 - 0.9 |
| Maintain | 3 | 2.5 - 3.5 | 0.9 - 1.1 |
| Slightly increase | 4 | 3.5 - 4.5 | 1.1 - 1.2 |
| Substantially increase | 5 | 4.5 - 5.0 | 1.2 - 1.3 |

Once the lambda objective is defined, integrated population models in PopR and Excel spreadsheet models are used to generate population projections for each DAU (lambda and abundance estimates) based on modeling inputs (e.g., adult female survival, adult male survival, juvenile survival, fawn survival, reproductive rates, and herd composition ratios). The projected (model generated) and objective lambdas are then compared and future antlerless harvest strategies are manipulated to achieve the desired lambda objective rate derived from the DAU management objective. Antlerless harvest is assumed to be additive and the number of antlerless deer added or removed from the population is calculated at the DAU level and then distributed to the unit level in accordance with the defined unit objective. Three-year average harvest success rates are calculated for all previously used license types within the management unit and license combinations needed to achieve unit level antlerless harvest recommendations are selected for future harvest season license recommendations. This process is repeated for all mule deer and white-tailed deer management firearm management units across the state. Firearm hunting management unit and DAU population objectives for both mule deer and white-tailed deer in 2016 can be found in Figures 2-5.

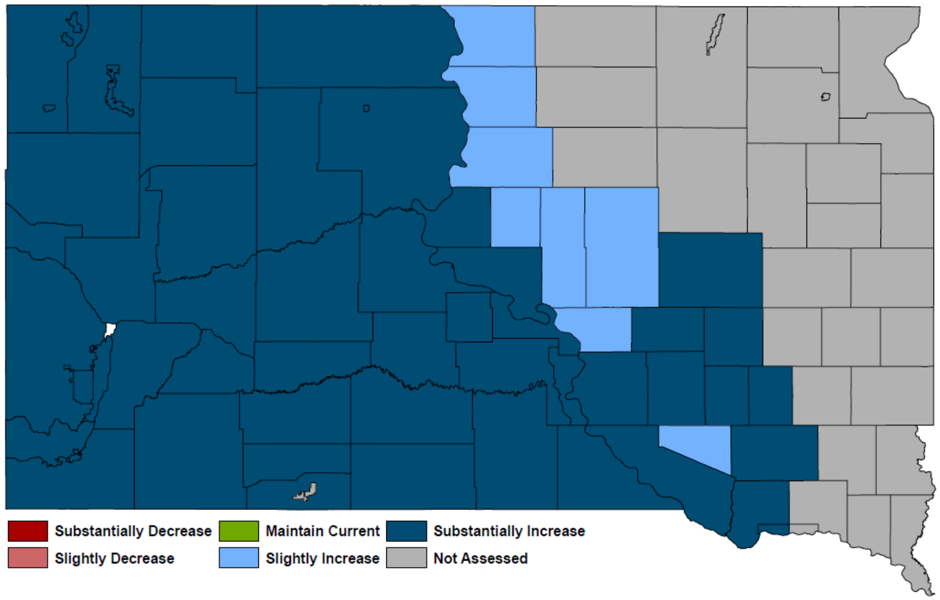



Figure 2. 2016 South Dakota mule deer hunting unit objectives.

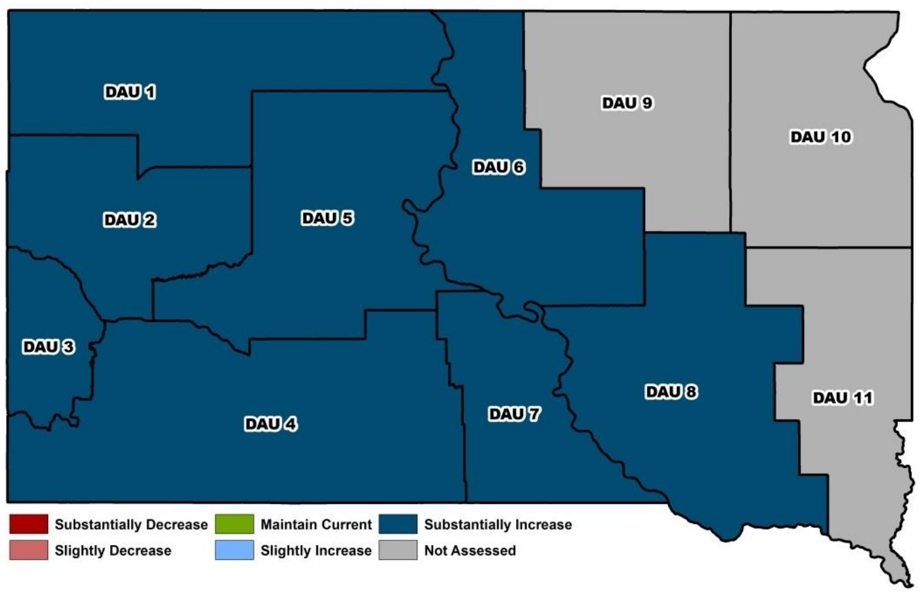



Figure 3. 2016 South Dakota mule deer Data Analysis Unit objectives.

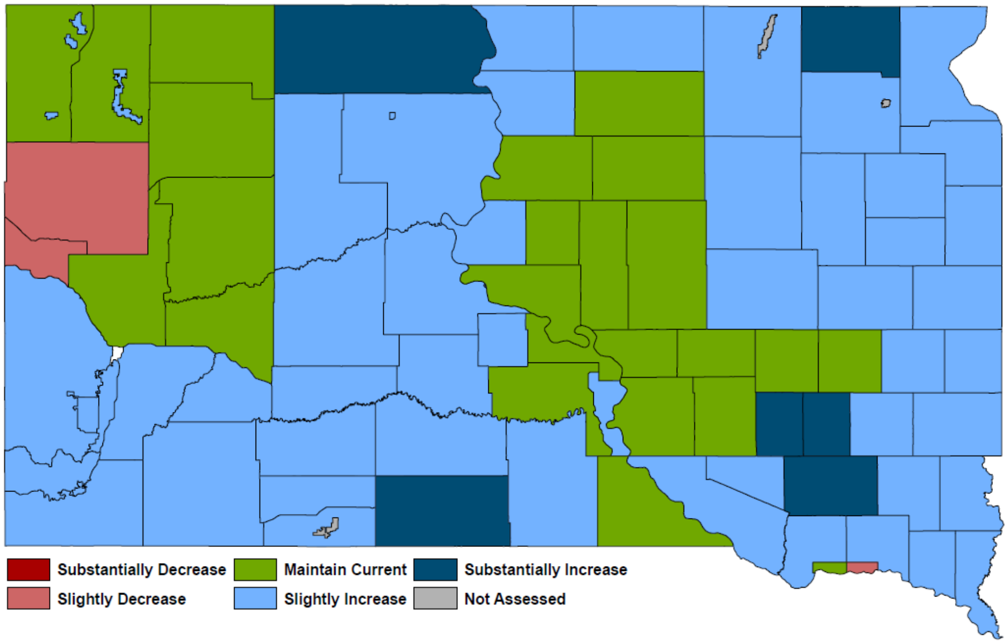



Figure 4. 2016 South Dakota white-tailed deer hunting unit objectives.

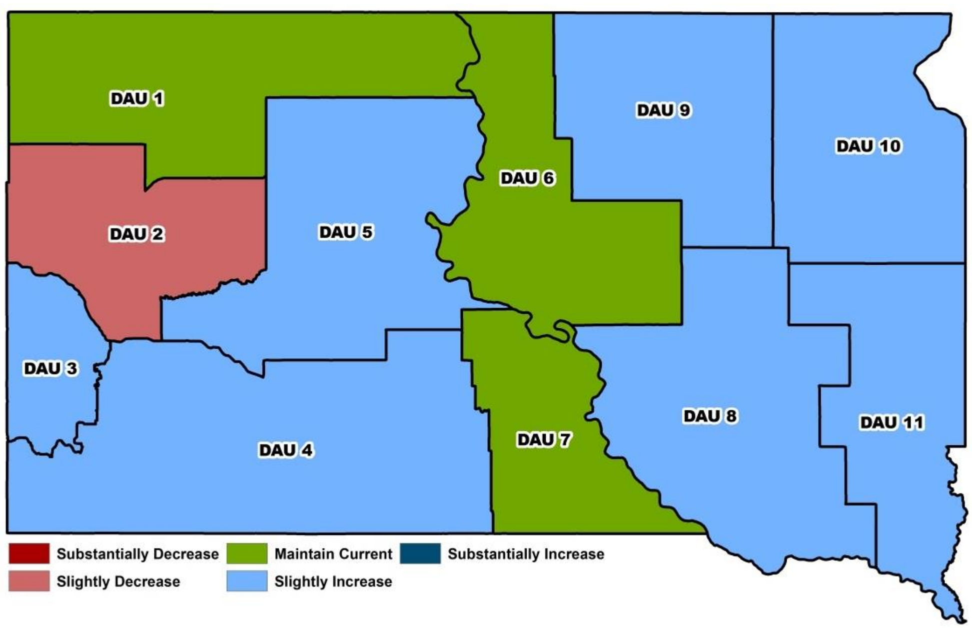



Figure 5. 2016 South Dakota white-tailed deer Data Analysis Unit objectives.

Each of the four SDGFP Wildlife Division administrative regions work closely with big game program staffs, human dimension specialists, harvest survey coordinator, and GIS staffs to assemble and present available information to regional biologists and wildlife managers, local conservation officers, wildlife damage specialists, and other staffs. Each administrative region then submits a "regional recommendation" to the Commission Recommendation and Development (CRD) group, which corresponds with appropriate harvest strategies to meet deer population objectives. Comprised of regional terrestrial resources supervisors, senior biologists, and administrators, the CRD group meets 2-3 weeks before each Commission meeting to review all regional recommendations and develop recommendations for consideration. The wildlife program administrators and senior big game biologist then meet with the SDGFP Secretary, Wildlife Division Director, and Wildlife Division Deputy Director to present the recommendations for consideration that were formulated by the CRD group. A final decision is made on a SDGFP recommendation and presented to the SDGFP Commission in the form of an action sheet for consideration by the Commission. Any changes to the formal SDGFP recommendation from regional recommendations or the recommendations for consideration from the CRD group are then communicated back to the CRD group and regional staffs.

**SDGFP Commission Action**

Acting within its legislative mandates, the SDGFP Commission serves as the advocate and liaison between SDGFP and its stakeholders—the people of South Dakota and nonresident visitors. The Commission consists of eight members, who are appointed by the Governor for four year terms and shall be comprised as outlined below in SDCL § 41-2-2.

> ***SDCL § 41-2-2. Political affiliations of commissioners--Farmer members--Residence and gross income requirements.*** *Not more than four of the game, fish and parks commissioners may be members of the same political party, and, at the time of their appointment, at least four shall be farmers actually residing on a farm, engaged in agriculture, deriving at least two-thirds of their gross annual incomes from crop or livestock production or both, and interested in wildlife conservation. At the time of their appointment three commissioners shall reside west of the Missouri River and five shall reside east of the Missouri River.*

Annually at each Commission meeting in May, SDGFP presents recommendations for adoption as an official rule proposal for all deer hunting seasons, except for hunting season dates and Special Buck which are proposed at the January commission meeting. The SDGFP Commission has the flexibility to change the recommendation in any fashion they determine appropriate or to simply take no action, which results in no change to current administrative rule.

Once the Commission adopts a formal proposal, the proposal is then open for public comment for one month or until the next Commission meeting. Commission proposals available for public comment can be found online at http://gfp.sd.gov/agency/commission/default.aspx. It is during this time period that the public can review all proposals and provide comments. Individuals can provide written comments on SDGFP Commission rule proposals by sending them to 523 East Capitol Avenue, Pierre, SD 57501, or via email to wildinfo@state.sd.us. Public comments received by the Commission and SDGFP indicating full name and city of residence are entered as part of the public record.

The SDGFP Commission takes formal action on all rule proposals at the Commission meeting following the public comment period. In addition, the Public Hearing portion of the Commission meeting provides those attending the meeting the opportunity to share comments with the SDGFP Commission on the specific rule changes scheduled for finalization. A rule change that receives a minimum of five supporting votes from the eight-member Commission is accepted for rules adoption. Fewer votes mean that the proposal has been rejected and the season will remain the same as the previous year, or the SDGFP Commission can amend the proposal within the scope of its intent.

The proposed rules are submitted to the South Dakota Legislative Research Council (LRC) and are thoroughly reviewed for legality, form, and style. A small business impact statement form is completed and submitted to the South Dakota Bureau of Finance and Management (BFM) indicating changes to fees and license numbers. Figure 6 shows a model as to how the Commission formally adopts changes to administrative rule.

**Post-SDGFP Commission Action**

The final rules adopted by the SDGFP Commission rules are again reviewed by LRC, and the final rules and minutes of the public hearing are sent to the Interim Rules Research Committee (IRRC), where the Wildlife Division Director or designee formally presents the materials. Following acceptance by the IRRC, the final rules and certificate of acceptance are then filed with the Secretary of State. Administrative rules may be implemented a minimum of 20 days after the final rules and certificate of compliance are filed with the Secretary of State (Figure 7).

The season setting process is a very diverse process involving multiple steps from start to end. Once the formal procedure is complete, SDGFP staffs follow up with the public via news releases, social media, and direct e-mails to those signed up to receive SDGFP notifications. Finally, appropriate updates are made to the SDGFP website, applications are printed, and applicants can start applying for limited-draw licenses in hopes of obtaining their desired deer license(s) for the upcoming fall hunting season.

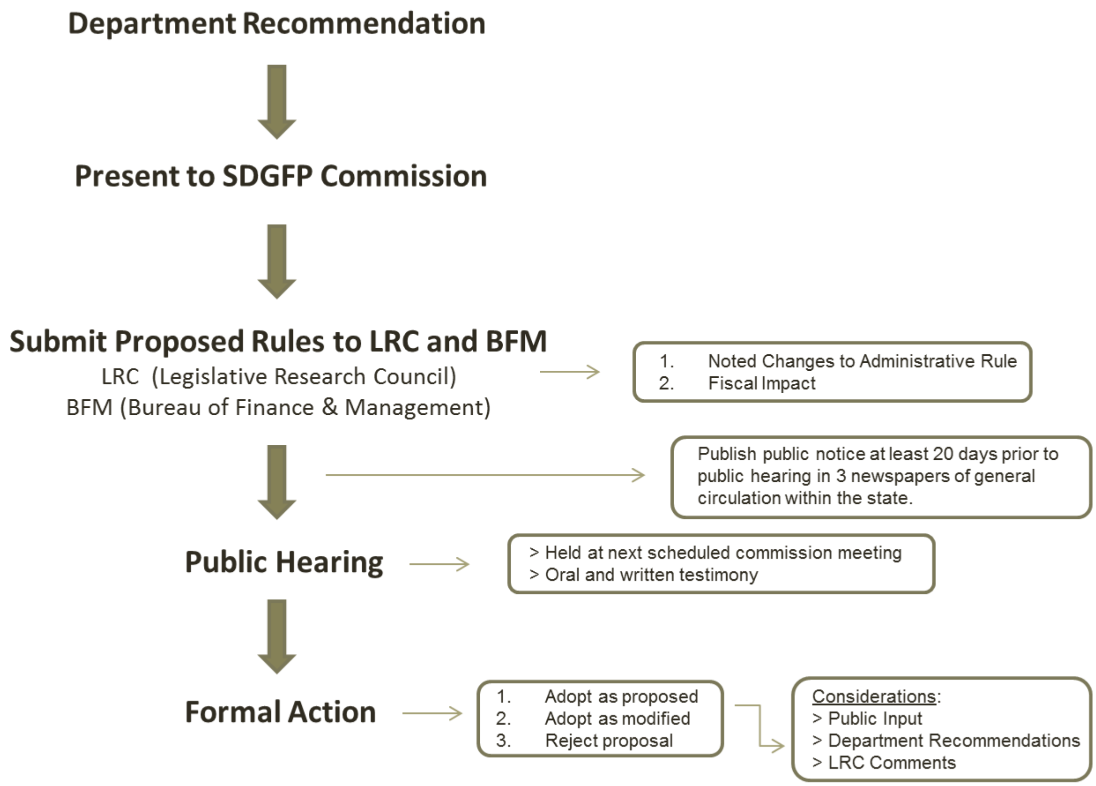



Figure 6. SDGFP Commission process for establishing hunting season regulations.


Figure 7. Post-SDGFP Commission administrative rule promulgation process.

## DEER HUNTING

Deer hunting is the foundation of North America's hunting heritage. Deer are the most sought after game species in North America, with approximately 10.9 million hunters nationwide pursuing deer in 2011 (USFWS 2011). Deer hunting is the most popular type of hunting compared to all other species combined, and in 2011 deer hunters contributed an estimated 15.9 billion dollars nationally, more than any other hunter segment (U.S. Department of Interior 2011). Within South Dakota, approximately 61,000 residents (7.5% of the resident population) and 6,850 non-residents hunted deer in 2015, with peak deer hunter participation occurring in 2010 when 81,478 residents and non-residents pursued deer. Hunting remains the number one tool for managing deer populations across South Dakota and harvest strategies are intended to ensure the well-being of the species and its habitat while maintaining populations at levels compatible with human activity and land use.

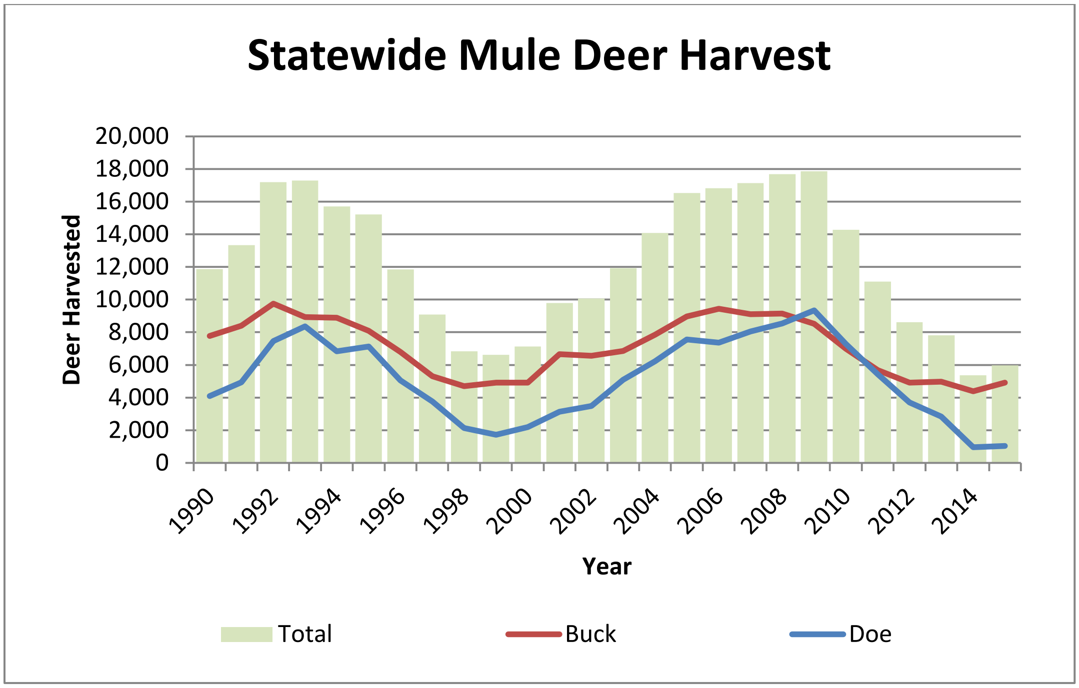
### Historical Harvest

South Dakota hunting seasons have changed over the years in response to deer population levels, habitat conditions and social demands (Table 4). Season structures began to take shape in 1929 with the regulated Black Hills deer season offering just over 2,000 licenses to resident hunters. The later creation of the East River deer season in 1947, and the West River Prairie deer season in 1952, introduced regulated hunting seasons to the rest of the state. Over the years, these three general deer seasons took on various boundaries and were split into different harvest management units to focus hunting pressure where deer populations needed to be reduced (Richardson and Peterson 1974, Appendix A). Throughout the 1940s and 1950s licenses were available over-the-counter and in most cases were unlimited. In 1959, SDGFP began limiting hunting permits for each hunting unit in the East River deer season, followed by similar restrictions for West River deer units in 1964. The Black Hills season had unlimited buck licenses until recently, but began limiting antlerless licenses in the 1970s. Through the 1970s, data including landowner tolerance levels, population trend data, buck-doe kill ratios, hunter reporting, and reproductive information from vehicle-killed deer were used to manage deer populations within each of these general regions (Richardson and Peterson 1974). During the early 1980s deer numbers increased across the state, and by 1985 the number of licenses offered exceeded hunter demand when 100,000 licenses were authorized and only 95,000 were sold (Rice 1985). Total licenses issued across the state for all seasons have steadily increased since 1999 from just over 75,000 to slightly less than 130,000 in 2010. Even more drastic is the increase in total tags issued as it has increased in the same time frame from 85,000 to over 200,000. Harvest reached an all-time high of nearly 95,000 deer in 2010, approximately 15% of which were mule deer. In recent years the harvest and license sales have returned to levels much similar to those seen in the late 1990s, with statewide total harvest of just under 63,000 and statewide license sales just under 100,000 (with the majority being single tag licenses).

The statewide proportion of mule deer in the harvest has always been small in comparison to white-tailed deer harvested in South Dakota, but mule deer are a significant resource in the western portion of the state. In 1959, the statewide harvest was comprised mostly of white-tailed deer, with mule deer making up only 4% of the harvest (Jackson 1972) and concentrated along the Missouri River breaks. Statewide white-tailed deer harvest rarely reached 50,000 animals until 2000 when it began to rise to a peak in 2010 of nearly 80,000 deer (Figure 8). Mule deer harvest reached a peak of nearly 17,000 in 1993 and again nearly 18,000 in 2009 (Figure 8). In 2015, white-tailed deer harvest was approximately 42,000 deer, while mule deer harvest was approximately 6,000 deer statewide (Figure 8). Mule deer harvest within the West River deer season increased to an average of 40% of the harvest from 1990-2015 (Figure 9).

Table 4. Timeline of important events during the development of the deer hunting season structures in South Dakota.

| **South Dakota Deer Seasons** | |
|---|---|
| 1883 | Dakota Territories prohibited hunting from January 1 - September 1 |
| 1909 | Initiation of the Game, Fish and Parks as the first Conservation officer was instated |
| 1911 | Buck Law passed |
| 1921 | Buck Law amended |
| 1925 | Buck Law amended to prohibit deer hunting in all counties of the state except the Black Hills |
| 1929 | Black Hills regulated deer season initiated |
| 1947 | Creation of the East River deer season |
| 1949 | Commission structure initiated and given regulatory power by the legislature |
| 1952 | Creation of the West River deer season |
| 1959 | Initiation of harvest reporting |
| 1976 | Statewide Archery season established |
| 1983 | Restrictions on hunters only acquiring either an East River or a West River license, but not both, were discontinued.<br>A total of 8% of all West River licenses were reserved for non-residents.<br>Non-residents were able to purchase an East River license for the first time ever.<br>Non-landowners were able to purchase an East River license every year, rather than every other year as previously allowed. |
| 1990 | Youth season established |
| 1991 | Muzzleloader season established |
| 2008 | Mentored youth season established |



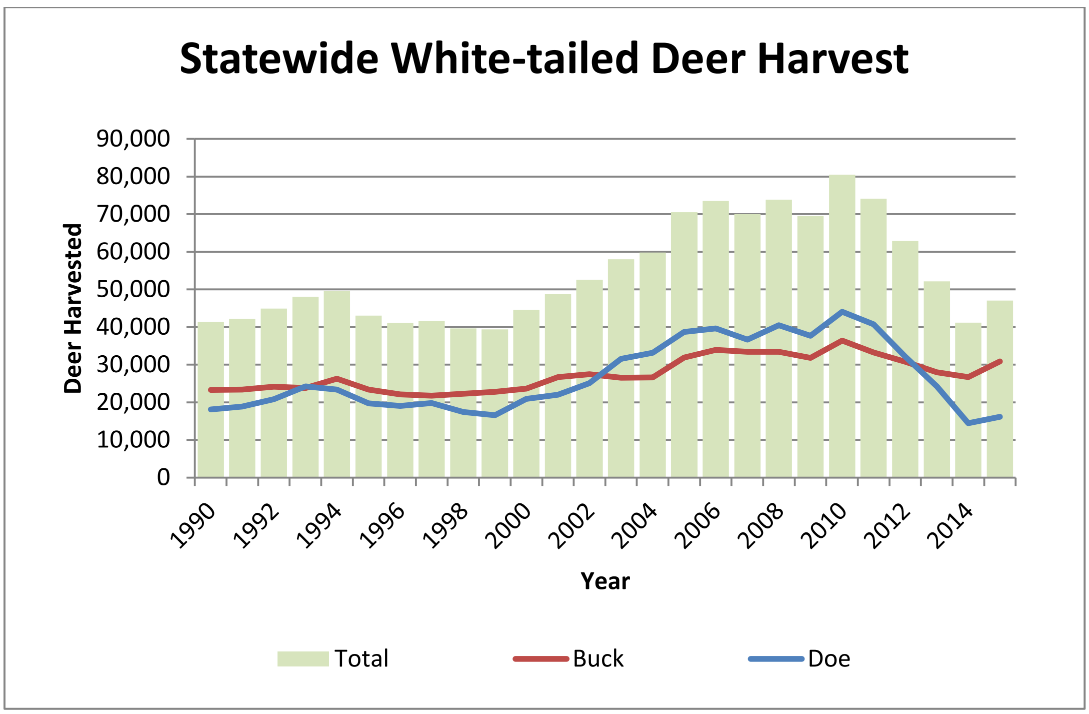




Figure 8. Statewide mule deer and white-tailed deer harvest, 1990-2015.

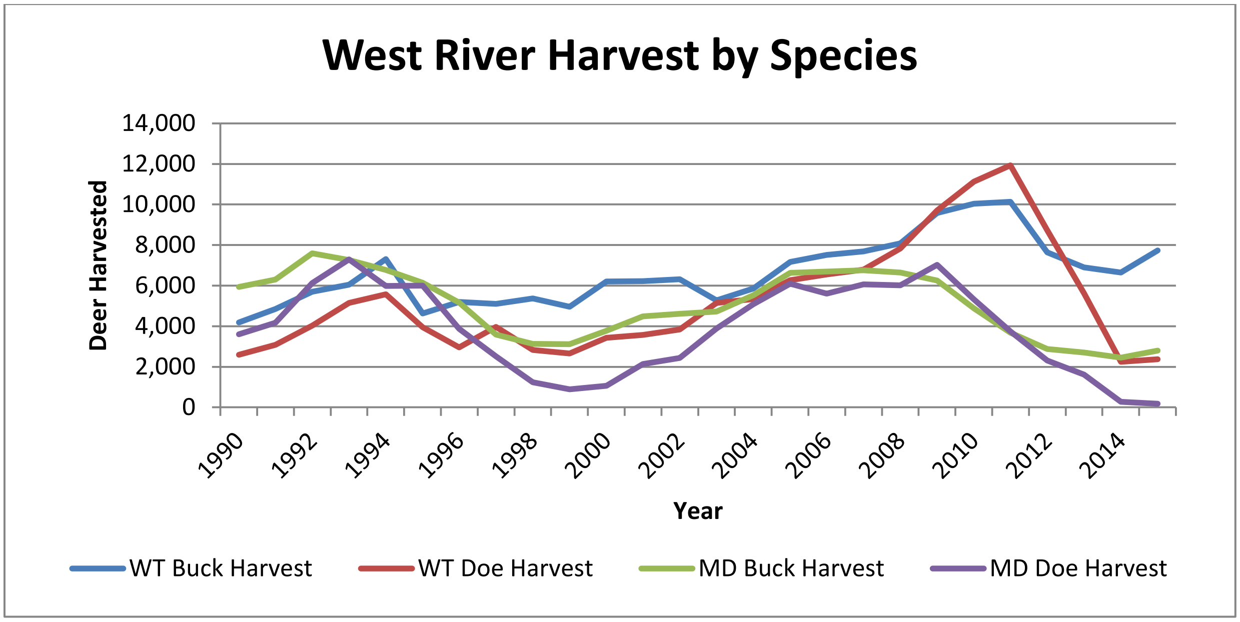



Figure 9. West River deer season harvest by species and sex, 1990-2015.

<u>Black Hills Firearm Season</u>

The season dates for the Black Hills deer season were November 1-20 from 1929-1953, restricting hunters to harvest one buck with 2 points on one antler or better (Table 5). In the 1930s-1940s, the non-resident licenses made up between 0-6% of the total licenses issued for each firearm season in the Black Hills (Rice, unpublished). In 1944, antlerless seasons were initiated with opening dates in the late November or December time frames. Estimated harvest in 1943 was just over 3,000 deer and rose to a peak of 19,000 deer in 1948 (Figure 10). Harvest peaked again to a one-year substantial high of 42,000 deer in 1953 as multiple tags were issued for each license to reduce a quickly growing deer population inciting a multitude of landowner damage complaints (Hipschman 1959). This same year the season dates were extended to include the entire month of November (Table 5). Licenses peaked in 1969 at just over 28,000 allowing a harvest of 15,200 deer in the Black Hills. Licenses and harvest gradually declined until 1993. In the next 5 years licenses were cut in half increasing the hunter harvest success rates dramatically.

In the mid-1970s the season structure began to stabilize offering unlimited buck licenses and limited antlerless licenses that were distributed within each subunit (SDGFP 2008). In 1990, over-the-counter tags were issued for specific sex and species of deer in the Black Hills resulting in the harvest of 3,720 white-tailed deer and 1,147 mule deer. In 1996, a 2-point or better restriction was placed on the buck licenses due to hunters asking for better quality buck availability in the Black Hills. This same year the Black Hills buck license distribution became limited at nearly 8,400 licenses and hunters had to draw their licenses rather than purchase them over the counter as previously allowed. The season structure remained the same through 2003, with limited “any antlerless” and “antlerless whitetail” licenses ranging from 300 to nearly 8,000 during that time. In 2004, the season structure changed to offer “any buck deer” (2-point or better), “any deer”, “any antlerless” and “any whitetail” licenses, ultimately replacing the two-season structure (Buck season and Special Antlerless season). In 2007, the 2-point antler restrictions were removed and replaced with “any deer”, “any whitetail”, “any antlerless deer” and “antlerless whitetail” licenses (SDGFP 2008). Since 1996, harvest and license numbers have declined to just over 3,500 licenses and 2,300 harvested deer in 2012 (Figure 10). This decline in available licenses allowed deer populations to rebound and overall hunter harvest success rates increased from 45% to over 70% from 1996-2015 (Figure 10). See Appendix B for species and sex-specific harvests in the Black Hills firearm deer season.

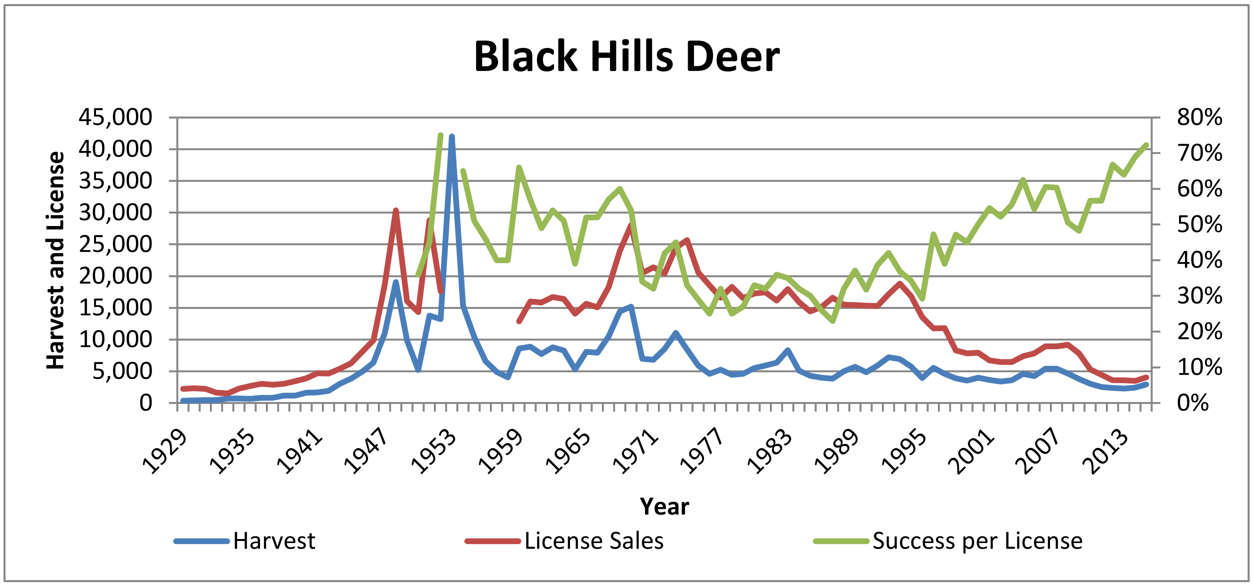



Figure 10. Black Hills firearm deer harvest and license sales, 1929-2015.

East River Deer Season

Hunting in the eastern portion of South Dakota was closed as a result of the 1921 “buck law” and reopened in 1947, which initiated a “boom and bust” East River deer season structure in which only nine seasons were held from 1947-1959, and unlimited licenses were offered to hunt within designated open counties (Popowski 1962, Table 6). These seasons were meant to diminish deer depredation issues within designated areas. In some years all 44 counties were open, and other years only 4 counties were open, or the season was closed completely. These early seasons incited poor hunter distribution as there was no regulation as to where the hunter could use the license and no limit to the number of licenses. The initial seasons were restricted to shotguns until 1952. In 1959, licenses became limited and each of the 44 counties were considered separate management units with specific license distribution, and rifles were a legal weapon in the 14 counties closest to the Missouri River, ultimately phasing out shotguns by 1963 (Jackson 1972). Hunters were restricted to hunting in the specific county that they applied for allowing more control over hunter distribution. License sales for each county ranged from 20-400 enabling more controlled hunter distribution and minimized competition between hunters (Popowski 1962). Buck only seasons were held in 21 of the southern counties, and “any deer” seasons were held in the remaining 23 northern counties (Appendix A). The seasons held in 1940s and 1950s were three to five days long around the beginning of

Table 5. Major events and season date changes for the Black Hills firearm season, 1929-2016.

| **Black Hills Deer Firearm Season** | |
|---|---|
| 1929 | Black Hills regulated deer season initiated |
| 1929-1953 | November 1-20 |
| 1944 | First antlerless season in the Black Hills (January 7-13) |
| 1953-1954 | November 1-30 ("any deer"/"any elk") |
| 1955-1959 | 1st Saturday in November - Last Saturday in November |
| 1960 | 2nd Saturday in November - 1st Saturday in December |
| 1961-1964 | November 1-30 |
| 1968 | November 1- 2nd Sunday in December |
| 1969-1980 | November 1-30 (Buck tag then "any deer" after November 25) |
| 1983 | Non-resident hunters can apply for 8% of the available Black Hills licenses |
| 1981-1989 | November 1-30 Buck Season |
| 1990-1995 | November 1-15 Antlerless Units and November 1-30 Buck Season |
| 1996 | Buck licenses become limited |
| 1996-2004 | November 10-19 Specific Antlerless Units, November 1-30 Black Hills-wide |
| 1996-2006 | Point restriction on buck tags that required two points or better on one side |
| 2005-2016 | November 1-30 |

December until 1958 when it became a nine-day season. In 1959, licenses were distributed on a first-come-first-served basis and landowners that wished to hunt in the county that they owned land were given first chance at 50% of the licenses available during an early application period (Popowski 1962). These limited license hunting units also enabled more useful and reliable data to be gathered from hunters and their harvested animals (Popowski 1962). Deer harvest during the East River season started slowly with only 2,000-3,000 deer harvested during open seasons in the 1940s and 1950s (Figure 11). Harvest remained at 7,000-9,000 deer from 1972-1981. Deer numbers began to increase in 1983 and several of the restrictions on license sales were removed to increase harvest. For example, hunters could now obtain both an East River and West River license within the same year, and the East River license could be purchased every year rather than every other year (Rice 1985). By 1989, harvest climbed to nearly 30,000 deer, and in 2006 it climbed again to just over 41,500 deer (Figure 11). Since then, license numbers and harvest have mostly declined to 27,000 licenses sold and 17,000 harvested deer in 2015. See Appendix B for species and sex-specific harvests in the East River deer firearm season.

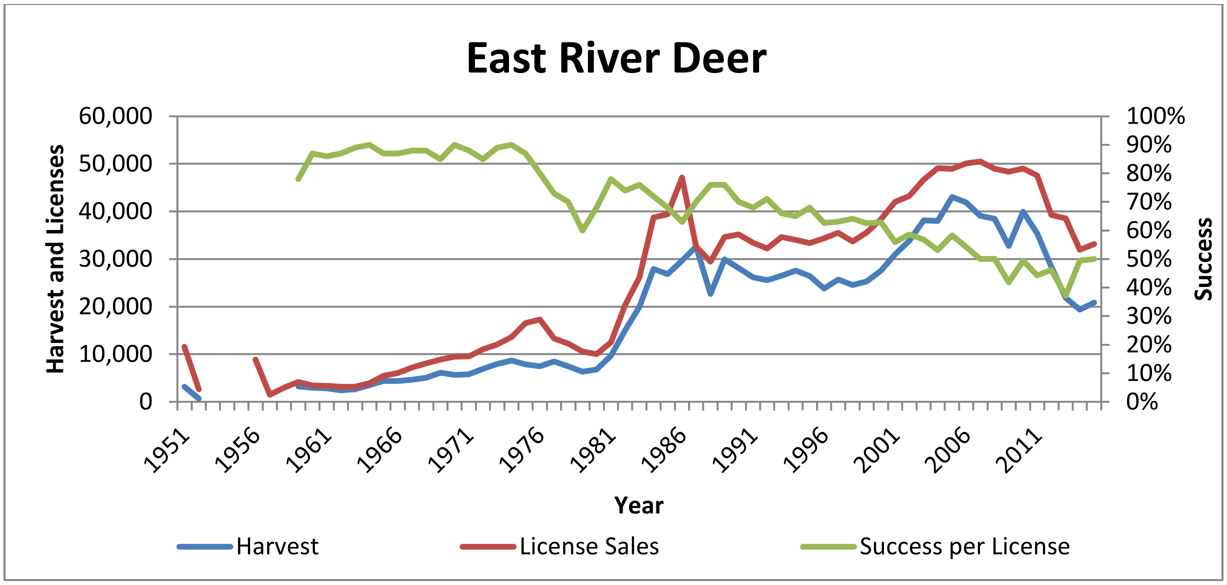



Figure 11. East River firearm season deer harvest and license sales, 1951-2015.

Table 6. Major events and season date changes for the East River firearm season, 1947-2016.

| East River Firearm Season | |
|---|---|
| 1947 | East River regulated deer season initiated as a 9-day season |
| 1959 | Hunting units and limited permits initiated for East River deer seasons |
| 1968-1981 | 4th Saturday in November - 1st Sunday in December |
| 1982-1983 | 4th Saturday in November - 2nd Sunday in December |
| 1984-1985 | 4th Saturday in November - 1st Sunday in December |
| 1985 | Non-resident hunters can apply for 8% of the licenses |
| 1987-1996 | Last Saturday in November - 1st Sunday in December |
| 1997 | 3rd Saturday in November - November 30 |
| 1998-2002 | 3rd Saturday in November - 1st Sunday in December |
| 2003 | November 15-30 |
| 2004 | November 20 - December 5 |
| 2005-2008 | 3rd Saturday in November- 1st Sunday in December, "any deer" converts to "any antlerless" and "any whitetail" converts to "antlerless whitetail" for the 1st week in December and the first week in January |
| 2009-2012 | 3rd Saturday in November - 1st Sunday in December, "any deer" converts to "any antlerless" and "any whitetail" converts to "antlerless whitetail" valid for 9 consecutive days beginning the Saturday following Christmas |
| 2013-2016 | Saturday prior to Thanksgiving for 16 consecutive days and an antlerless season valid for 9 consecutive days beginning the Saturday following Christmas.<br>"any deer" and "any whitetail" deer licenses no longer convert to "any antlerless" deer or "antlerless whitetail" deer licenses for the 9-day antlerless season. |

West River Deer Season

The West River deer firearm season began in 1952 with season dates of November 1-5 restricting harvest to buck only, along with a Missouri River area hunt with season dates of December 6-15 for "any deer" harvest (Richardson and Peterson 1974, Table 7). Until 1959 hunting unit structure changed almost annually, with units closed to hunting some years and portions open the next (Appendix A). In 1964 the West River deer season boundaries mirrored the East River deer season boundaries and were defined on a county basis (Richardson and Peterson 1974). Hunting unit boundaries continued to change along with season dates for specific areas, but the county specific harvest limits remained and became more specific as time progressed (Appendix A). Antlerless deer seasons began to appear in the West River deer season around 1970 for most counties (Ross 1972). Starting in 1985 an established 8% of the West River licenses were added for non-resident hunters, marking the same year the West River deer season had a significant increase in license sales. The number of West River deer harvested was around 4,000-5,000 in the 1950s, and harvest continued to increase until 1993 and 1994 when it reached approximately 25,500 harvested deer (Figure 12). After a decline in 2000 when harvest dipped to around 14,500, harvest increased to a record of 32,500 in 2009. Since then licenses and harvest numbers have declined to around 20,000 licenses and 15,500 harvested deer in 2015 (Figure 12). See Appendix B for species and sex-specific harvests in the West River deer firearm season.

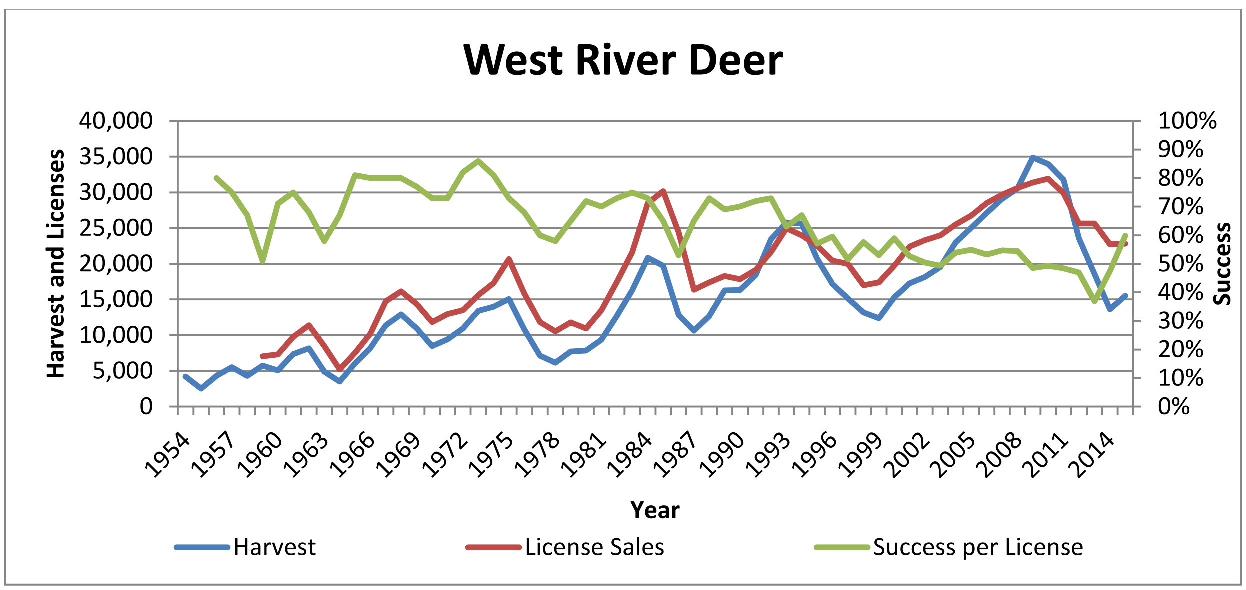



Figure 12. West River firearm harvest and license sales, 1954-2015.

Table 7. Major events and season date changes for the West River firearm season, 1952-2016.

| **West River Firearm Season** | |
|---|---|
| 1952 | West River regulated deer season initiated with seasons running November 1-5 in most areas West of the Missouri River and December 6-15 in the Missouri River breaks |
| 1958-1960 | November 1-11 “any deer”, November 12-25 “Buck Only” (spike or larger) |
| 1961-1965 | November 1-5 One “any deer”, November 6-12 One “Buck Only” deer with 2 or more points on one antler and October 1-31 “any deer” |
| 1964 | Hunting units and limited permits initiated for West River deer seasons |
| 1966 | October 1-28 and December 1-31 |
| 1967 | October 28-November 5 and November 24-26 and September 25-October 25, and November 11 - December 17 |
| 1968 | November 13-21 and November 29 - December 1 |
| 1970 | Antlerless seasons began |
| 1971 | November 13-21 |
| 1972-1975 | 2nd week and last week in November |
| 1976 | 2nd week in November |
| 1977-1979 | 2nd week and last week in November |
| 1980-1981 | Last week in November |
| 1982-1985 | 2nd Saturday in November - last Sunday in November |
| 1985 | Non-resident hunters can apply for 8% of licenses |
| 1987 | 2nd and last week in November |
| 1988-2002 | 2nd Saturday in November - last Sunday in November |
| 2003 -2008 | 2nd Saturday in November - last Sunday in November Antlerless tags valid during Antelope season in October and an Antlerless season the last Saturday in December - 1st Sunday in January (“any deer” and “any whitetail” deer tags convert to antlerless tags) |
| 2009-2012 | 2nd Saturday in November - last Sunday in November and an Antlerless season valid for 9 consecutive days beginning the Saturday following Christmas (“any deer” and “any whitetail” deer tags convert to antlerless tags in this late season) |
| 2013-2014 | The Saturday 12 days prior to Thanksgiving for 16 consecutive days and antlerless season the Saturday following Christmas for 9 consecutive days (only antlerless tags valid during the late antlerless season) |
| 2015-2016 | The Saturday 12 days prior to Thanksgiving for 16 consecutive days |

Archery Deer Season

The Archery season began in 1953 in the Black Hills and 1956 in the East and West River regions (Table 8). The West River archery season originally ran the last half of October while the East River archery season encompassed late November into December. Archery Deer harvest was around 1,000 deer until 1980. In 1983, archery permits were valid statewide for either sex and either species for residents and non-residents. There was also an "antlerless only" license that could be purchased in specific units (Rice 1985). Archery harvest remained between 1,000 and 3,000 deer from 1983-2000, more recently peaking at nearly 10,000 deer from 2005-2010 (Figure 13). License sales remained fairly constant at just over 10,000 licenses from 1982-1999. When an increasing interest in the Archery season began to appear, the sales of these unlimited licenses increased from around 11,000 to a peak around 28,000 in recent years (Figure 13).

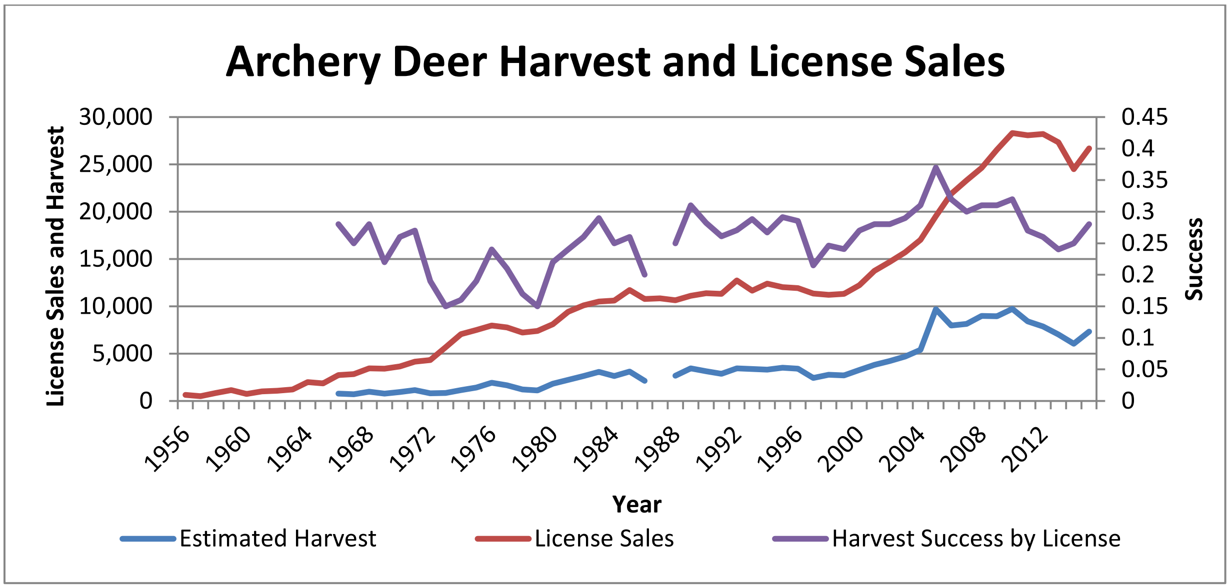



Figure 13. Archery Deer harvest and license sales, 1956-2015.

Muzzleloader Deer Season

The Muzzleloader Deer season began in 1991 with 309 "any antlerless" deer licenses available to residents with a harvest of 119 deer (Table 9). Residents were allowed up to three muzzleloader licenses and the season ran the second week in December. In 2001, residents were able to apply for licenses in the first and second draw, and then both residents and non-residents were able to purchase leftover licenses up to a maximum of three licenses per hunter. In 2002, the season was extended and ran till the end of January. By 2003, just over 1,000 licenses were available to hunters and distributed in nearly every county across the state. In 2004, a hunter could have a maximum of five muzzleloader licenses. In 2005, license allocation went down to only one license per person but total license numbers were made unlimited and valid statewide. This same year, "any deer" licenses became available to residents only but they had to choose to apply for the 400 "any deer" licenses or the unlimited "any antlerless" licenses. Prior to 2005 non-residents could only purchase leftover licenses, but after 2005 non-residents were able to purchase licenses from the unlimited number of antlerless deer licenses available. In 2006, residents were able to purchase both an "any deer"

Table 8. Major events and season date changes for the Archery Deer season, 1953-2016.

| **Archery Season** | |
|---|---|
| 1953-1971 | Initiation of Black Hills archery season opening the 3rd Saturday in October and running for 2 weeks |
| 1956-1960 | Initiation of prairie archery season open the month of October and December |
| 1961-1964 | East and West River archery as separate seasons with West River opening October 1 and East River opening November 1 |
| 1965-1975 | West River opening October 1 and East River opening the first Saturday in November |
| 1972-1975 | Black Hills archery season opening October 1 |
| 1976-1993 | Archery became a Statewide season; dates of October 1 - December 31 |
| 1994-2004 | Statewide season opening the 4th Saturday in September - December 31 with an antlerless season from January 1-31. Antlerless deer licenses were allocated at the unit level ("any deer" licenses convert to antlerless deer licenses for this late season) |
| 2005 | Unlimited single and double tag antlerless deer licenses were available statewide |
| 2005-2010 | Statewide season opening the 4th Saturday in September - December 31 with an antlerless season from January 1-31 ("any deer" licenses convert to antlerless deer licenses for this late season) |
| 2011-2012 | Statewide season opening the 4th Saturday in September - December 31 with an antlerless season from January 1-15 ("any deer" licenses convert to antlerless deer licenses for this late season) |
| 2013-2016 | "any deer" licenses no longer convert to antlerless deer licenses for the January 1-15 antlerless season |

license and an "any antlerless" license in the same year. In 2008, the limited "any deer" licenses increased to 1,000 and on January 1 they converted to "any antlerless" licenses for the remainder of the season. In 2012, the antlerless season continued but only existing unfilled antlerless tags were valid during that late season; "any deer" tags no longer converted to antlerless tags. The muzzleloader season reached a peak harvest in 2008 of nearly 3,700 deer and has since returned to around 1,000 deer harvested in recent years (Figure 14). Currently, 1,000 "any deer" statewide licenses and an unlimited number of "antlerless whitetail" licenses are available.

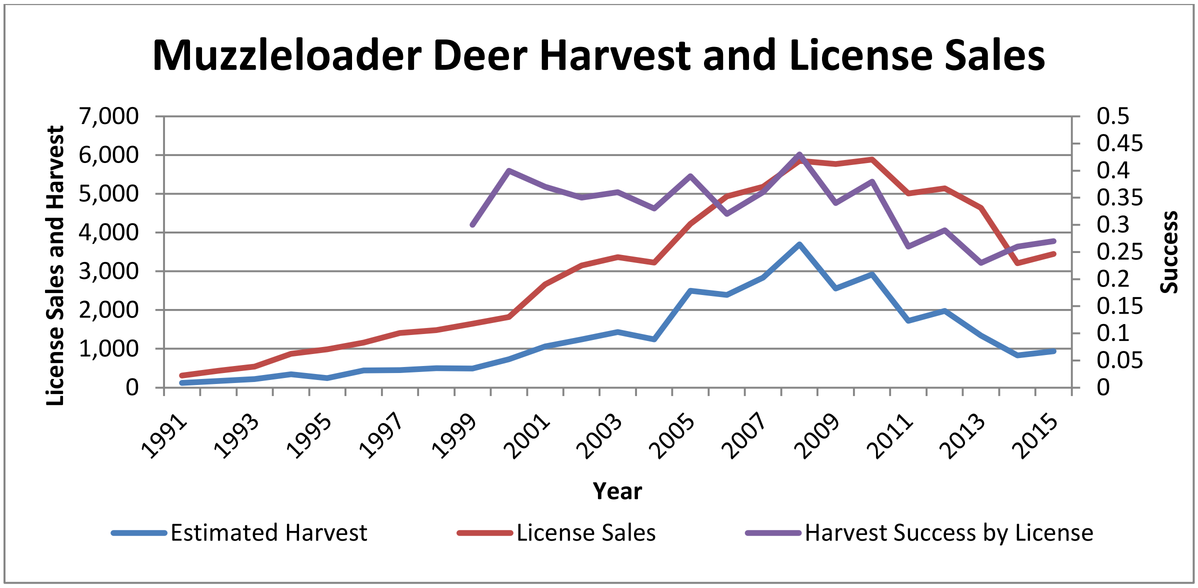



Figure 14. Muzzleloader Deer harvest and license sales, 1991-2015.

Table 9. Major events and season date changes for the Muzzleloader season, 1991-2016.

| **Muzzleloader Season** | |
|---|---|
| 1991-1996 | 2nd Saturday in December - 3rd Sunday in December (antlerless licenses were allocated at the unit level from 1991-2004) |
| 1997-2000 | 2nd Saturday in December - December 31 |
| 2001 | 2nd Saturday in December - last Sunday in January |
| 2002-2005 | 2nd Saturday in December - January 31 |
| 2005 | Non-residents able to purchase antlerless deer muzzleloader licenses |
| | Statewide "any deer" licenses became available |
| | Unlimited single and double tag antlerless deer licenses were available statewide |
| 2005-2010 | 2nd Saturday in December- December 31, antlerless season from January 1-31 ("any deer" tags convert to antlerless tags January 1) |
| 2011-2012 | December 1-31, antlerless season from January 1-15 ("any deer" tags convert to antlerless tags January 1) |
| 2013-2016 | December 1-31, antlerless season from January 1-15 (only antlerless tags valid) |

Refuge Deer Seasons

In 1966, the Sand Lake National Wildlife Refuge opened a deer hunting season followed by Lacreek National Wildlife Refuge and Waubay National Wildlife Refuge, but limited information was gathered on harvest or license sales for these seasons until 1978 (Figure 15). Several of the seasons from 1989-1995 included a reduction or extension of season dates to manage the deer population in these specific areas. These seasons have become more restrictive in the number of licenses available while the number of applicants has increased from 630 in 2000 to 1,080 in 2015. Many of the refuges have muzzleloader only seasons including the early Sand Lake season, all Lacreek seasons, and all except the last season in Waubay.

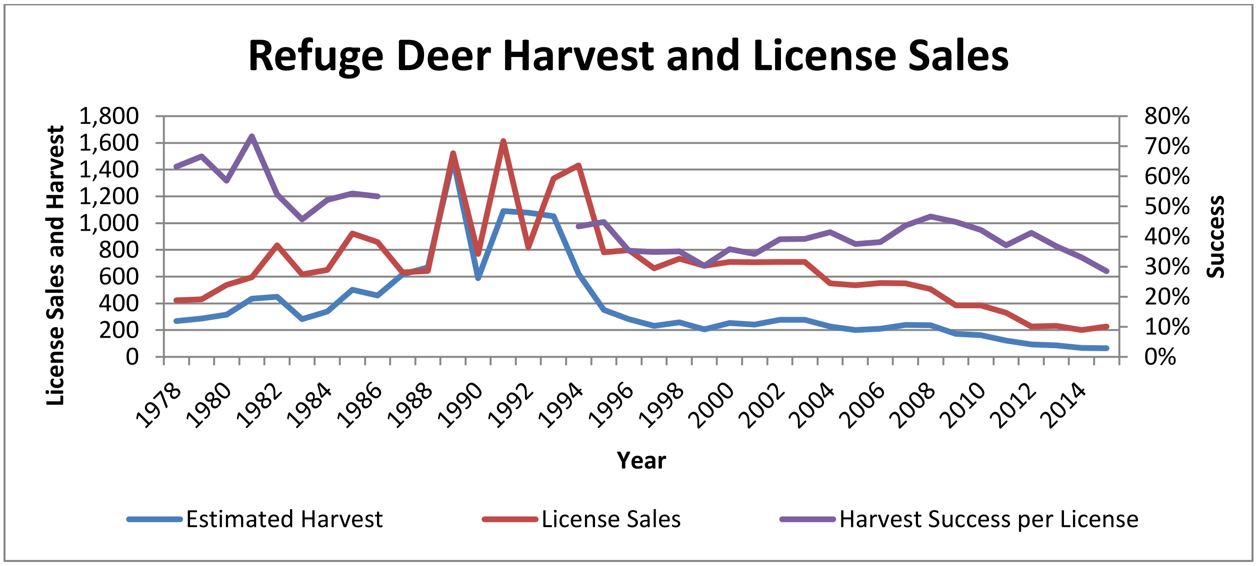



Figure 15. Refuge deer harvest and license sales, 1978-2015.

## Youth Deer Season

The Youth Deer season began in 1990, with season dates of September 22-23 and 29-30, and offered 2,020 “any antlerless” deer licenses available to resident youth hunters (Figure 16). In 1993, the season dates changed to September 18-26 and 3,600 “any antlerless” licenses were available. In 1998, the dates changed again to offer a December season (September 19-27 and December 12-31) and 3,085 “any antlerless” or “antlerless whitetail” licenses were available. In 2004, double tags were available to youth hunters. In 2005, this season became a statewide unlimited antlerless deer season. The next year the late season extended to January 31, and in 2007 the season dates were September 22-January 31 consecutively. This increase in license availability and extension of the season allowed license sales to rise from over 3,000 licenses in 2005 to over 7,000 licenses in 2010 and 2011. In 2011 the season was shortened, ending on January 15. License sales have begun to decline slightly, but have remained over 5,000 since 2008 (Figure 16). Youth Deer hunters must be between ages 12 and 18 and are required to attend and pass hunter safety courses prior to obtaining a deer license.

## Mentored Youth Deer Season

In 2008, a Mentored Youth Deer season was started by legislative action allowing unlimited “antlerless” licenses to young aspiring hunters (Table 10). This season was similar to the Youth Deer season in date and location, but allowed hunters between 10 and 16 years of age to hunt with the assistance of an unarmed mentor to teach them safe and ethical hunting practices. The mentored hunter is not required to pass the hunter safety course. License sales were just over 1,000 “antlerless” licenses at the season’s initiation (Figure 17).  Recent licenses sales have increased to over 3,000 “antlerless” licenses for this popular unlimited season.

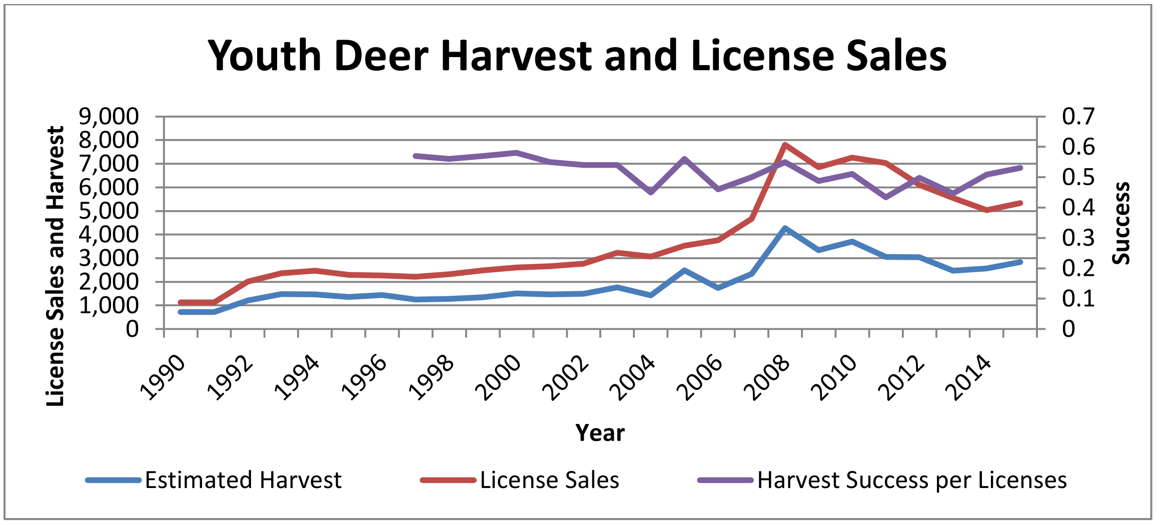



Figure 16.  Youth Deer harvest and license sales, 1990-2015.

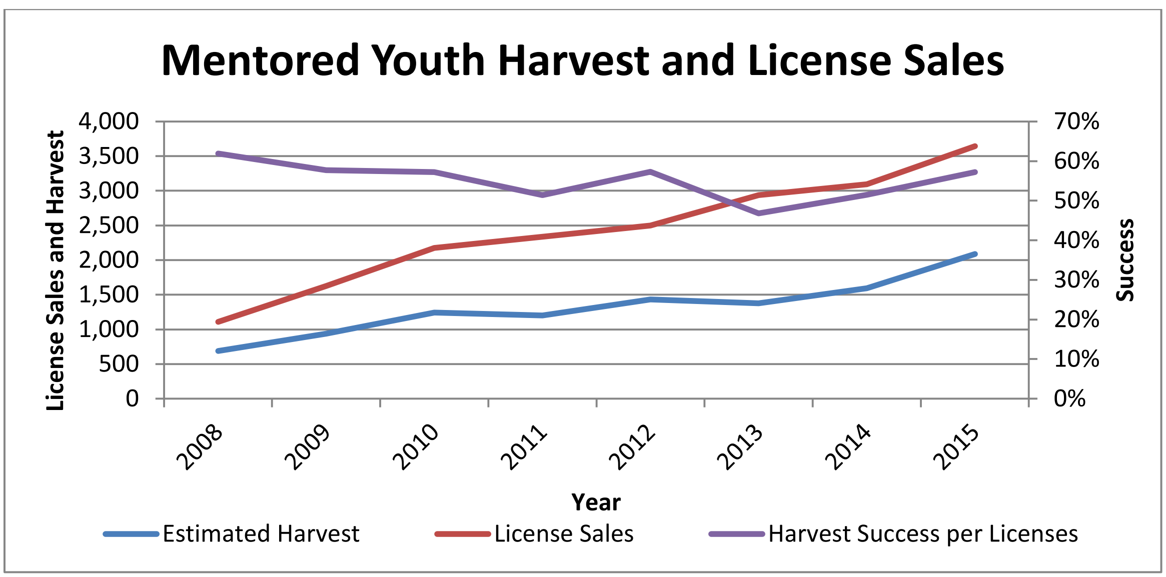



Figure 17.  Mentored Youth Deer harvest and license sales, 2008-2015.

Table 10. Major events and season date changes for the Youth Deer and Mentored Youth seasons, 1990-2016.

| **Youth and Mentored Youth Seasons** | |
|---|---|
| 1990 | Youth season initiated |
| 1990-1992 | 3rd and 4th weekends in September |
| 1993-1995 | 3rd week in September |
| 1996-1997 | 4th week in September |
| 1998-2001 | 3rd week in September and 2nd Saturday in December - December 31 |
| 2002-2005 | 3rd week in September and 1st Saturday in December - December 31 |
| 2005 | Youth season changed to a statewide unit with unlimited single and double tag antlerless licenses |
| 2006-2007 | 2nd week in September and 2nd Saturday in December - January 31 |
| 2008 | Mentored Youth statewide unlimited season initiated |
| 2008-2010 | 2nd Saturday in September - January 31 |
| 2011-2016 | 2nd Saturday in September - January 15 |

Custer State Park Deer Season

Custer State Park (CSP) was established in 1919, however, hunting seasons were not initiated until 1981 for white-tailed deer, 1984 for mule deer, and antlerless white-tailed deer harvest began in 2003 (Tables 11, 12, 13). Recreational harvest of deer in CSP has been determined using anecdotal observations of available mature bucks and potential impacts to public viewing opportunities. Seasons include no-hunt buffers around roads and visitor areas to reduce impacts to viewing opportunities. The season runs for two weeks beginning on the first Saturday in November. Any whitetail and any mule deer licenses have remained relatively constant over the years, and “antlerless whitetail” licenses have increased in response to an increasing whitetail population in the park (Table 12). No antlerless licenses were available in 2012 and 2013.

Table 11.  Historical harvest of male white-tailed deer in Custer State Park, 1981-2015.

| Year | Any White-tailed Deer Licenses Sold | Total Harvest | Harvest Success (%) | Applications |
|---|---|---|---|---|
| 1981 | 24 | 19 | 79 | NA |
| 1982 | 25 | NA | NA | NA |
| 1983 | 25 | NA | NA | NA |
| 1984 | 25 | 10 | 40 | NA |
| 1985 | 25 | 8 | 32 | 62 |
| 1986 | 25 | 19 | 76 | 70 |
| 1987 | 25 | 13 | 52 | 187 |
| 1988 | 25 | 14 | 56 | NA |
| 1989 | 25 | 13 | 52 | 168 |
| 1990 | 25 | 20 | 80 | NA |
| 1991 | 0 | 0 | 0 | NA |
| 1992 | 0 | 0 | 0 | NA |
| 1993 | 0 | 0 | 0 | NA |
| 1994 | 0 | 0 | 0 | NA |
| 1995 | 0 | 0 | 0 | NA |
| 1996 | 0 | 0 | 0 | NA |
| 1997 | 0 | 0 | 0 | NA |
| 1998 | 2 | 2 | 100 | NA |
| 1999 | 2 | 2 | 100 | NA |
| 2000 | 2 | 2 | 100 | 230 |
| 2001 | 2 | 2 | 100 | 317 |
| 2002 | 4 | 4 | 100 | 367 |
| 2003 | 10 | 10 | 100 | 385 |
| 2004 | 10 | 9 | 90 | 437 |
| 2005 | 10 | 10 | 100 | 331 |
| 2006 | 10 | 9 | 90 | 365 |
| 2007 | 10 | 9 | 90 | 399 |
| 2008 | 10 | 9 | 90 | 408 |
| 2009 | 10 | 10 | 100 | 556 |
| 2010 | 10 | 8 | 80 | 610 |
| 2011 | 10 | 8 | 80 | 598 |
| 2012 | 10 | 10 | 100 | 730 |
| 2013 | 10 | 7 | 70 | 1,415 |
| 2014 | 10 | 8 | 80 | 1,663 |
| 2015 | 10 | 8 | 80 | 1,787 |

Table 12. Historical harvest of female white-tailed deer in Custer State Park, 2003-2015.

| Year | Antlerless White-tailed Deer Licenses Sold | Total Harvest | Harvest Success (%) | Applications |
|---|---|---|---|---|
| 2003 | 29 | 19 | 67 | 30 |
| 2004 | 28 | 14 | 50 | 28 |
| 2005 | 21 | 10 | 48 | 21 |
| 2006 | 50 | 26 | 52 | 53 |
| 2007 | 37 | 35 | 94 | 37 |
| 2008 | 44 | 37 | 84 | 44 |
| 2009 | 57 | 45 | 79 | 57 |
| 2010 | 55 | 40 | 73 | 55 |
| 2011 | 35 | 28 | 80 | 62 |
| 2012 | 0 | 0 | NA | NA |
| 2013 | 20 | 17 | 87 | 60 |
| 2014 | 20 | 13 | 65 | 96 |
| 2015 | 20 | 15 | 75 | 87 |

**SD Deer Hunter Profile**

<u>Hunters' Expectations</u>

People participate in recreational activities with the intention that their participation will meet certain expectations (Vroom 1964, Driver and Tocher 1970). Hunters' specific expectations for any given experience are influenced by both individual and environmental factors (Schreyer and Roggenbuck 1978). The very basis of recreation hinges on choice; therefore, the motivations for participating in a given activity may vary considerably (Graefe et al. 1984). While particular expectations tend to be associated with certain activities, a high degree of variation can be found among individuals doing the same activity, using the same environment, or even within a given individual at different times (Graefe et al. 1981). Knowledge of hunters' motivations and expectations allow managers to better understand the different experiences sought by individuals (Bryan 1979).

SDGFP has used public opinion surveys for over twenty years to measure the attitudes, preferences, and interests of deer hunters in the state. South Dakota deer hunters' motivations have remained fairly consistent over this time period and across various deer seasons (Gigliotti 2003abc, Gigliotti 2011a and 2011b, Longmire 2017a). The top reasons indicated for why they deer hunt are enjoying the outdoors (nature), being with friends and family (social), and experiencing the challenge of the hunt (experience).

Table 13. Historical harvest of male mule deer in Custer State Park, 1984-2015.

| Year | "Any Deer" Licenses Sold[1] | Total Harvest | Harvest Success (%) | Applications |
|---|---|---|---|---|
| 1984 | 5 | 5 | 100 | NA |
| 1985 | 5 | 5 | 100 | 174 |
| 1986 | 0 | NA | NA | NA |
| 1987 | 0 | NA | NA | NA |
| 1988 | 5 | 5 | 100 | NA |
| 1989 | 0 | NA | NA | NA |
| 1990 | 0 | NA | NA | NA |
| 1991 | 0 | NA | NA | NA |
| 1992 | 0 | NA | NA | NA |
| 1993 | 0 | NA | NA | NA |
| 1994 | 0 | NA | NA | NA |
| 1995 | 0 | NA | NA | NA |
| 1996 | 0 | NA | NA | NA |
| 1997 | 0 | NA | NA | NA |
| 1998 | 2 | 2 | 100 | NA |
| 1999 | 2 | 2 | 100 | NA |
| 2000 | 2 | 2 | 100 | 335 |
| 2001 | 2 | 2 | 100 | 289 |
| 2002 | 2 | 2 | 100 | 284 |
| 2003 | 2 | 2 | 100 | 296 |
| 2004 | 2 | 2 | 100 | 292 |
| 2005 | 2 | 2 | 100 | 524 |
| 2006 | 2 | 2 | 100 | 598 |
| 2007 | 2 | 2 | 100 | 767 |
| 2008 | 2 | 2 | 100 | 636 |
| 2009 | 2 | 2 | 100 | 1,054 |
| 2010 | 2 | 2 | 100 | 1,167 |
| 2011 | 2 | 2 | 100 | 1,169 |
| 2012 | 2 | 1 | 50 | 1,093 |
| 2013 | 0 | 0 | NA | NA |
| 2014 | 0 | 0 | NA | NA |
| 2015 | 0 | 0 | NA | NA |

[1]from 1984-2004, licenses were "any mule deer"

In 2016, the vast majority of deer hunters (91%) indicated nature was an important or very important reason for why they hunted deer. In addition, 82% indicated social reasons were important or very important, and 83% placed a high degree of importance on the experience of the hunt (Table 14; C. Longmire, unpublished data). Out of the many recreational activities which can provide nature appreciation and social interaction, hunting also brings an aspect of sport recreation and obtaining food (Gigliotti and Metcalf 2016). When classified by importance of each reason for hunting deer, four distinct groups were formed from a cluster analysis (Table 15). Three of the four groups (groups 1, 2 and 4) were similar in the importance hunters placed on the social aspects, the experience of the hunt, and enjoyment of nature; however, approximately 23% of hunters (group 4) placed higher importance on bringing meat home while being fairly neutral on solitude, harvesting a large-antlered deer, harvesting any antlered deer, or a doe. Approximately 23% (group 2) placed a higher importance than all other hunters on harvesting large-antlered deer, were neutral on bringing deer meat home to eat and harvesting any antlered deer. They also indicated harvesting a doe was unimportant. Nearly half (48%) of hunters (group 1) rated all the motivations, as measured by the survey instrument, as being important reasons for why they deer hunt, and for the remaining 5% of deer hunters (group 3) all of the motivations were considered unimportant (Longmire 2017a). Gender differences can be seen among South Dakota deer hunters with regards to the importance of sporting aspects and obtaining meat (Gigliotti and Metcalf 2016). In South Dakota, female deer hunters were more likely than their male counterparts to be motivated by the food aspect of hunting, while males were more motivated by the sporting aspects of the hunt (Gigliotti and Metcalf 2016).

Table 14. Deer hunters' reasons for why they deer hunt (SDGFP unpublished).

| Reason | Very Unimportant | Unimportant | Neutral | Important | Very Important | Mean[1] | Standard Error |
|---|---|---|---|---|---|---|---|
| | ………………percent……………….. | | | | | | |
| Enjoying the outdoors | 5.5 | 0.9 | 3.0 | 29.0 | 61.6 | 4.40 | 0.020 |
| Being with friends and family | 5.5 | 2.7 | 10.0 | 30.2 | 51.6 | 4.20 | 0.022 |
| Experiencing the challenge of the hunt | 3.3 | 2.4 | 11.4 | 42.9 | 39.9 | 4.14 | 0.019 |
| Bringing deer meat home to eat | 5.9 | 5.2 | 17.3 | 34.5 | 37.2 | 3.92 | 0.023 |
| Solitude | 4.3 | 6.7 | 27.4 | 38.8 | 22.8 | 3.69 | 0.021 |
| Harvesting large-antlered deer | 5.1 | 8.1 | 33.7 | 35.7 | 17.4 | 3.52 | 0.021 |
| Harvesting any antlered deer | 9.3 | 14.9 | 40.2 | 28.1 | 7.4 | 3.09 | 0.021 |
| Harvesting a doe | 11.7 | 14.9 | 46.4 | 21.6 | 5.5 | 2.94 | 0.020 |

[1] Importance Scale: 1 Very Unimportant; 2 Unimportant; 3 Neutral; 4 Important; 5 Very Important

Table 15. Classification of mean importance of reasons for deer hunting (Longmire 2017a).

| | Group 1 | Group 2 | Group 3 | Group 4 |
|---|---|---|---|---|
| | ………….Mean Importance…………. | | | |
| Enjoying the outdoors | 4.82 | 4.64 | 1.26 | 4.09 |
| Being with friends and family | 4.68 | 4.45 | 1.90 | 3.50 |
| Experiencing the challenge of the hunt | 4.52 | 4.23 | 1.89 | 3.79 |
| Bringing deer meat home to eat | 4.47 | 2.77 | 2.29 | 4.34 |
| Solitude | 4.10 | 3.68 | 2.32 | 3.19 |
| Harvesting large-antlered deer | 3.66 | 3.86 | 2.45 | 3.15 |
| Harvesting any antlered deer | 3.42 | 2.56 | 2.72 | 3.06 |
| Harvesting a doe | 3.34 | 1.94 | 2.73 | 3.14 |
| N | 1,125 | 543 | 121 | 541 |
| % of Hunters | 48.3% | 23.3% | 5.2% | 23.2% |

[1] Importance Scale: 1 Very Unimportant; 2 Unimportant; 3 Neutral; 4 Important; 5 Very Important

There are several factors which can influence hunters' satisfaction with deer hunting seasons. Among them are hunters' evaluation of deer populations, relative importance of deer hunting as a recreational activity, perceptions of crowding, and hunters' success. In 2010, one-third (33%) of East River deer hunters indicated there were too few white-tailed deer and 75% said there were too few mule deer in the areas they hunted (Table 16). Nearly half (49%) of East River deer hunters rated the white-tailed deer populations as just about right, and 22% rated the mule deer population as just about right. Similarly, approximately one-third (35%) of West River deer hunters indicated there were too few white-tailed deer and 55% thought there were too few mule deer in the areas they hunted. Forty-seven percent of West River deer hunters rated the white-tailed deer populations as just about right, and 37% indicated mule deer populations were just about right (Gigliotti 2011b). During this same time period, just over half (53%) of Black Hills deer hunters indicated there were too few white-tailed deer, while 80% felt there were too few mule deer. Slightly more than one-third (39%) of hunters felt the white-tailed deer populations in the Black Hills were just about right, and 17% rated the mule deer populations as just about right (Gigliotti 2011a). In 2016, deer hunters evaluated the changes in white-tailed and mule deer populations over a five year period (2010 to 2015). Nearly half of deer hunters (48%) thought the white-tailed deer populations in the areas they hunted most had decreased; 30% felt they were about the same and 22% thought the populations had increased. Fifty-two percent of deer hunters felt the mule deer populations had stayed about the same over the past five years, while 39% thought they had decreased and only 9% indicated the mule deer populations had increased (Longmire 2017a).

Table 16. 2010 deer hunters' evaluations of South Dakota deer populations.

| | White-tailed Deer | | | Mule Deer | | |
|---|---|---|---|---|---|---|
| | Too Few | Just About Right | Too Many | Too Few | Just About Right | Too Many |
| 2010 East River Deer Hunters[1] | 33% | 49% | 18% | 75% | 22% | 3% |
| 2010 West River Deer Hunters[1] | 35% | 47% | 18% | 55% | 37% | 9% |
| 2010 Black Hills Deer Hunters[2] | 53% | 39% | 7% | 80% | 17% | 3% |

[1] Gigliotti 2011b, [2] Gigliotti 2011a

About one-fifth (21%) of deer hunters indicated deer hunting was their most important recreational activity, and another 44% indicated it was a very important recreational activity for them (Gigliotti 2011a, Gigliotti 2011b). Approximately 20% of deer hunters indicated that harvesting the type of deer (species, sex, antler size, etc.) they were hunting for was very important to their overall satisfaction with their deer hunting season (Gigliotti 2011a, Gigliotti 2011b). While the relative percentage of hunters rating this as very important has fluctuated slightly over the past decade and across different hunting seasons, the percentage has stayed at 25% or fewer deer hunters. Approximately two-thirds (64%) of East River/West River deer hunters indicated having an uncrowded, undisturbed deer hunting experience is very important. On the scale used to measure the importance of harvest vs. crowding, deer hunters rated having an uncrowded, undisturbed experience as 25% more important than harvesting a deer (Gigliotti 2011b). In 2016, 45% of deer hunters thought the number of deer hunters in the field had stayed about the same from 2010 to 2015, while 34% thought the number of hunters had increased (Longmire 2017a).

Hunters' Deer Season Preferences

There were a total of 78,556 unique deer license applicants in 2015 (69,887 residents and 8,669 non-residents). There were nearly 22,000 applicants for the Archery Deer season, 6,242 (29%) of which applied only for the archery season. Approximately 87% of Archery Deer applicants were South Dakota residents (18,881 residents and 2,920 non-residents), and 60% of applicants who only applied for the Archery Deer season were residents (3,765 residents and 2,477 non-residents). There were approximately 72,000 unique applicants (66,120 residents and 6,194 non-residents) for firearm deer seasons in 2015, 7,983 of which were Muzzleloader Deer applicants (7,836 residents and 147 non-residents). Five percent of muzzleloader applicants only applied for the muzzleloader season. Approximately 56,000 licensed hunters held at least one "any deer" license in 2015. Three-quarters only held one "any deer" license, 19% held two "any deer" licenses, and 5 percent held 3 "any deer" licenses. The remaining 1% held 4 or more "any deer" licenses in 2015. The vast majority of non-resident deer hunters (96%) held only one "any deer" license, 4% held two "any deer" licenses, less than 1% of non-resident deer hunters held 3 or more "any deer" licenses.

Nearly half (49%) of resident applicants for deer licenses in South Dakota indicate their most preferred deer hunting season is the East River season (Table 17; Longmire 2015). In a typical year two-thirds (67%) of deer hunters apply for the East River season (including East River Special Buck), and 41% of deer hunters typically apply for the West River season (including West River Special Buck). Nearly one-third (32%) of deer hunters apply for the Archery season and 23% typically apply for the Black Hills deer season (Longmire 2015).

Table 17. Deer hunter season rankings (Longmire 2017a).

| Season | Rank (# of 1st choice) |
|---|---|
| East River Deer | 1st (1,057) |
| West River Deer | 2nd (626) |
| Archery Deer | 3rd (452) |
| Black Hills Deer | 4th (287) |
| Muzzleloader Deer | 5th (24) |
| Refuge Deer | 6th (21) |

In 2016, deer hunters were asked their opinions regarding the length and dates of the major deer seasons in South Dakota (Table 18). The majority of hunters believe the East River (59%) and Archery (56%) seasons are just about right in length. Forty percent of hunters think the West River deer season is just about right and 33% believe it is too short. The majority felt the Black Hills deer season was either just about right (49%) or had no opinion (41%) about the season length. Similarly, the majority of hunters felt the length of the Muzzleloader Deer season was just about right (42%) or had no opinion (45%) about it. The majority of hunters believe the East River (64%), West River (65%), Archery (58%), and Black Hills (53%) deer season dates were just about right. Forty-seven percent of deer hunters indicated they had no opinion regarding the Muzzleloader Deer season dates, and 39% believed they were just about right (Longmire 2017a).

Table 18. Deer hunters' opinions on deer seasons length and dates (Longmire 2017a).

| | Season Lengths | | | | Season Dates | | | |
|---|---|---|---|---|---|---|---|---|
| | Too Short | Just About Right | Too Long | No Opinion | Too Early | Just About Right | Too Late | No Opinion |
| East River | 11.8% | 58.8% | 8.5% | 20.8% | 3.5% | 64.1% | 11.9% | 20.5% |
| West River | 33.1% | 40.2% | 1.1% | 25.6% | 3.5% | 64.5% | 5.6% | 26.4% |
| Archery | 6.0% | 55.9% | 8.8% | 29.4% | 5.5% | 57.7% | 4.8% | 32.0% |
| Muzzleloader | 5.0% | 41.5% | 8.2% | 45.2% | 0.9% | 39.3% | 12.8% | 47.0% |
| Black Hills | 7.4% | 48.7% | 2.7% | 41.2% | 2.1% | 52.7% | 1.6% | 43.7% |

**Deer Hunter Participation**

National estimates suggest 1 out of every 22 Americans or 8 out of 10 hunters (over age 16) go hunting for deer (Fuller 2016). Nationally, deer hunting contributes approximately $15.9 billion annually to the economy and is an essential component of funding the sustainable wildlife management practices by many state fish and wildlife agencies (Fuller 2016, USFWS et al. 2011).

Except for deer license types that are unlimited (youth/mentored, archery, landowner-own-land, antlerless muzzleloader), South Dakota deer hunter participation is greatly influenced by the number of deer licenses available. If deer license allocations decrease, the number of unique hunters also decreases. If deer license allocations increase, the number of hunters also increases. For example, in 2010, there were 81,478 unique individuals who purchased 128,250 licenses to hunt deer (Huxoll 2016, Figure 18). Alternatively, in 2015, 67,394 hunters purchased 99,394 deer licenses (Huxoll 2016, Figure 18). The differences between these years represents a -22.5% decline in deer licenses sold and a -17.3% decline in the number of unique deer hunters.

Nevertheless, since 1998, an average of 70,768 deer hunters purchased an average of 105,953 deer licenses. Since 2011, deer hunters in South Dakota purchased an annual average of 108,724 licenses, contributed over $25 million in license fee revenue (plus millions in federal aid), and harvested over 300,000 deer to assist with the wildlife management practices of SDGFP (Huxoll 2016).

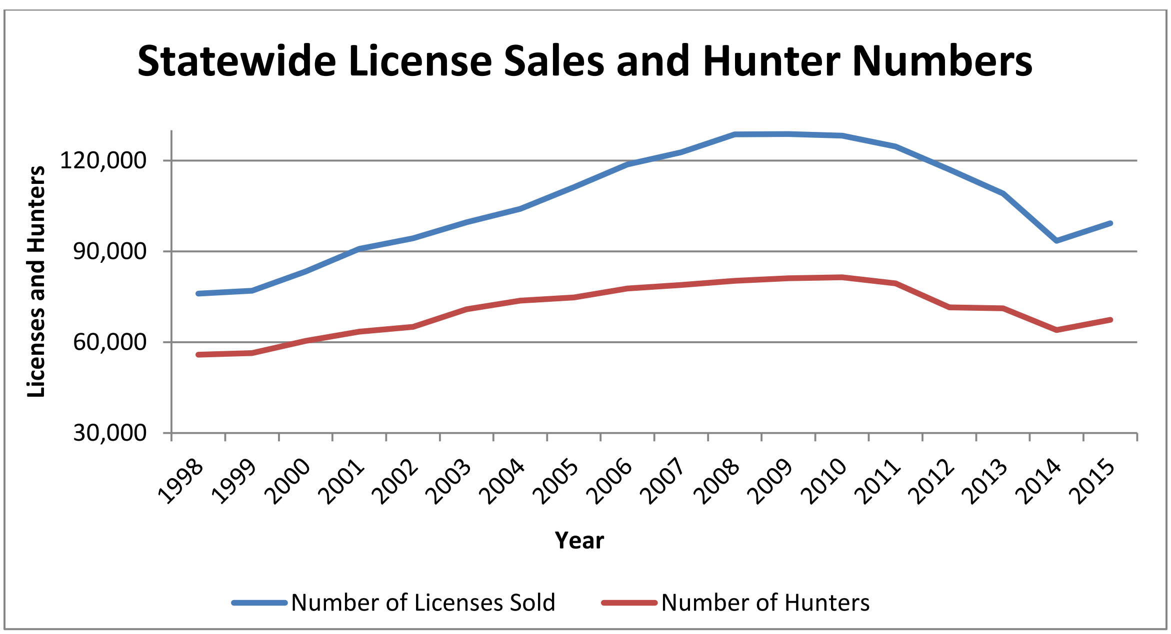



Figure 18. Number of deer licenses sold and the number of deer hunters in South Dakota, 1998-2015.

Hunter Recruitment, Retention and Reactivation- Hunter R3

On a national level, the number of people who participate in hunting has been on the decline since the early 1980s (USFWS 2015; Figure 19). This decline poses an increasing threat to wildlife conservation and sustainable wildlife management practices by many state fish and wildlife agencies. As a result, many state fish and wildlife agencies, including SDGFP, have implemented strategies and programs to increase hunter recruitment, retention and reactivation (R3).

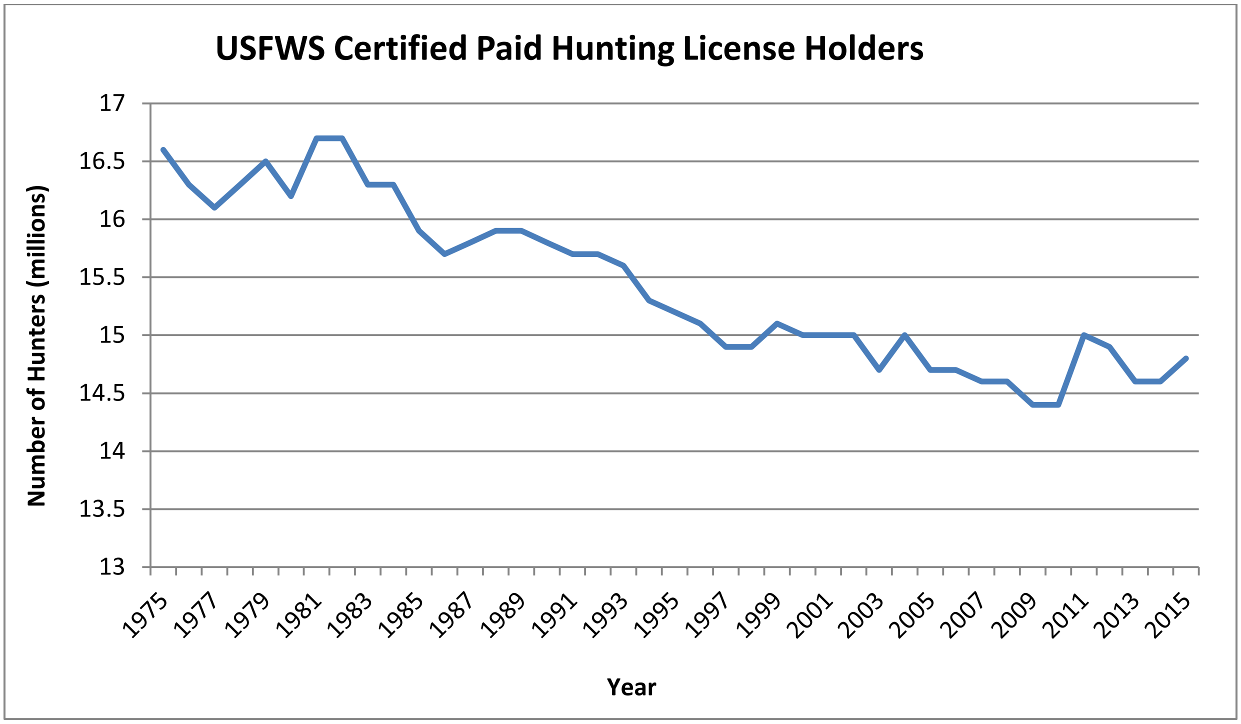



Figure 19. National license certification data generated from the Federal Aid Information Management System (FAIMS) database (USFWS 2015).

According to the National Shooting Sports Foundation (2010), thirty-one states have attempted to remove constraints with the intent to increase youth hunter participation or youth hunter recruitment. In South Dakota, through lowering the minimum age to 10 (mentored program), developing lengthy youth seasons, allowing unlimited antlerless licenses, as well as keeping licenses at minimal cost ($5.00 for residents, $10.00 for non-residents), the idea is that youth participation would not be constrained thus increasing hunter recruitment.

There is no doubt that removing constraints has allowed youth to participate at earlier ages, and possibly go hunting more frequently; however, it is unlikely that these efforts actually recruited many new youth hunters who would not otherwise have gone hunting. In fact, despite efforts to recruit youth, the proportion of youth (age 10-14) as a percent of total license sales have been declining in South Dakota for small game and youth/mentored deer since the mid-2000s (Figure 20).

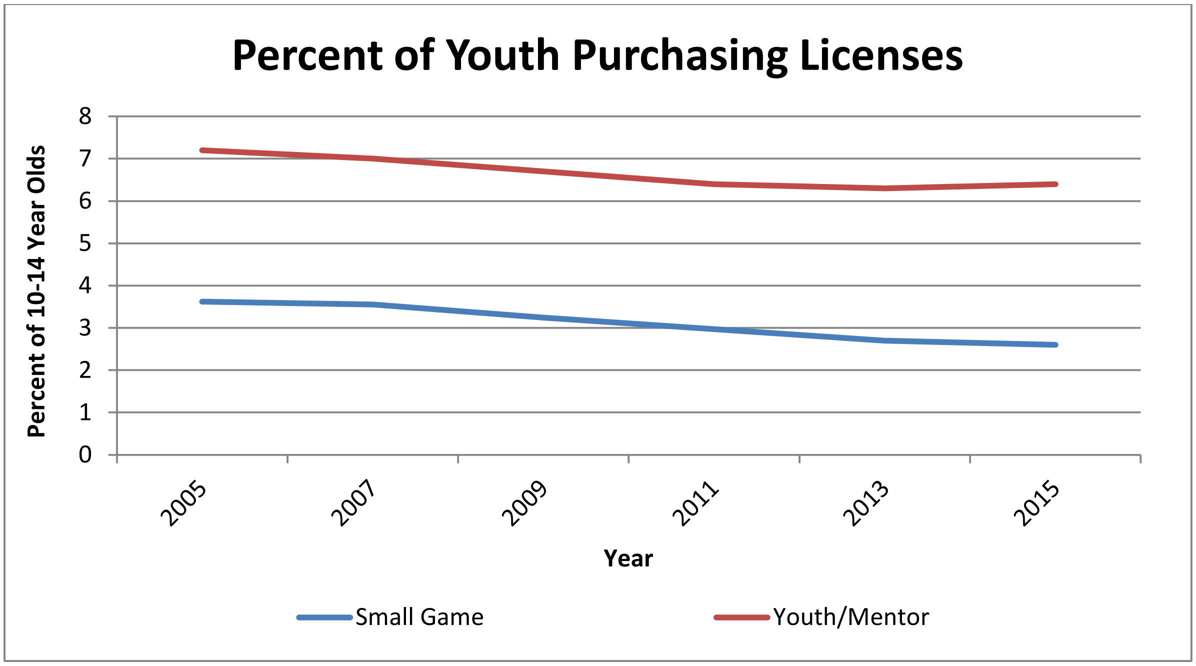



Figure 20. Percent of 10-14 year olds out of all licenses sold for small game and deer, 2005-2015.

Due to the continued national declines in hunting participation, state agencies, non-government organizations (NGOs) and the hunting and shooting industry came together to draft a National Hunting and Shooting Sports Action Plan to: 1) increase participation in hunting and the shooting sports and 2) increase support for hunting and the shooting sports. The plan provides a strategic approach to hunter R3 as well as provides:

- Tools, expertise, and resources to help states evaluate their existing capacity to implement R3 programs and retool programs to effectively prioritize audiences, track participation, apply evaluation tools and expand existing opportunities for engagement in R3 activities.

- Assistance to states in identifying and delivering high priority, customer-facing R3 strategies that integrate education and outreach, communications, marketing, licensing, regulations, and access.

- Recommendations and prioritized opportunities to states for developing partnerships with NGOs, industries and other stakeholders within the hunting and recreational shooting sports sectors.

Overall, by incorporating strategies suggested through the National Hunting and Shooting Sports Action Plan it will help South Dakota enhance R3 efforts thus providing a more stable funding base for wildlife conservation (Council to Advance Hunting and the Shooting Sports 2016).

**Hunter Access**

In 2016, over 4.75 million acres or 10% of South Dakota were open to public deer hunting access. A majority of this public land (over 2 million acres) is owned and managed by the US Forest Service (USFS), with smaller portions owned by the US Bureau of Land Management (BLM; 274,00 acres), US Fish and Wildlife Service (USFWS; 150,000 acres), SD Office of School & Public Lands (SDSPL; 750,000 acres), and SDGFP (281,000 acres). A large portion (over 1.2 million acres) of the land made publicly accessible is leased by SDGFP from private landowners through the Walk-In Area (WIA) program (Figure 21). Land leased as WIA received up to $13/acre in 2016 depending on where it was located in the state, the amount of hunting opportunity it provided, and the quality of habitat. For example, most WIAs in the western part of the state are rangeland and received $1 or less/acre, while many WIAs in central and eastern South Dakota that are primarily CRP received $6/acre. All types of hunting during all legal hunting seasons are allowed on the majority of WIA lands.

Another program that provides public hunting on private land is the James River Watershed Conservation Reserve Enhancement Program (CREP). CREP is a partnership between the United States Department of Agriculture (USDA), Farm Service Agency (FSA), and SDGFP. Landowners enroll in CREP and receive annual rental rates from both the FSA and SDGFP in return for converting cropland to undisturbed grassland and wetland habitat and providing public hunting access for 10 to 15 years. In 2016 there were over 80,000 acres enrolled in CREP offering considerable deer hunter access. Landowners receive up to 90% cost-share to restore the cropland to grassland and wetland cover as well as an annual rental rate based on the 3 predominate soils in the field and what their cash rent would be if it was leased for agricultural production. SDGFP pays an additional 10% cost share and an annual rental payment to participants equal to 40% of the base rental rate paid by the FSA.

SDGFP also leases land for deer and other game hunting opportunities through the Controlled Hunting Access Program (CHAP). In 2016 the CHAP program consisted of 20,000 acres and paid between $6 and $10 per hunter day. If the private landowner provided access to over 1,000 acres of land an additional $250 payment was made. The range in pay per hunter day is dependent on how many restrictions are placed on the CHAP area. If a CHAP is open to all hunting it receives a higher payment than if hunting is restricted to certain methods of take, certain big game hunting seasons, or a certain time period.

All lands open to public hunting access are presented in the annually published South Dakota Hunting Atlas, through interactive maps on the SDGFP website (http://www.gfp.sd.gov/hunting/areas/default.aspx), downloadable layers for Garmin GPS units, and on maps within the SDGFP Android and Apple smartphone apps. Lands owned and leased by SDGFP for public hunting access are also posted with appropriate signs.

In 2015, 32% of South Dakota deer hunters hunted on publicly owned land and 25% hunted on Walk-In Areas. Those that hunted public land primarily hunted on state owned lands with 59%hunting on SDGFP Game Production Areas, 35% hunting SDSPL lands, and 7% hunting SDGFP State Park and Recreation Areas (Longmire 2017b). Federal owned lands were used less with 26% of public land hunters using USFWS Waterfowl Production Areas, 23% hunting on

USFS National Forests, 11% hunting on USFS National Grasslands, 11% hunting on BLM land, 10% hunting on Army Corps of Engineer land, and 3% hunting on USFWS National Wildlife Refuges.

In 2015, deer hunters spent most of their time deer hunting on private land. East River deer hunters spent 78% of their time hunting on private land, which makes up 96% of the land in eastern South Dakota, 13% hunting on public land, 7% hunting on WIAs, and 2% hunting on CREP (Longmire 2017b). West River deer hunters spent more time hunting on public land (27%) and on WIAs (18%); however most of their time (55%) was spent hunting on private land, which makes up 85% of the land in western South Dakota.

In 2016 there were 200,550 acres of publicly inaccessible land owned by SDSPL and another 98,460 acres of publicly inaccessible land owned by the BLM. These lands are only publicly accessible by traveling down unmarked section lines which, depending on the terrain and distance from a public road, can be difficult to do without trespassing on private land. Over 90% of these inaccessible public acres are located in western South Dakota. SDGFP Conservation Officers provide access to some of these inaccessible public lands by working with neighboring private landowners to enroll them in the WIA program when a landowner contacts them. In 2016, the WIA program provided public access to almost 74,681 acres that would otherwise have been inaccessible.

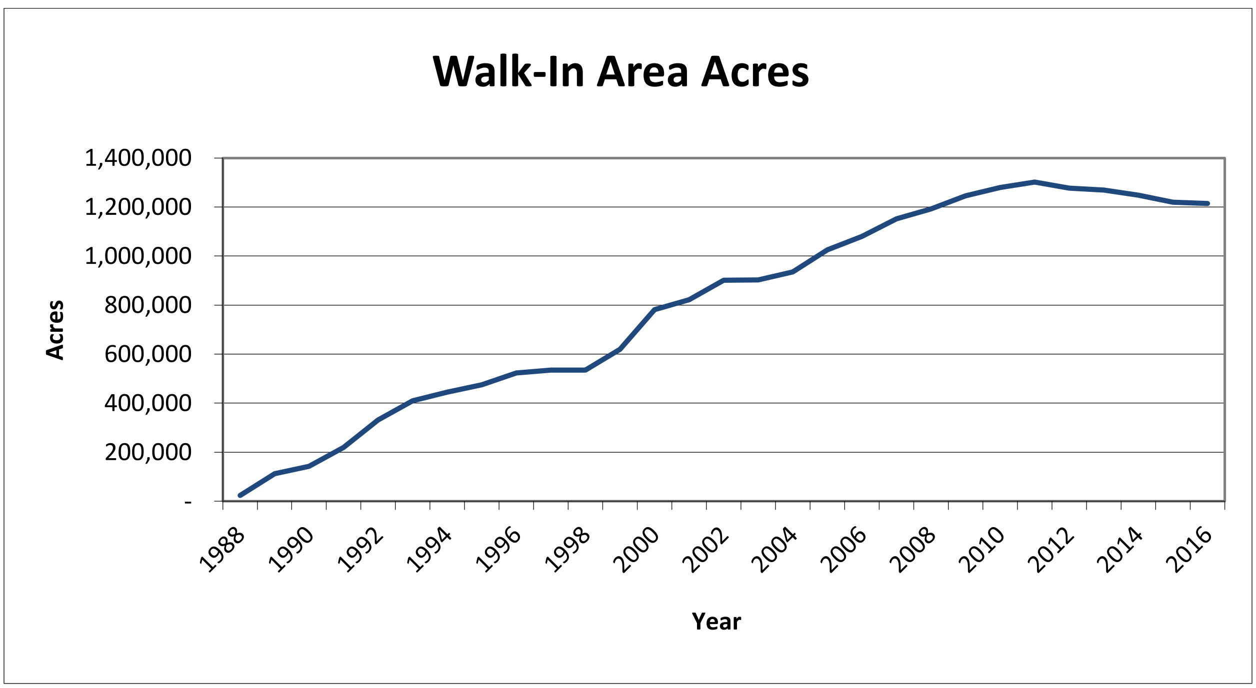



Figure 21. Number of Walk-In Area acres enrolled, 1988-2016.

## Economics

Consumptive Use

Since the implementation of regulated hunting by federal and state governments in the early 20th century, funding for the management of wildlife and their associated habitats is largely due to the sale of hunting licenses, habitat stamps, and other similar type permits purchased by those who hunt. In addition, the Federal Aid in Wildlife Restoration Act, also known as the Pittman-Robertson Act (PR), became law in 1937. The revenue generated from this excise tax is apportioned to state wildlife agencies by the USFWS for conservation efforts, hunter education and shooting programs. State wildlife agencies like SDGFP, can use this federal aid on eligible costs for wildlife management and research activities at a ratio of 75% (federal) to 25% (non-federal). The 25% non-federal aid match is provided by SDGFP through the sale of license fees collected from hunters. Without this federal excise tax placed on sales of firearms, ammunition, and other items, state wildlife agencies would be very financially limited.

Many local businesses such as gas stations, restaurants, motels, and sporting goods stores rely substantially on the economic benefits from outdoor recreationists such as deer hunters. Aside from business owners, a secondary economic benefit is the full-time, part-time, and seasonal employees who benefit from the jobs created by hunter spending. Local communities also benefit from the economic growth generated from deer hunters and other outdoor recreationists.

Since 1955, the US Department of the Interior and the US Department of Commerce have conducted the "The National Survey of Fishing, Hunting, and Wildlife-Associated Recreation Survey". Completed every five years, this survey collects information on the number of anglers, hunters, and those who enjoy watching wildlife, how often they participate in these activities, and how much they spend on these activities.

For consistency and comparability amongst surveys related to deer hunting, only results from the 2006 and 2011 national surveys are reported herein (USFWS and USCB 2006, USFWS 2011). From these survey results, average dollars spent per hunter were reported for big game hunting for both resident and nonresident deer hunters, combined. Categorical expenditures for big game hunting included the following: food and lodging, transportation, other trip costs, and equipment. Average expenditure per big game hunter in 2006 and 2011 were $412 and $464, respectively. An annual inflation rate of 3% was used as an adjustment factor between survey years. The significant increase of expenditure per big game hunter in 2011 is directly related to the new data reported by the USFWS. Ideally, a report of expenditures separated by residents and nonresidents would be desired; thus, these expenditures should be analyzed and reviewed with some caution. Reports dating back to 1955 provide specific expenditures for residents and nonresidents, respectively, but are lumped together for all hunting and are not specific to big game. Finally, the expenditures are for big game hunting and not specific to deer hunting. However, in looking at the total number of big game licenses sold to South Dakota residents and nonresidents from 2006-2015, 76% were for deer hunting, while 15.3% were for wild turkey (*Meleagris gallopavo*), 6.2% for pronghorn (*Antilocapra Americana*), and the remaining 2.5% big game licenses were issued for elk (*Cervus elaphus*), mountain goat (*Oreamnos americanus*), bighorn sheep (*Ovis canadensis*), and mountain lions (*Puma concolor*). Deer hunting does leave a substantial economic footprint in South Dakota, with expenditures of resident and nonresidents in 2015 estimated at $86 million and $13 million, respectively. Estimated deer hunting economics are reported in Table 19.

Table 19. Number of unique resident and nonresident deer hunters and estimated expenditures while deer hunting in South Dakota, 2006-2015.

| Year | Number of Unique Hunters | | | Estimated Dollars Spent by Unique Hunters | | |
|---|---|---|---|---|---|---|
| | Resident | Nonresident | Total | Resident | Nonresident | Total |
| 2006 | 70,235 | 7,486 | 77,721 | $41,508,885 | $8,811,022 | $50,319,907 |
| 2007 | 70,878 | 8,034 | 78,912 | $43,164,702 | $9,737,208 | $52,901,910 |
| 2008 | 71,971 | 8,296 | 80,267 | $45,125,817 | $10,353,408 | $55,559,492 |
| 2009 | 72,070 | 9,091 | 81,161 | $46,557,220 | $11,681,935 | $58,320,316 |
| 2010 | 72,162 | 9,316 | 81,478 | $47,987,730 | $12,334,384 | $60,403,592 |
| 2011* | 70,366 | 9,054 | 79,420 | $88,661,160 | $16,614,090 | $105,275,250 |
| 2012 | 63,921 | 7,581 | 71,502 | $82,969,458 | $14,328,090 | $97,297,548 |
| 2013 | 63,549 | 7,643 | 71,192 | $84,965,013 | $14,445,270 | $99,410,283 |
| 2014 | 57,634 | 6,428 | 64,062 | $79,362,018 | $12,515,316 | $91,877,334 |
| 2015 | 60,714 | 6,680 | 67,394 | $86,092,452 | $13,393,400 | $99,485,852 |

*The significant increase of expenditures per big game hunter in 2011 is directly related to the new data reported by the USFWS.

Estimated expenditures of resident deer hunters while hunting in South Dakota were obtained from the US Fish & Wildlife Service National Survey of Fishing, Hunting and Wildlife-Associated Recreation-South Dakota (USFWS 2006 and 2011) and adjusted for an annual inflation rate of 3 percent.

While this long-term, comprehensive survey has one of the largest datasets and is used often because of these reasons, response rates and sample sizes are often limited and results may have large standard errors. In addition, some of the information is not specific enough to make inferences for state wildlife agencies. As a result, SDGFP contracted with Southwick Associates to provide improved state and user-specific economic data.

For the 2015 deer hunting season, a total of $160,312,211 was reported for direct spending in South Dakota by resident and nonresident deer hunters at $112,455,415 ($2,126 per resident hunter) and $47,856,796 ($7,682 per nonresident hunter), respectively (Southwick Associates 2017). Data reported by Southwick Associates (2017) will be used for all future economic reports until new information is made available.

Non-Consumptive Use

A significant amount of time is dedicated to the design and implementation of deer harvest seasons, but SDGFP is well aware that many residents and visitors enjoy viewing mule deer and white-tailed deer throughout the year, both on private lands and public lands.

Wildlife watching remains one of the most popular types of outdoor recreation in the United States and has substantial economic impacts at the local, state, and national levels. According to a USFWS report on Economic Impacts of Wildlife Watching (Caudill 2014), 31% (or 72 million) of the US population 16 years of age and older enjoyed observing, feeding, and photographing wildlife in 2011. Of those 72 million wildlife watchers, 384,000 were estimated to be residents of South Dakota. That is about 47% of South Dakota's population enjoy observing, feeding or photographing wildlife. Wildlife watching has a significant impact on the nation's economy, generating approximately $54.9 billion in 2011. Most of this money collected from non-consumptive users was on wildlife equipment and trips related to wildlife and wildlife viewing. Participants buy equipment such as binoculars, cameras, trail cameras, wildlife food, camping equipment, off-road vehicles, and memberships to wildlife organizations for the primary purpose of engaging in wildlife watching.

In 2011, the economic impact of wildlife watching in South Dakota created nearly $167 million in expenditures, over 3,700 jobs, $15.6 million in state and local tax revenue, and $15.4 million in federal tax revenue (Caudill 2014). Unfortunately most studies and reports do not break down economic expenditures by species or wildlife group (e.g., deer, waterfowl, songbirds).

In a study of Wildlife and Environmental Attitudes of South Dakota citizens conducted by Gigliotti (2012), almost half of residents (49%) reported that they have taken trips sometime in their lifetime for which fish and wildlife viewing was the primary purpose of the trip. Furthermore, half of the recent wildlife viewing trips reported by residents included both traveling within South Dakota and to other states, whereas 43% involved travel only within South Dakota. The majority of residents who reported taking a trip primarily for wildlife viewing (83%) rated the importance of wildlife viewing as slightly (24%), moderately (36%), or very (23%) important. Wildlife viewers rated the recreational importance of wildlife viewing almost as high as the hunters' rating of the recreational importance of hunting. Gigliotti (2012) suggested that the importance/value of fish and wildlife indicate that South Dakota citizens place a relatively high value on having healthy populations of fish and wildlife. About 80% of the citizens feel that fish and wildlife was a contributing factor of their "quality of living" in South Dakota.

The continued popularity of wildlife watching is evidence that people value and enjoy watching wildlife. Public interest in wildlife encompasses more than just traditional hunting activities. New technology makes it easier to watch or view wildlife. For example, use of trail cameras, webcams and even drones has recently increased. There are many links to "live wildlife webcams" readily available online. Millions of visitors annually are attracted to public lands, especially our state parks, to engage in recreational activities and to view wildlife. Additionally, SDGFP continues to reach out to non-consumptive users by offering a variety of classes and outreach efforts at the Outdoor Campuses to engage the public in various wildlife related activities.

South Dakota residents also enjoy maintaining natural areas and food plots in hopes of enhancing opportunities for enjoyment of non-consumptive use of deer and other wildlife. SDGFP offers numerous options for private landowners to attract or enhance various habitats for wildlife on their properties (http://habitat.sd.gov/). Every year, the wildlife food plot program is the most utilized habitat program offered by SDGFP. Food plots may provide supplemental food sources and attract wildlife during times when food is otherwise scarce. In 2016, SDGFP enrolled 10,509 acres in the food plots program, however; number of food plots planted specifically for deer are not known. Payments to the 904 landowner partners totaled approximately $209,622. Furthermore, in 2016, SDGFP provided landowners with cost-share and incentive payments exceeding $1.5 million for establishing wildlife habitat (P. Coughlin, personal communication). Unfortunately, SDGFP does not record or monitor for the particular species a landowner is establishing habitat, i.e., acres established just for deer habitat is unknown. In 2016, SDGFP established partnerships with 46 private landowners to create roughly 154 new acres of woody habitat at a cost-share of $228,300 (B. Pauly, personal communication). Additionally, based on discussions with landowners, there are other landowners who choose to establish wildlife habitat and food plots on their own and are not enrolled in SDGFP specific programs.

## DEER POPULATION SURVEYS

Monitoring of harvested populations is arguably one of the most important management activities conducted by agencies, but limited revenues preclude intensive monitoring for all or even a majority of populations within a given jurisdiction. Depending on intensity, harvest has the potential to influence most deer population parameters, including sex ratios, age structure, and abundance (Erickson et al. 2003). Not all populations of white-tailed deer and mule deer are managed in the same way. Some population management strategies require more intensive monitoring of population demographics than others, because different components of the population may have differing effects on population trends (Keegan et al. 2011). On the other hand, populations of small size and uncertain viability require more intensive monitoring than do larger populations under similar harvesting strategies because overharvest or environmental variation can quickly lead to extirpation of small populations. As a result, monitoring intensity may be driven by both biological and socio-political needs (Keegan et al. 2011).

Trends within the deer population are more telling than simple herd counts. Managers are interested in knowing if the population is increasing, decreasing or stable. By looking at trends, management actions can be assessed. In the absence of this knowledge, managers would have no way to gauge a program's effectiveness and make adjustments if necessary. There are a number of methods to gauge deer population trends; techniques and costs can vary widely.

Mule deer and white-tailed deer herds are monitored frequently across their range in South Dakota. Survey efforts are completed to assess herd status and predict population trends in eight data analysis units (DAUs) for mule deer and 11 DAUs for white-tailed deer. Current surveys conducted to evaluate deer populations include harvest surveys, aerial surveys, spotlight abundance surveys, herd composition surveys, reproduction surveys, survival monitoring, and population modeling. Survey data are presented at different forums at many geographic scales, but most data are collected and analyzed at the DAU level for purposes of evaluating herd abundance and trends and for determining proper license allocation.

**Data Analysis Units**

Recently SDGFP completed a cooperative project with the University of Montana where one of the objectives was to develop Data Analysis Units (DAUs) for deer management in South Dakota. A DAU can be defined as an aggregate of management units that is large enough to account for auto-correlated biotic and abiotic factors and processes that uniformly influence vital rates. Given this definition, a DAU also serves as the definition of the geographic extent of a biological population, but we assume that potentially large amounts of heterogeneity may exist in animal abundance within a DAU because of factors that can be controlled by fine scale management. Functionally, a DAU should be a continuous area that facilitates fine scale management decisions working in concert to manage the larger biological population (Nowak and Lukacs, unpublished).

In an ideal setting, estimates of deer vital rates and their variation over time would be used to assign units to DAUs, but in the absence of this onerous dataset environmental variables that are believed to be important to the species' ecology were used as a surrogate. A hierarchical cluster analysis technique was used to find similarity among units. This technique found clusters of similar units that could be used outright as a DAU or provide a useful layer to combine with expert opinion. Four main working hypotheses were developed and multiple covariates were included into each analysis based on abiotic and biotic factors potentially impacting deer ecology across South Dakota. The hypothesis chosen included factors aimed at describing the general biological potential of an area. These factors included fall snow, which has been described as a means of ending the growing season and which has been demonstrated to have an effect on deer overwinter survival. Spring snow was included and has a similar effect on overwinter survival, but acts more directly as a mortality factor on already weakened deer with minimal reserve fat stores. Precipitation and temperature were also included because of their role in controlling vegetative communities and the productivity of those communities. Similarly, net primary productivity was included as a measure of the actual productivity of vegetative communities in each management unit. However, these measures of plant growth do not account for the potentially large effects of agriculture, so a coarse scale measure of agriculture was also included. In summary, the covariates used included vegetative layer, agricultural layer, net primary productivity, canopy cover, fall and spring snowfall, temperature, and precipitation (Nowak and Lukacs, unpublished).

As emphasized in the definition of a DAU, these large aggregations should be useful in the context of management, but it is unlikely that any analysis will produce a logistically feasible and biologically meaningful DAU without some help from expert opinion. The final product of the cluster analysis and expert opinion resulted in 11 DAUs (Figure 22).

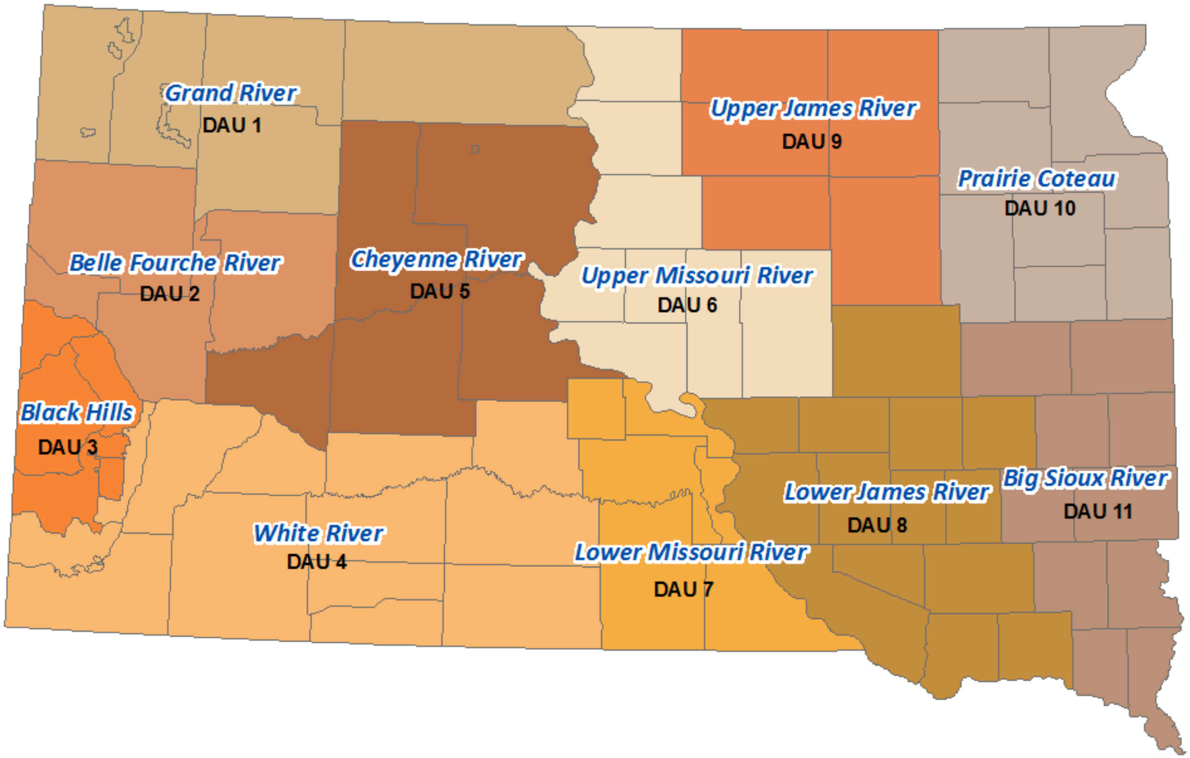



Figure 22. Data Analysis Units (DAUs) for deer management in South Dakota.

**Harvest Surveys**

Regulated deer harvest is the primary tool available to manage deer population abundance. Because white-tailed deer are relatively abundant across the entire state and mule deer are abundant in the western half of the state, numerous opportunities to harvest deer exist in South Dakota. There are currently a variety of deer hunting opportunities and a number of license types that a hunter can choose from when applying for a deer license.

Beginning in the 1950s, each hunter was provided a card to fill out with information on their harvest success to be mailed to state biologists (Richardson and Petersen 1974). Hunters submitted information on species, gender, and age of each deer harvested, as well as days hunted. In the Prairie regions about 55-66% of hunters returned cards compared to only one-third of hunters in the Black Hills. A study in 1972 indicated that hunters in the Prairie regions that did not return cards were only 70-75% as successful as those that did return cards while Black Hills non-reporters were thought to be only half as successful. Beginning in 1987, only a subsample of hunters were sent hunter report cards on harvest success (Hauk 1989).

Beginning in 1977 and continuing through the present, comprehensive reports of deer management surveys have been prepared that detail the success of hunters as a gauge of population levels. When combined with deer license data, researchers use the information provided in hunter report cards to determine hunter success, the distribution of harvest by area and time, and the species and gender composition of the deer harvested in each hunting unit (Schroeder 1979). Total state harvests for 1959-2015 are available and ranged from 17,233

(1960) to 94,726 (2010; McPhillips 1989, Huxoll 2014). In the East River region the species ratios of harvested deer from 1963-73 was 97% white-tailed deer and 3% mule deer, while in West River and Black Hills regions about 75% were white-tailed deer and 25% mule deer (Richardson and Petersen 1974).

Beginning with the 1990 report (McPhillips and Rice 1991a) narratives by state and regional big game biologists were added to the comprehensive reports describing the current year's harvest in relation to recent regional population trends and survival, the severity of the previous winter, any non-harvest mortality events (disease, drought), and any anticipated adjustments to the next season's license numbers to address population changes.

Current hunting seasons include Firearms (Black Hills, West River, and East River), Special Buck (West River and East River), Landowner-own-land (West River and East River), Archery, Muzzleloader, Youth, Mentored Youth, Refuge Deer, and Custer State Park seasons. In most situations, hunters may apply for a license in each of these seasons within the same year. There may also be an opportunity to purchase additional licenses from seasons with leftover licenses or unlimited license. All firearm deer licenses are limited in number and issued via a lottery drawing. Firearm hunters can apply and purchase one license from the first or second drawing, up to five licenses in the third drawing, and an unlimited number of leftover licenses after the third drawing.

Each deer hunting season has a different assortment of license types available which determines the available tag distribution. License types (Table 20) define the type and number of deer tags available for a respective license. This provides wildlife managers with the ability to manipulate deer harvest to target specific portions of the deer population for more intensive harvest methods if necessary. One preference point can be purchased for any limited draw season per year if a hunter is unsuccessful at obtaining a first choice license for that season, or if a hunter chooses only to apply for a preference point.

Random samples of deer license holders are selected to receive surveys using a modified Tailored Design Method (Dillman et al. 2014) using a ±5% sampling error at a 95% confidence interval. Sampling takes place at the hunting unit level for the majority of seasons unless units within the season overlap geographically. Surveys are administered using a mixed mode approach including both internet and mail surveys in order to obtain the number of hunting recreation days, species, gender and age (adult/fawn) of deer harvested, type of land hunted, geographic location of harvest, and hunter satisfaction.

All randomly selected license holders who list an email in their licensing profile receive an email at the end of the season followed by two reminder emails over a 2-week period. License holders that do not list an email and those that do not respond to the email survey are sent paper surveys followed by two or three subsequent mailings at 12-14 day intervals in order to maximize response rate and precision by limiting non-response bias.

Table 20. Deer license types currently offered in South Dakota deer hunting seasons.

| Current License Type | License Description |
|---|---|
| 01 | “any deer” |
| 03 | “any antlerless deer” |
| 06 | “any deer” and 2 “any antlerless deer” |
| 07 | 3 “any antlerless deer” |
| 08 | “any deer” and “any antlerless deer” |
| 09 | “any antlerless deer” and “any antlerless deer” |
| 11 | “any whitetail” |
| 13 | “antlerless whitetail” |
| 16 | “any whitetail” and 2 “antlerless whitetail” |
| 17 | 3 “antlerless whitetail” |
| 18 | “any whitetail” and “antlerless whitetail” |
| 19 | “antlerless whitetail” and “antlerless whitetail” |

Responses to email surveys are given through a link to the Internet using Qualtrics survey software (www.Qualtrics.com). Postage paid survey cards are returned to the SDGFP office in Pierre, South Dakota, where the data are compiled and analyzed. Hunters may also report harvest information through the Department’s web site, which records answers directly to a database.

Returned hunter surveys are entered and summarized, and harvest statistics are generated as proportions of responding hunters for each unit. Proportional statistics from the sample are then accepted as representative of the unit population of hunters and extrapolated to the total number of hunters in that unit. Hunters in archery, youth, and muzzleloader seasons, which have statewide or regional units, are asked to list the management unit where each deer was harvested. Hunters who do not respond to the survey are included in the hunter population when estimating harvest statistics. The response rate goal has been established as 80 percent. Confidence intervals are calculated to monitor precision and accuracy.

Statewide Summary

In 2015, there were 49,881 limited draw resident deer licenses available plus unlimited licenses; 91,896 licenses were issued (Huxoll 2016). Nonresidents had 2,267 limited draw licenses (plus unlimited licenses) available; 7,440 were issued. Statewide, there were a total of 99,336 licenses sold that represented a total of 111,050 tags, an increase in 5,062 licenses and 6,586 tags from 2014 (Figure 23). No triple-tag licenses were offered for either the East or West River deer seasons in 2015. A total of 67,395 individual hunters were issued deer licenses in 2015, up from 64,064 in 2014.

Random samples were taken within each unit in each season unless the numbers of hunters were low enough that all were sampled to satisfy the statistical analyses. Response rates ranged from 71% for the Landowner West River survey to 92% for the Custer State Park survey (online only).

The projected statewide deer harvest was 52,589, a 13% increase from 2014 (Table 21, Figure 24). This estimate included 30,687 white-tailed bucks, 15,997 white-tailed does, 4,888 mule deer bucks and 1,017 mule deer does. An increase in overall harvest of over 6,000 deer with a moderate increase in the number of tags issued resulted in a 2% increase in harvest success from 2014.

Increases in buck harvest accounted for most of the increase from 2014, however, doe harvest also increased. Both white-tailed and mule deer doe harvest estimates increased from 2014 by 1,544 and 44 respectively. White-tailed and mule deer buck harvest increased from 2014 by 3,983 and 492 respectively. Mule deer made up approximately 11% of the total harvest.

The 2015 overall statewide tag harvest success increased slightly to 47% from 45% in 2014. Harvest success ranged from 24% for Waubay National Wildlife Refuge to 79% for West River Special Buck and Custer State Park.

Respondents reported hunting an average of 5.30 days per hunter, which projects to a statewide total of 526,636 recreation days in 2015. The average number of days hunted increased from 2014. That combined with an increase in license sales resulted in an increase of approximately 38,000 total days of recreation from 2014.

Average hunter satisfaction values (1=very dissatisfied to 7=very satisfied) varied between seasons and ranged from 4.06 at Waubay National Wildlife Refuge to 6.33 for Custer State Park.

Table 21. South Dakota deer license and harvest statistics, 2015.

| SOUTH DAKOTA Harvest Statistic | Season | Archery | Youth Antlerless | Mentored Youth | Muzzleloader | Landowner-own-land Antlerless | West River | West River Landowner-own-land | West River Special Buck Unit | East River | East River Landowner-own-land | East River Special Buck Unit | Sand Lake NWR | Lacreek NWR | Waubay NWR | Black Hills | Custer State Park | Grand Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Licenses/Tags*** | | | | | | | | | | | | | | | | | | |
| **Resident Licenses** | | | | | | | | | | | | | | | | | | |
| Available | | Unlimited | Unlimited | Unlimited | Unlimited | 0 | 18,060 | Unlimited | 500 | 26,825 | Unlimited | 556 | 150 | 30 | 30 | 3,700 | 30 | 49,881 |
| **Sold** | | 23,507 | 4,754 | 3,646 | 3,303 | 0 | 17,671 | 2,248 | 498 | 25,916 | 5,816 | 555 | 152 | 30 | 30 | 3,741 | 29 | 91,896 |
| **Resident Tags** | | | | | | | | | | | | | | | | | | |
| Available | | Unlimited | Unlimited | Unlimited | Unlimited | 0 | 19,680 | Unlimited | 500 | 31,925 | Unlimited | 556 | 150 | 30 | 30 | 3,700 | 30 | 56,601 |
| **Sold** | | 23,507 | 4,754 | 3,646 | 3,303 | 0 | 19,267 | 3,640 | 498 | 30,485 | 9,380 | 555 | 152 | 30 | 30 | 3,741 | 29 | 103,017 |
| **Nonresident Licenses** | | | | | | | | | | | | | | | | | | |
| Available | | Unlimited | Unlimited | N/A | Unlimited | N/A | 1,449 | N/A | 500 | Leftovers | N/A | N/A | 15 | 4 | 3 | 296 | N/A | 2,267 |
| **Sold** | | 3,180 | 577 | N/A | 143 | N/A | 1,894 | N/A | 500 | 836 | N/A | N/A | 13 | 0 | 3 | 294 | N/A | 7,440 |
| **Nonresident Tags** | | | | | | | | | | | | | | | | | | |
| Available | | Unlimited | Unlimited | N/A | Unlimited | N/A | 1,579 | N/A | 500 | Leftovers | N/A | N/A | 15 | 4 | 3 | 296 | N/A | 2,397 |
| **Sold** | | 3,180 | 577 | N/A | 143 | N/A | 2,047 | N/A | 500 | 1,276 | N/A | N/A | 13 | 0 | 3 | 294 | N/A | 8,033 |
| **Total Licenses** | | | | | | | | | | | | | | | | | | |
| Available | | Unlimited | Unlimited | Unlimited | Unlimited | 0 | 19,509 | Unlimited | 1,000 | 26,825 | Unlimited | 556 | 165 | 34 | 33 | 3,996 | 30 | 52,148 |
| **Sold** | | 26,687 | 5,331 | 3,646 | 3,446 | 0 | 19,565 | 2,248 | 998 | 26,752 | 5,816 | 555 | 165 | 30 | 33 | 4,035 | 29 | 99,336 |
| **Total Tags** | | | | | | | | | | | | | | | | | | |
| Available | | Unlimited | Unlimited | Unlimited | Unlimited | 0 | 21,259 | Unlimited | 1,000 | 31,925 | Unlimited | 556 | 165 | 34 | 33 | 3,996 | 30 | 58,998 |
| **Sold** | | 26,687 | 5,331 | 3,646 | 3,446 | 0 | 21,314 | 3,640 | 998 | 31,761 | 9,380 | 555 | 165 | 30 | 33 | 4,035 | 29 | 111,050 |
| **Hunters** | | 21,803 | 5,331 | 3,646 | 3,389 | 0 | 18,515 | 2,248 | 998 | 25,975 | 5,816 | 555 | 165 | 30 | 33 | 4,035 | 29 | 67,395 |
| ***Recreation*** | | | | | | | | | | | | | | | | | | |
| Average Days Hunted | | 11.24 | 4.54 | 3.96 | 4.03 | | 3.12 | 3.76 | 3.38 | 4.15 | 4.55 | 4.95 | 2.89 | 2.71 | 2.10 | 4.61 | 2.88 | 5.30 |
| Total Days Hunted | | 245,077 | 24,201 | 14,449 | 13,661 | 0 | 57,754 | 8,457 | 3,374 | 111,125 | 26,490 | 2,748 | 477 | 81 | 69 | 18,589 | 83 | 526,636 |
| Mean Satisfaction Score | | 5.14 | 5.59 | 5.89 | 4.76 | | 5.27 | 5.26 | 5.72 | 4.97 | 5.02 | 5.32 | 4.75 | 4.33 | 4.06 | 5.75 | 6.33 | |

| SOUTH DAKOTA Harvest Statistic | Season | Archery | Youth Antlerless | Mentored Youth | Muzzleloader | Landowner-own-land Antlerless | West River | West River Landowner-own-land | West River Special Buck Unit | East River | East River Landowner-own-land | East River Special Buck Unit | Sand Lake NWR | Lacreek NWR | Waubay NWR | Black Hills | Custer State Park | Grand Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Harvest*** | | | | | | | | | | | | | | | | | | |
| **White-tailed Deer** | | | | | | | | | | | | | | | | | | |
| Bucks | | 5,043 | 329 | 261 | 313 | | 7,739 | 958 | 394 | 10,041 | 2,687 | 332 | 30 | 12 | 7 | 2,533 | 8 | 30,687 |
| Does | | 1,593 | 2,137 | 1,557 | 529 | | 2,367 | 135 | 20 | 6,413 | 908 | 8 | 9 | 0 | 1 | 307 | 15 | 15,997 |
| **Total** | | 6,635 | 2,466 | 1,818 | 842 | 0 | 10,106 | 1,092 | 414 | 16,454 | 3,595 | 340 | 39 | 12 | 8 | 2,840 | 23 | 46,684 |
| **Mule Deer** | | | | | | | | | | | | | | | | | | |
| Bucks | | 632 | 33 | 25 | 77 | | 2,804 | 504 | 365 | 245 | 103 | 21 | 5 | 0 | 0 | 74 | 0 | 4,888 |
| Does | | 73 | 333 | 243 | 16 | | 181 | 58 | 5 | 59 | 43 | 2 | 1 | 0 | 0 | 2 | 0 | 1,017 |
| **Total** | | 704 | 365 | 268 | 93 | 0 | 2,985 | 562 | 370 | 305 | 146 | 24 | 6 | 0 | 0 | 76 | 0 | 5,905 |
| **Total Deer Harvest** | | | | | | | | | | | | | | | | | | |
| Bucks | | 5,674 | 362 | 287 | 390 | 0 | 10,543 | 1,462 | 759 | 10,287 | 2,790 | 353 | 35 | 12 | 7 | 2,607 | 8 | 35,575 |
| Does | | 1,665 | 2,469 | 1,799 | 545 | 0 | 2,548 | 193 | 24 | 6,472 | 951 | 11 | 10 | 0 | 1 | 309 | 15 | 17,014 |
| **Total** | | **7,340** | **2,831** | **2,086** | **935** | **0** | **13,091** | **1,654** | **783** | **16,759** | **3,741** | **364** | **45** | **12** | **8** | **2,917** | **23** | **52,589** |
| **Success** | | 28% | 53% | 57% | 27% | | 61% | 45% | 79% | 53% | 40% | 66% | 27% | 40% | 24% | 72% | 79% | 47% |

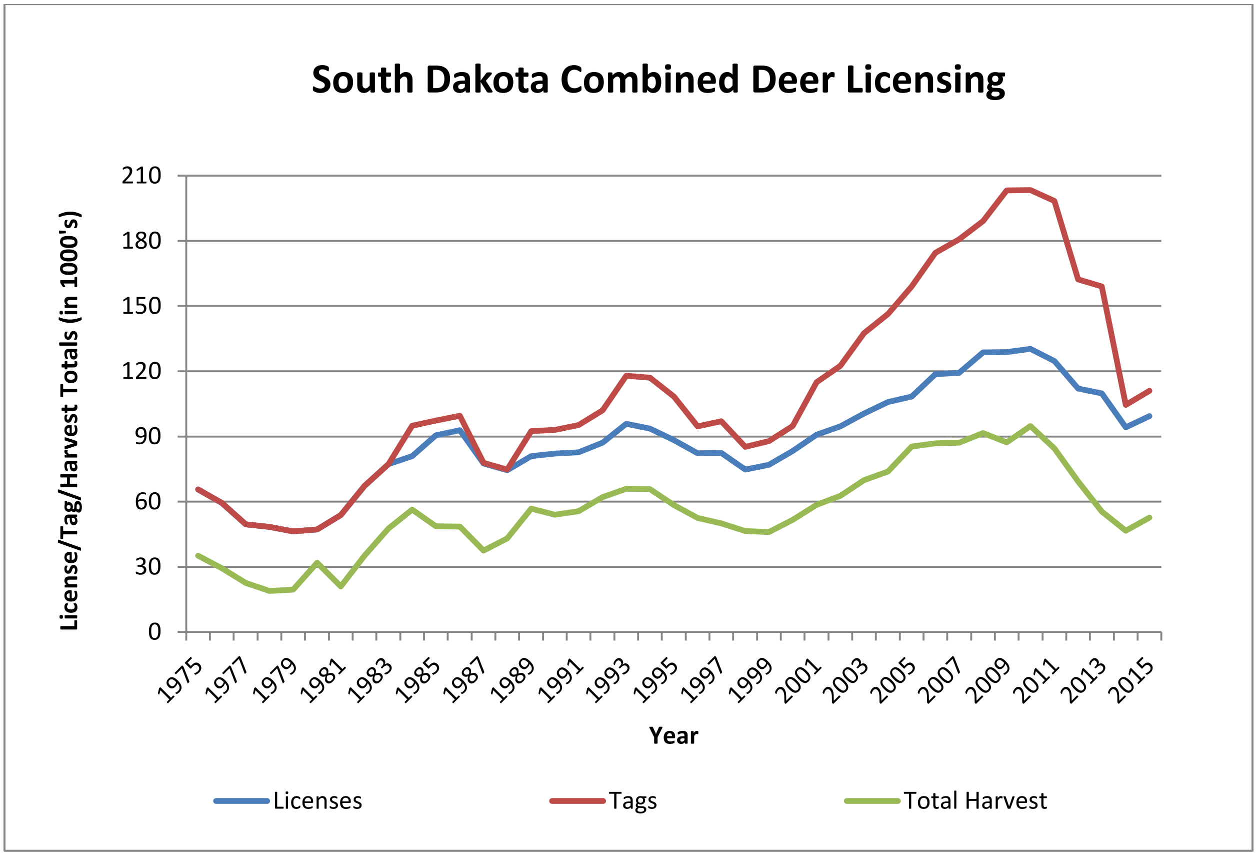



Figure 23. Deer license sales and harvest, 1975-2015.

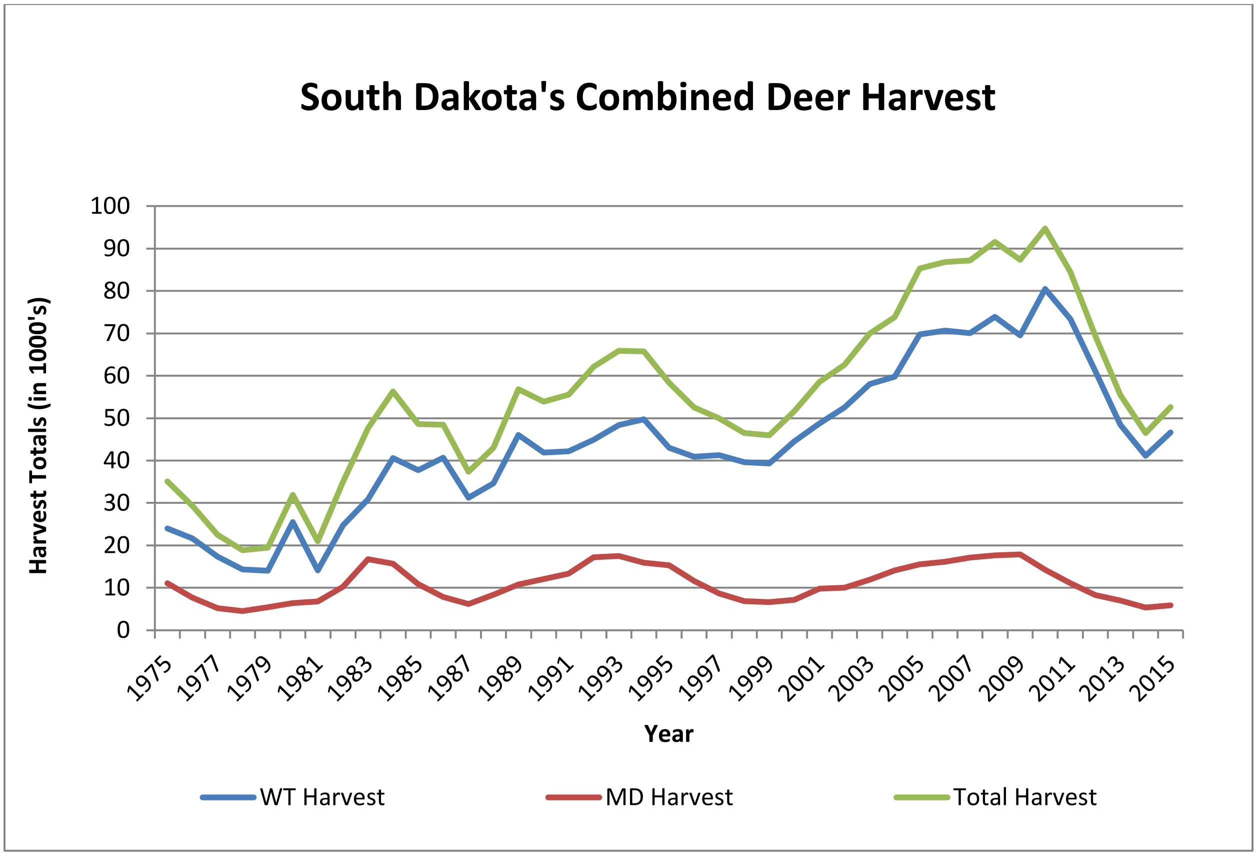



Figure 24. Estimated deer harvest by species, 1975-2015.

<u>Custer State Park Deer</u>

The Custer State Park (CSP) firearm season dates were November 5-18 in 2016. Only resident hunters who have not received a CSP "buck" or "any deer" license in the preceding nine years are able to apply for the "any whitetail" deer license for this season. Applicants who receive an "any deer", or "any whitetail" deer, licenses as their first choice may reapply in 10 years for their next "any deer", or "any whitetail" deer, license. Those who receive their "any deer" or "any whitetail" CSP license in the second drawing are able to keep their eligibility for next year's draw. Residents may apply for muzzleloader antlerless licenses in CSP each year. CSP was closed to archery hunting in 2016. Currently the license types include "any whitetail" deer and "antlerless whitetail" deer (muzzleloader only).

All 2015 license holders that provided an email address when they applied for their license were surveyed by email and 24 were returned for a 92% return rate. Those responding to the survey reported hunting an average of 2.88 days, which projected to 84 recreation days for the season.

The harvest projection for the 2015 CSP deer season was 23 deer (8 adult white-tailed bucks, 14 adult white-tailed does, and 1 fawn white-tailed doe). The overall season harvest success rate was 79% (Table 22).

Table 22. Summary of Custer State Park deer seasons, 2011-2015.

| | | | Bucks | | Does | | | | Avg Days |
|---|---|---|---|---|---|---|---|---|---|
| **Year** | **Apps** | **Licenses** | **WT** | **MD** | **WT** | **MD** | **Total** | **Success** | **Hunted** |
| 2011 | 1,831 | 47 | 10 | 2 | 23 | 0 | 35 | 88% | 2.6 |
| 2012 | 1,825 | 12 | 10 | 1 | 0 | 0 | 11 | 92% | 3.5 |
| 2013 | 1,474 | 30 | 7 | 0 | 17 | 0 | 24 | 80% | 3.3 |
| 2014 | 1,755 | 30 | 8 | 0 | 13 | 0 | 21 | 68% | 2.2 |
| 2015 | 1,866 | 29 | 8 | 0 | 15 | 0 | 23 | 79% | 2.9 |

<u>Mentored Youth Deer</u>
Mentored Youth seasons in 2016 were the second Saturday of September to January 15, 2017. The Mentored Youth season has unlimited (resident only) antlerless deer licenses available. This season encourages resident hunters to mentor young hunters (10 to 16 years of age) in their early hunting years. The adult mentor must be unarmed during the hunt, 18 years of age or older, and have successfully completed a hunter safety or hunter education course. The "any antlerless" deer license is valid during the Mentored Youth Deer season and is open statewide.

There were 3,646 resident single-tag antlerless Mentored Youth Deer licenses issued for 2015. All mentors/hunters were surveyed and 2,688 responses (77%) were received. Approximately 72% of responding mentors/hunters used the Internet to respond. Respondents reported hunting an average of 3.96 days each, which projected to 14,438 recreation days for the season.

Projections for the season indicated that a total of 261 white-tailed bucks (without antlers), 1,556 white-tailed does, 25 mule deer bucks (without antlers), and 243 mule deer does were harvested. The total harvest for the Mentored Youth Deer season was 2,086, and the overall success rate was 57% (Table 23, Figure 25). The five deer management units with the highest reported harvest were the Black Hills, Minnehaha, Brown, Brookings, and Yankton.

The average satisfaction rating for those responding (1 being very dissatisfied and 7 very satisfied) was 5.89.

Table 23. Summary for the Mentored Youth Deer hunting seasons, 2011-2015.

| Year | Licenses Sold | Bucks WT | Bucks MD | Does WT | Does MD | Total | Success | Avg Days Hunted | Average Satisfaction |
|---|---|---|---|---|---|---|---|---|---|
| 2011 | 2,335 | 143 | 14 | 872 | 171 | 1,200 | 51% | 4.16 | 5.70 |
| 2012 | 2,497 | 207 | 28 | 1,015 | 182 | 1,431 | 57% | 3.77 | 5.78 |
| 2013 | 2,939 | 179 | 14 | 1,028 | 154 | 1,375 | 47% | 3.87 | 5.57 |
| 2014 | 3,096 | 214 | 29 | 1,187 | 167 | 1,595 | 52% | 3.98 | 5.70 |
| 2015 | 3,646 | 261 | 25 | 1,556 | 243 | 2,086 | 57% | 3.96 | 5.89 |

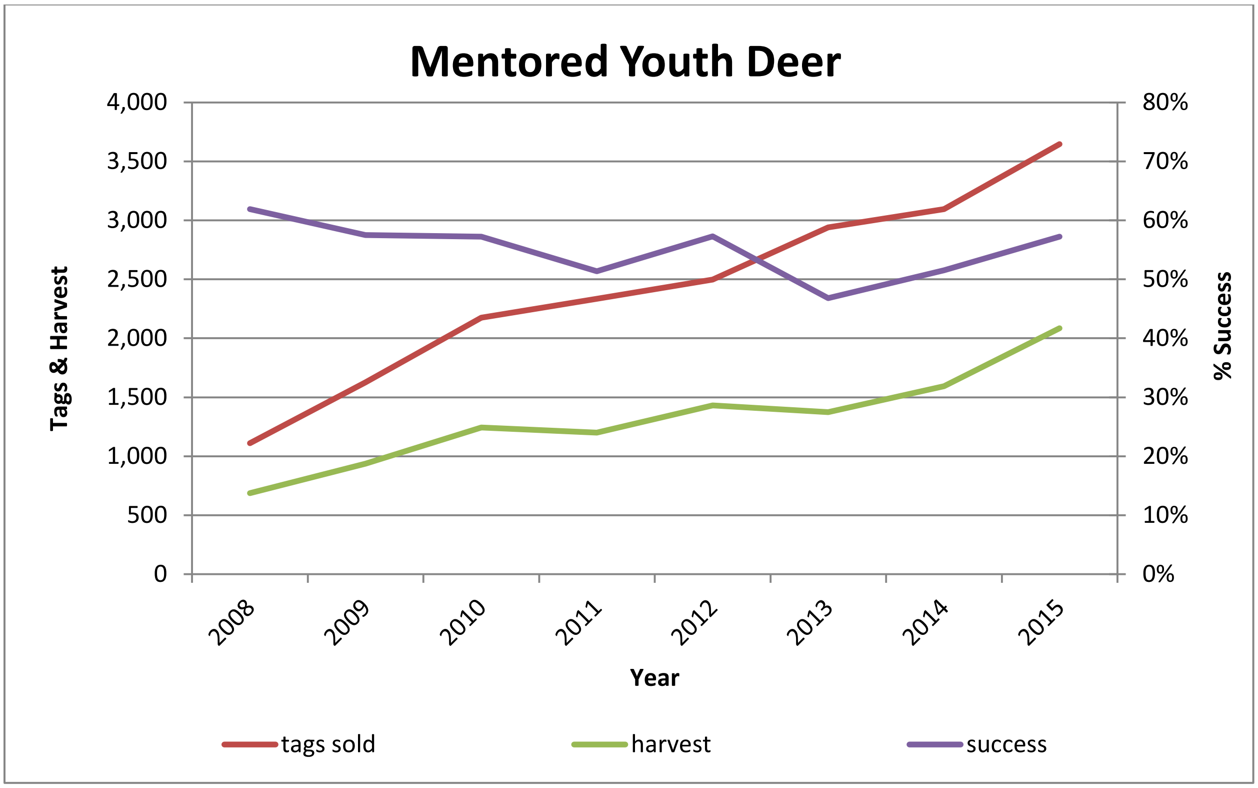



Figure 25. Mentored Youth Deer license sales and harvest, 2008-2015.

Youth Deer

Youth Deer season in 2016 was from the second Saturday of September to January 15, 2017. Unlimited statewide youth (resident and nonresident) antlerless deer licenses were available. Youth that were at least 12 years old on December 31, 2016 and were younger than 18 years old on June 30, 2016, and had attended a gun safety course, were eligible to purchase an "any antlerless" deer license for the statewide unit. If the youth hunts with an adult, the adult must be unarmed (unless the adult has a firearm big game license valid for the same area and time of year as the youth hunter, or the adult is carrying a pistol and possesses a valid concealed pistol permit). There is no deadline to apply for this season.

There were 5,331 single-tag antlerless licenses issued for the 2015 Youth Deer hunting season (4,754 residents, 577 nonresidents). Approximately 75% of hunters were sampled and 2,951 responses (74%) were received. Approximately 59% of responding hunters used the Internet to respond. Respondents reported hunting an average of 4.54 days each, which projected to 24,203 recreation days for the season.

Projections for the 2015 season indicated that a total of 329 white-tailed bucks, 2,137 white-tailed does, 33 mule deer bucks, and 333 mule deer does were harvested. The estimated total harvest for the Youth Deer season was 2,831, and the overall success rate was 53% (Table 24, Figure 26). The five deer management units with the highest reported harvest were the Black Hills, Minnehaha, Brown, Brookings, and Roberts, which accounted for 22% of the total youth season harvest.

The average satisfaction rating for those responding (1 being very dissatisfied and 7 very satisfied) was 5.59.

Table 24. Summary of the Youth Deer hunting seasons, 2011-2015.

| | Licenses | Bucks | | Does | | | | Avg Days | Average |
|---|---|---|---|---|---|---|---|---|---|
| **Year** | **Sold** | **WT** | **MD** | **WT** | **MD** | **Total** | **Success** | **Hunted** | **Satisfaction** |
| 2011 | 7,033 | 339 | 43 | 2,349 | 322 | 3,053 | 43% | 5.58 | 5.02 |
| 2012 | 6,110 | 321 | 33 | 2,387 | 305 | 3,046 | 50% | 4.87 | 5.32 |
| 2013 | 5,548 | 346 | 32 | 1,756 | 344 | 2,477 | 45% | 4.64 | 5.23 |
| 2014 | 5,038 | 317 | 37 | 1,924 | 287 | 2,565 | 51% | 4.61 | 5.47 |
| 2015 | 5,331 | 329 | 33 | 2,137 | 333 | 2,831 | 53% | 4.54 | 5.59 |

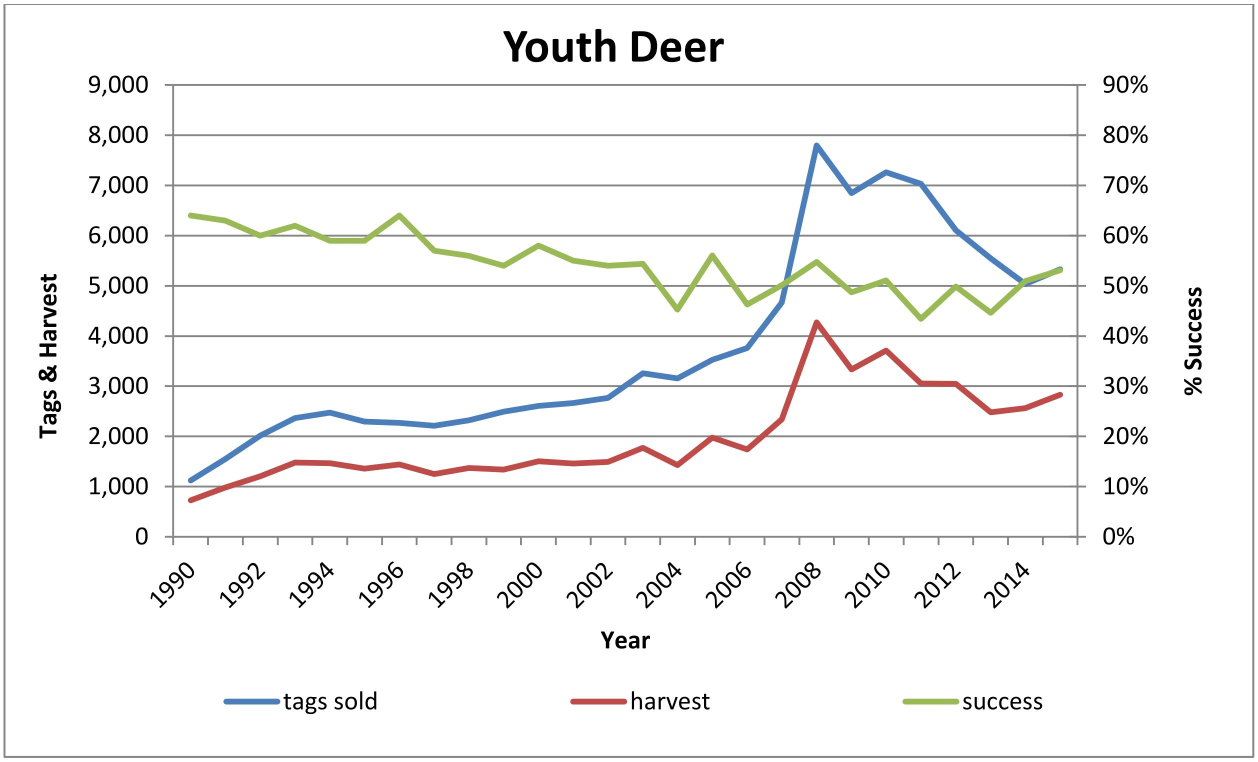



Figure 26.  Youth Deer season license sales and harvest, 1990-2015.

<u>Archery Deer</u>

The Archery Deer season in 2016 was open from the third Saturday of September (Sept 24) to January 15.  Only antlerless licenses were valid from January 1-15.  Unlimited resident and nonresident "any deer" licenses were available, with hunters being eligible to purchase one statewide license or one West River license and one East River license.  Unlimited antlerless white-tailed deer licenses were also available, with hunters being able to purchase only one antlerless license.  Several units were closed to antlerless harvest (Figure 27).

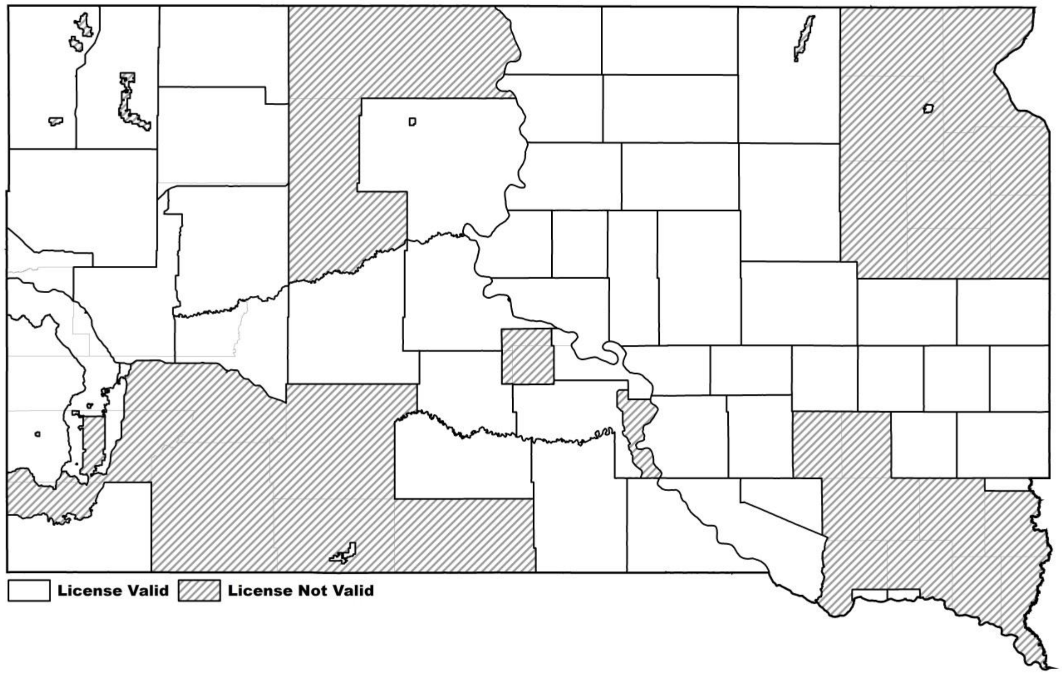



Figure 27. Archery antlerless (Unit LM1), 2016. Antlerless tags not valid in shaded portions of the map.

There were 26,687 Archery Deer licenses issued in 2015 (23,507 resident, 3,180 nonresident) for a total of 26,687 tags. All were single any-deer tags or single antlerless whitetail tags for the Statewide, LM1 (Limited Statewide), East River or West River units.

A random sample of 6,558 hunters were surveyed and 5,005 responded for a 77% return rate. Approximately 67% of responding hunters used the Internet to respond. Respondents reported hunting 11.24 days per hunter, which projects to a total of 245,066 recreation days for the season.

The projected harvest for the 2015 archery season was 7,340 deer (5,042 white-tailed bucks, 1,593 white-tailed does, 632 mule deer bucks, and 73 mule deer does). The success rate for the season was 28% (Table 25, Figure 28). The six deer management units with the highest reported harvest were the Black Hills, Brown, Minnehaha, Beadle, Brookings, and SW Butte/Lawrence, accounting for approximately 21% of all archery season harvest.

Satisfaction was also measured (1=very dissatisfied to 7=very satisfied) and the average satisfaction rating for this season was 5.14.

Table 25. Summary of the Archery Deer seasons, 2011-2015.

| Year | Licenses Sold Res | Licenses Sold Nonres | Bucks WT | Bucks MD | Does WT | Does MD | Total | Tag Success | Ave Days Hunted | Average Satisfaction |
|---|---|---|---|---|---|---|---|---|---|---|
| 2011 | 24,681 | 3.386 | 4,216 | 459 | 3,534 | 193 | 8,401 | 27% | 12.51 | 4.86 |
| 2012 | 25,100 | 3,128 | 4,086 | 379 | 3,264 | 137 | 7,866 | 26% | 11.78 | 4.86 |
| 2013 | 24,315 | 3,036 | 3,875 | 424 | 2,585 | 141 | 7,025 | 24% | 11.11 | 4.76 |
| 2014 | 21,647 | 2,840 | 3,948 | 562 | 1,459 | 83 | 6,052 | 25% | 10.80 | 4.97 |
| 2015 | 23,507 | 3,180 | 5,042 | 632 | 1,593 | 73 | 7,340 | 28% | 11.24 | 5.14 |

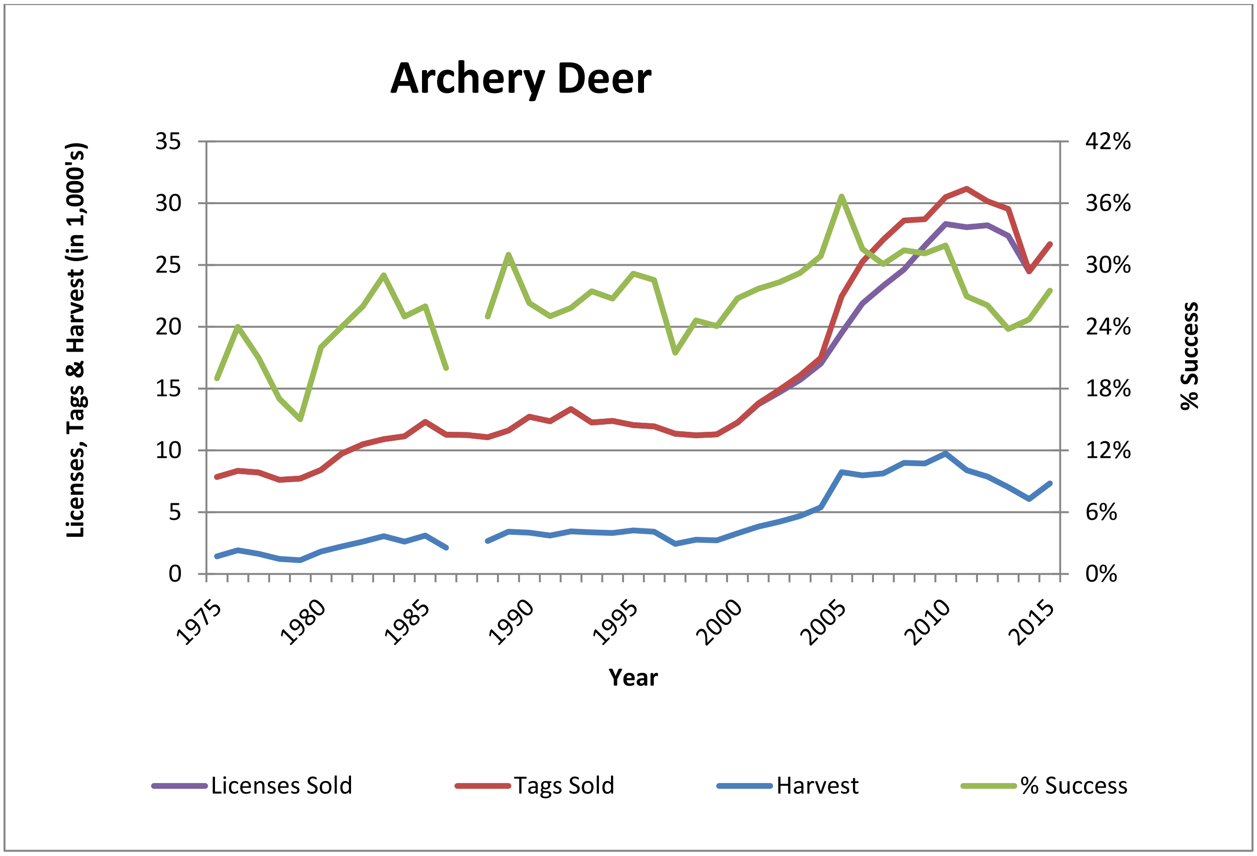



Figure 28. Archery Deer license sales and harvest, 1975-2015 (Harvest and success data missing from 1987 and 1988).

Muzzleloader Deer

The Muzzleloader Deer season was open from December 1, 2016 to January 15, 2017. Only antlerless licenses were valid from January 1-15. Unlimited resident and nonresident antlerless white-tailed deer licenses were available in the LM1 unit (Figure 29). Licenses for buck harvest were limited to 1,000 resident statewide “any deer” licenses. Hunters are allowed two

Muzzleloader Deer licenses of which only one can be an “antlerless white-tailed” deer license. The two license types available in the Muzzleloader Deer season are “any deer” and “antlerless white-tailed” deer.

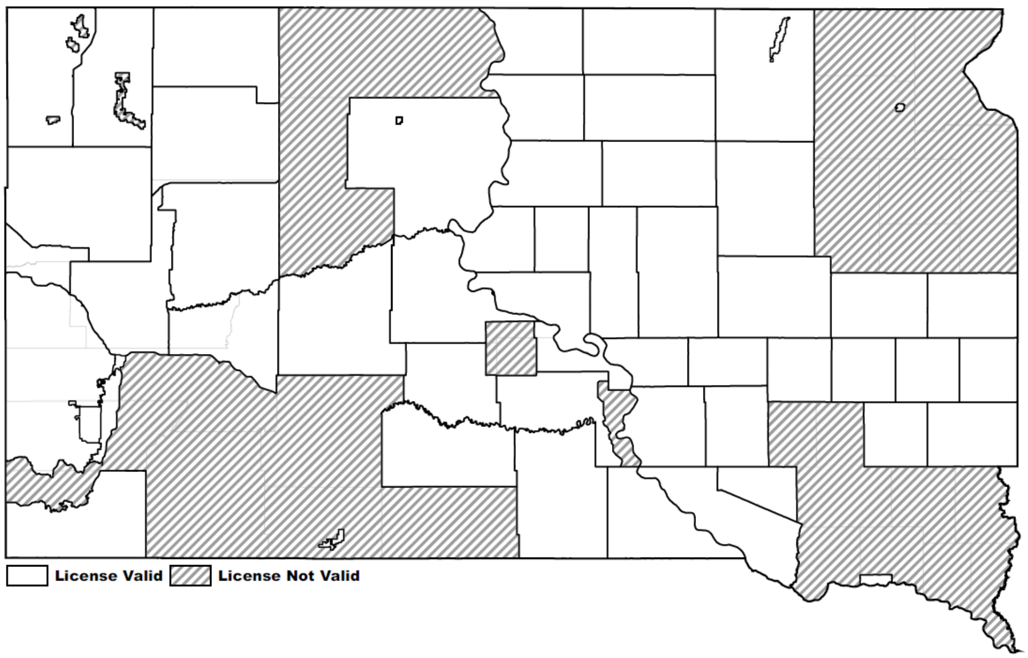



Figure 29. Muzzleloader antlerless (Unit LM1), 2016. Antlerless tags not valid in shaded portions of the map.

There were 2,433 antlerless deer licenses (2,290 residents, 143 nonresident) and 1,013 “any deer” licenses issued for the 2015 Muzzleloader Deer season, which represented a total of 3,446 tags. A sample of 3,363 hunters were surveyed and 2,624 responded for a response rate of 78 percent. Approximately 73% of muzzleloader hunters used the Internet to respond.

2015 marked the eleventh year that “any deer” licenses were available for the muzzleloader season with 6,892 applicants. The number of “any deer” licenses available increased from 400 to 1,000 in 2008. Respondents averaged 4.03 days of hunting for a projected total of 13,888 recreation days for the season.

The estimated harvest for the 2015 Muzzleloader season was 935 deer (313 white-tailed bucks, 539 white-tailed does, 77 mule deer bucks, and 16 mule deer does). The overall success rate for the muzzleloader season was 27% (Table 26, Figure 30) and average satisfaction was 4.76 (1 = very dissatisfied, 7 = very satisfied).

The six deer management units with the highest reported harvest were Brown, Gregory, Black Hills, SW Butte/Lawrence, Kingsbury, and Sanborn accounting for approximately 27% of the total season harvest.

Table 26. Summary of the Muzzleloader Deer seasons, 2011-2015.

| | Licenses Sold | | Bucks | | Does | | | | Ave Days | Average |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Res | Nonres | WT | MD | WT | MD | Total | Success | Hunted | Satisfaction |
| 2011 | 4,747 | 265 | 308 | 83 | 1,113 | 216 | 1,720 | 26% | 4.82 | 4.36 |
| 2012 | 4,856 | 288 | 433 | 115 | 1,218 | 211 | 1,977 | 29% | 4.51 | 4.75 |
| 2013 | 4,350 | 286 | 312 | 62 | 821 | 146 | 1,340 | 23% | 4.14 | 4.57 |
| 2014 | 3,073 | 140 | 235 | 85 | 498 | 11 | 829 | 26% | 3.79 | 4.58 |
| 2015 | 3,303 | 143 | 313 | 77 | 539 | 16 | 935 | 27% | 4.03 | 4.76 |

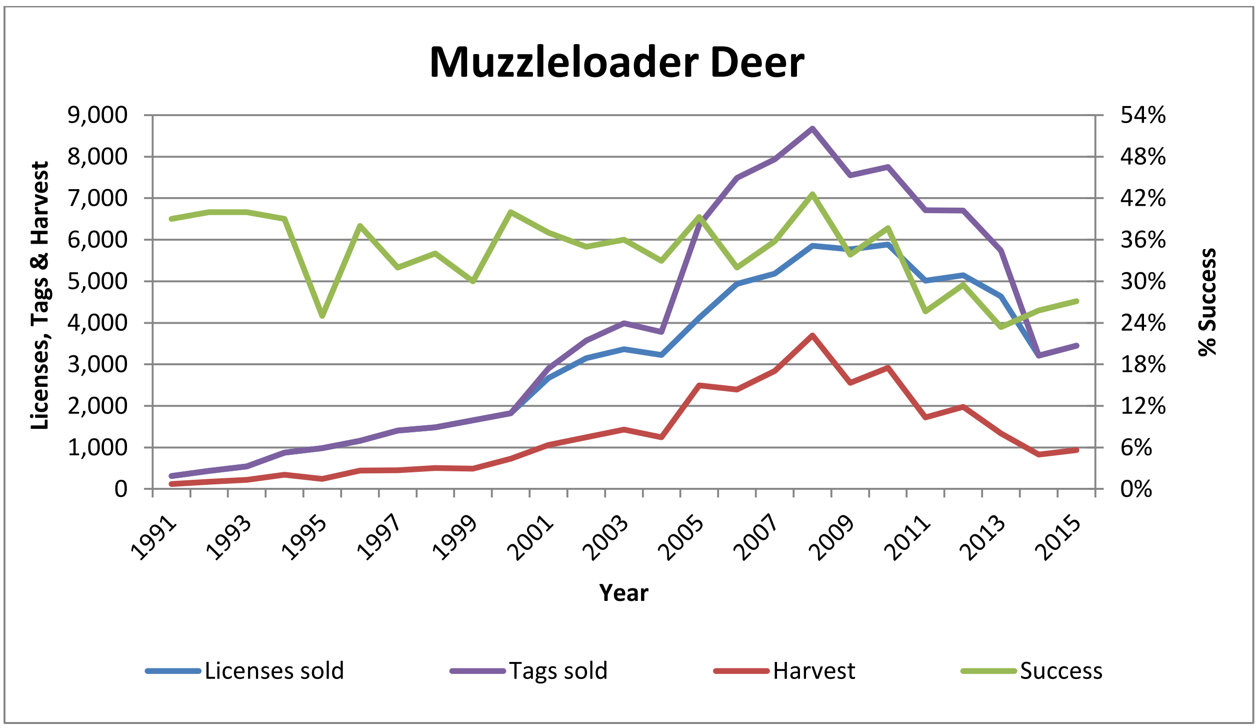



Figure 30. Muzzleloader Deer license sales and harvest, 1991-2015.

Black Hills Deer

The 2016 Black Hills firearm deer season was open the entire month of November, with 4,100 resident licenses and 328 nonresident licenses made available. The Black Hills Deer unit excludes CSP, Mount Rushmore National Memorial, Jewel Cave National Monument, and Wind

Cave National Park (Figure 31; BH1). License types included “any deer”, “any whitetail” and “antlerless whitetail”.

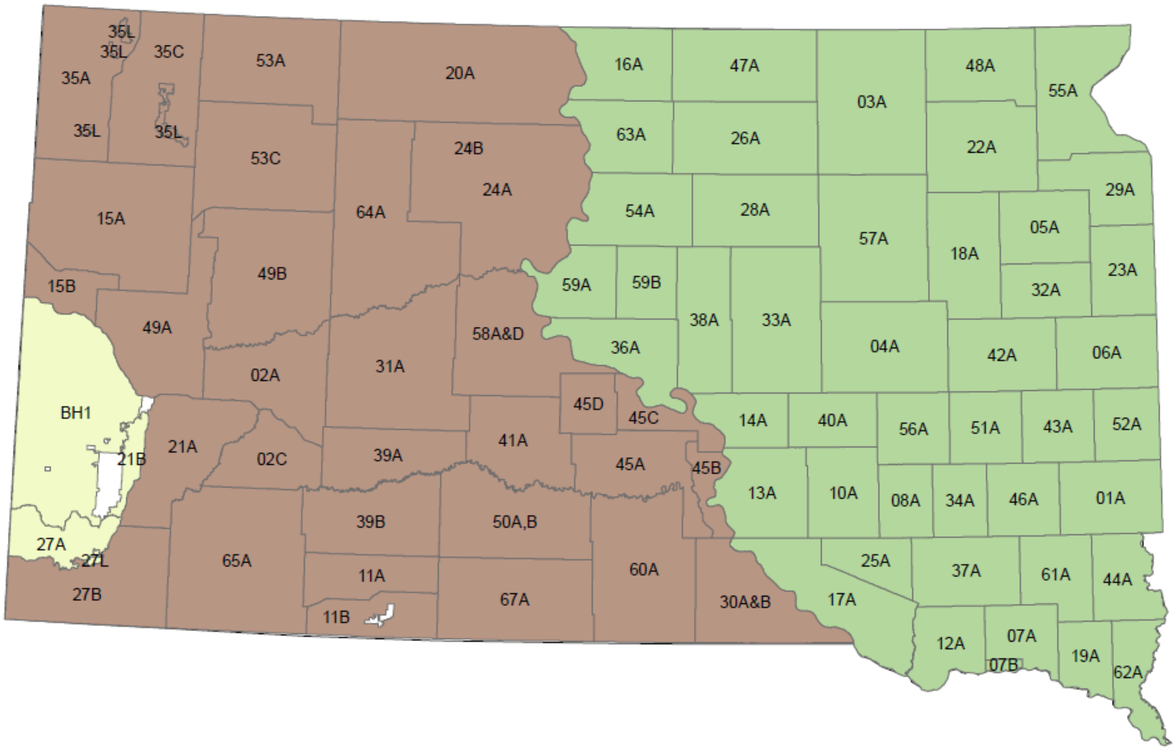



Figure 31. Black Hills (tan colored units on map), West River (brown), and East River (green) firearm management units, 2016.

There were 4,035 single-tag licenses issued for the 2015 Black Hills Deer season (3,741 residents, 294 nonresident).

A random sample of 1,255 hunters was taken (31% of license holders) and there were 1,033 responses for an 82% return rate. Approximately 74% of responses were received through the Internet. Those responding to the survey reported hunting an average of 4.61 days, which projected to 18,602 recreation days for the season. Of those responding, 6% stated they did not hunt at all during the season. The mean satisfaction rating was 5.75 on a scale ranging from 1 = “very dissatisfied” to 7 = “very satisfied”.

The harvest projection for the Black Hills Deer season was 2,917 deer (2,500 adult white-tailed bucks, 33 fawn white-tailed bucks, 292 adult white-tailed does, 15 fawn white-tailed does, 74 adult mule deer bucks, and 2 adult mule deer does. The overall season harvest success rate was 72% (Table 27, Figure 32).

Including the estimated Black Hills harvest of 1,079 deer from the Archery, Youth and Muzzleloader seasons, approximately 3,996 deer were harvested in the Black Hills proper.

Table 27. Harvest summaries for the Black Hills deer seasons, 2011-2015.

| | Licenses Sold | | Bucks | | Does | | | | Ave Days | Average |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Res | Nonres | WT | MD | WT | MD | Total | Success | Hunted | Satisfaction |
| 2011 | 4,137 | 329 | 2,011 | 107 | 401 | 10 | 2,530 | 57% | 4.78 | 4.89 |
| 2012 | 3,337 | 243 | 2,008 | 88 | 289 | 6 | 2,391 | 67% | 4.23 | 5.22 |
| 2013 | 3,330 | 261 | 1,912 | 62 | 318 | 2 | 2,294 | 64% | 4.68 | 5.27 |
| 2014 | 3,242 | 252 | 2,076 | 59 | 275 | 0 | 2,410 | 69% | 4.82 | 5.48 |
| 2015 | 3,741 | 294 | 2,533 | 74 | 307 | 2 | 2,917 | 72% | 4.61 | 5.75 |

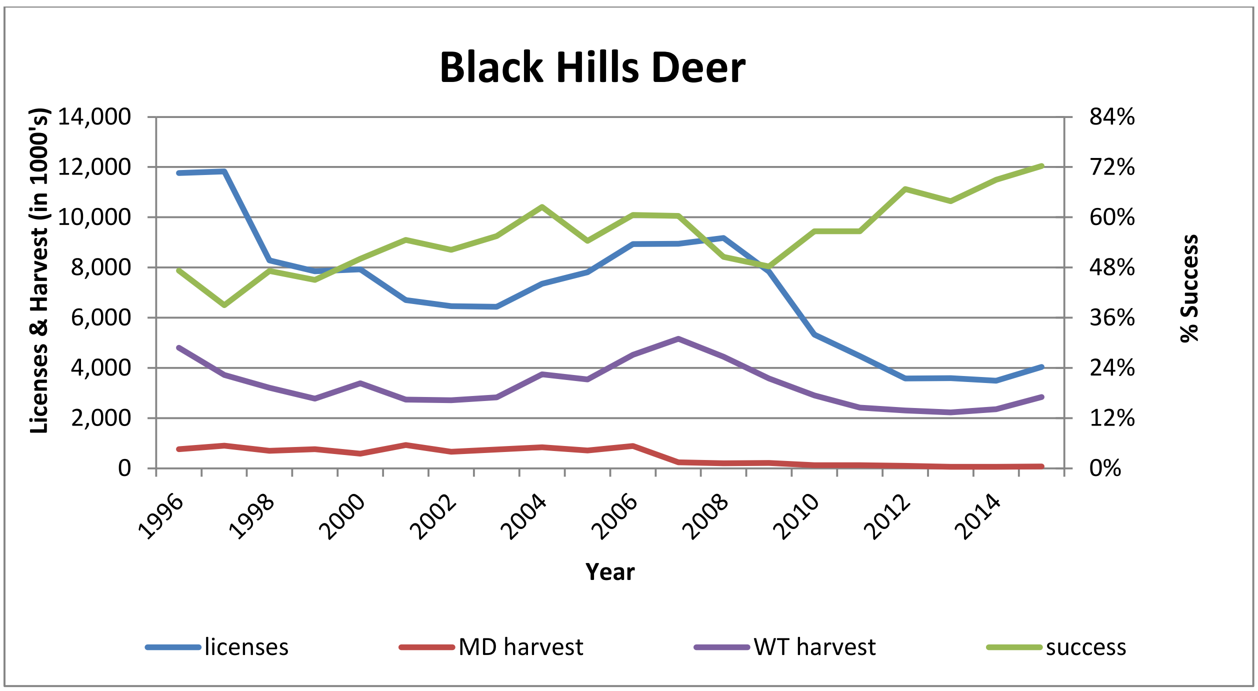



Figure 32. Black Hills deer season license sales and harvest, 1996-2015.

West River Firearm Deer

The West River firearm deer season in 2016 began on the Saturday 12 days prior to Thanksgiving and lasted 16 days (November 12-27) in most of the 38 management units excluding portions of Gregory and Mellette counties which were November 5-8 and 12-27. There were 19,765 resident licenses (25,185 tags) and 1,585 nonresident licenses (2,019 tags) available in the 2016 West River deer season. In addition, there were 500 resident and 500 nonresident West River Special Buck licenses, valid only on private land. License types available during the 2016 West River firearm season included “any deer”, “any whitetail”, “any whitetail and one antlerless whitetail”, single “antlerless whitetail”, and double “antlerless whitetail”.

There were 22,811 licenses issued for the 2015 West River firearm Deer season (19,565 regular, 998 Special Buck and 2,248 Landowner-own-land only) for a total of 25,952 tags.

In both West River and East River firearm deer seasons, there were unlimited half price Landowner-own-land licenses available. Landowners in some units were eligible for up to two single tag free antlerless licenses (Figure 33).

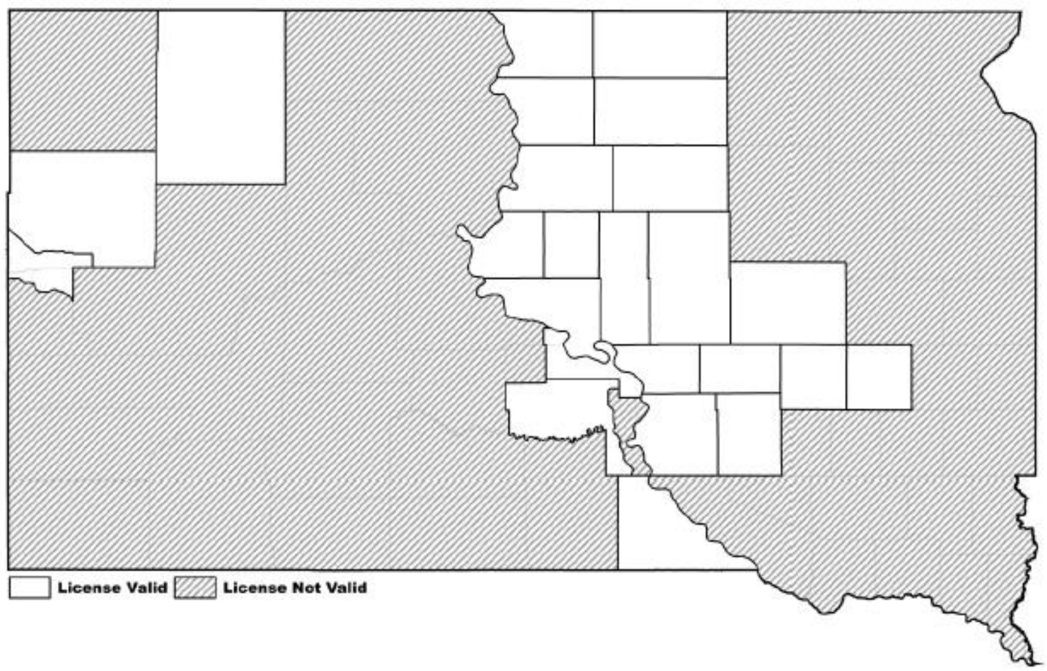



Figure 33. Free landowner antlerless units, 2016. No free licenses available in shaded portions of map.

A random sample of 8,790 hunters was taken from the regular West River season, 2,174 from the Landowner-own-land licenses, and 997 from the Special Buck licenses. Final response rates were 78% for regular West River deer, 71% for Landowner-own-land and 86% for Special Buck. Of all responding hunters, 71% of regular West River, 49% of Landowner-own-land and 78% of Special Buck hunters responded over the Internet.

Respondents reported hunting an average of 3.12 days during the regular West River season, 3.76 days on the landowner own land license and 3.38 days on the Special Buck license. These averages projected to a total of 69,585 recreation days for all West River firearm deer seasons.

The West River projected deer harvest was 13,091 for the regular season, 1,654 for Landowner-own-land, and 783 for the Special Buck licenses (Table 28, Figure 34). Success rates were 61% for the regular season, 45% for Landowner-own-land, and 79% for Special Buck.

The mean satisfaction rating for those responding to the regular West River season was 5.27 (1 being very dissatisfied and 7 very satisfied).

Table 28. Summary of the West River deer seasons (including Special Buck and Landowner-own-land), 2011-2015.

| | Licenses Sold | | | | Harvest | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Resident | | Nonres | | Bucks | | Does | | | Tag | Avg | Avg |
| Year | Lics | Tags | Lics | Tags | WT | MD | WT | MD | Total | Success | Days | Satis |
| 2011 | 25,917 | 57,091 | 3,978 | 8,645 | 11,139 | 4,456 | 12,301 | 3,901 | 31,797 | 48% | 3.64 | 5.00 |
| 2012 | 22,511 | 44,080 | 3,143 | 6,173 | 8,606 | 3,650 | 8,946 | 2,391 | 23,594 | 47% | 3.63 | 4.96 |
| 2013 | 22,422 | 44,118 | 3,216 | 6,257 | 7,749 | 3,358 | 5,785 | 1,678 | 18,570 | 37% | 3.56 | 4.46 |
| 2014 | 20,736 | 23,533 | 2,035 | 2,216 | 7,646 | 3,246 | 2,415 | 334 | 13,642 | 53% | 3.25 | 4.88 |
| 2015 | 20,417 | 23,405 | 2,394 | 2,547 | 9,091 | 3,673 | 2,521 | 246 | 15,528 | 60% | 3.12 | 5.27 |

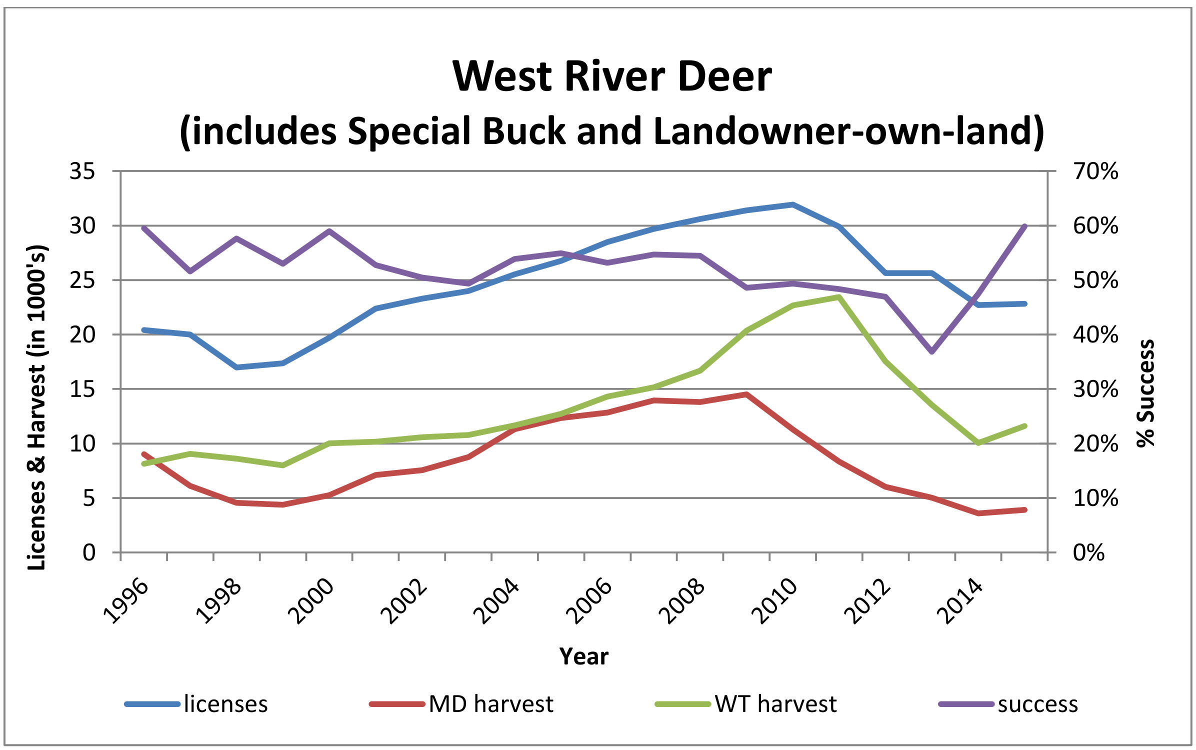



Figure 34. West River deer license sales and harvest, 1996-2015.

East River Firearm Deer

The 2016 East River firearm deer season began on the Saturday prior to Thanksgiving and was open for 16 consecutive days (November 19 – December 4), and an antlerless only season was also open for nine days beginning the Saturday following Christmas (December 31 – January 8). There were 31,048 resident licenses and 44,311 resident tags available in 49 management units in 2016, and an additional 549 resident East River Special Buck licenses. Non-resident hunters are only able to apply for unsold East River licenses within the third drawing which resulted in 759 non-resident licenses and 1,595 tags being distributed to non-residents. License types available included "any deer, "any antlerless" deer, "any deer" and one "any antlerless", two "any antlerless" deer, "any whitetail", "antlerless whitetail", "any whitetail" and one "antlerless whitetail", and two "antlerless whitetail".

In both West River and East River firearm deer seasons, there were unlimited half price Landowner-own-land licenses available. Landowners in some units were eligible for up to two single tag free antlerless licenses (Figure 33).

There were 33,123 licenses issued for the 2015 East River Firearm Deer season (26,752 regular, 555 Special Buck and 5,816 Landowner-own-land only) for a total of 41,696 tags.
A random sample of 12,555 hunters was taken from the regular East River season, 2,484 from the Landowner-own-land only licenses, and all 553 Special Buck hunters (2 were undeliverable). Final response rates were 79% for regular East River deer, 71% for Landowner-own-land and 84% for Special Buck. Of all responding hunters, 64% of regular East River, 49% of Landowner-own-land and 75% of Special Buck hunters responded over the Internet.

The 2015 East River projected deer harvest was 16,759 for the regular season, 3,741 for Landowner-own-land, and 364 for the Special Buck season. Success rates were 53% for the regular season, 40% for Landowner-own-land, and 66% for Special Buck. Success during the regular East River season for the "any deer and any antlerless deer" and "any whitetail and antlerless whitetail" license type was 60% (1st tag) and success for the 2nd (antlerless only) tag averaged 37 percent. Success for "any antlerless deer and any antlerless deer" and "antlerless whitetail and antlerless whitetail" license 1st tags was 54% and success for 2nd tags was 29%. No triple-tag licenses were available in 2015.

Respondents reported hunting an average of 4.15 days per hunter for the regular season, 4.55 days for Landowner-own-land and 4.95 days for Special Buck, resulting in a projected total of 140,363 recreation days for the entire East River season. Hunters reported harvesting approximately 95% of their deer during the regular season and 5% from December 26 - January 3 (Table 30).

The mean satisfaction score for those responding to the regular East River survey was 4.96, for the Landowner-own-land survey was 5.02, and for the Special Buck survey was 5.32 (1 = "very dissatisfied" and 7 = "very satisfied").

Table 29. Summary of the East River deer seasons (including Special Buck and Landowner-own-land), 2011-2015.

| | Licenses Sold | | | | Harvest | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Resident | | Nonresident | | Bucks | | Does | | Total | | Avg | Avg |
| Year | Lics | Tags | Lics | Tags | WT | MD | WT | MD | Harvest | Success | Days | Satis |
| 2011 | 45,589 | 75,512 | 1,950 | 4,461 | 14,970 | 502 | 19,401 | 513 | 35,386 | 44% | 4.73 | 4.51 |
| 2012 | 37,865 | 58,693 | 1,419 | 2,813 | 13,522 | 383 | 14,153 | 337 | 28,394 | 46% | 4.23 | 4.64 |
| 2013 | 37,137 | 56,030 | 1,366 | 2,715 | 10,733 | 278 | 10,592 | 256 | 21,858 | 37% | 4.44 | 4.19 |
| 2014 | 31,037 | 37,835 | 912 | 1,326 | 12,213 | 376 | 6,673 | 86 | 19,347 | 49% | 4.10 | 4.80 |
| 2015 | 32,287 | 40,420 | 836 | 1,276 | 13,060 | 369 | 7,331 | 104 | 20,866 | 50% | 4.15 | 4.96 |

Table 30. 2015 East River deer harvest by date.

| **2015 East River Deer harvest by date** | | | |
|---|---|---|---|
| | Total | Nov 22 - Dec 7 | Dec 27 - Jan 4 |
| Reports | 3,223 | 3,060 | 163 |
| Percent of total | | 95% | 5% |
| Projected | 16,759 | 15,911 | 848 |

| **2015 East River Deer antlerless harvest by date** | | | |
|---|---|---|---|
| | Total | Nov 22 - Dec 7 | Dec 27 - Jan 4 |
| Percent of total | | 88% | 12% |
| Projected | 7,080 | 6,232 | 848 |

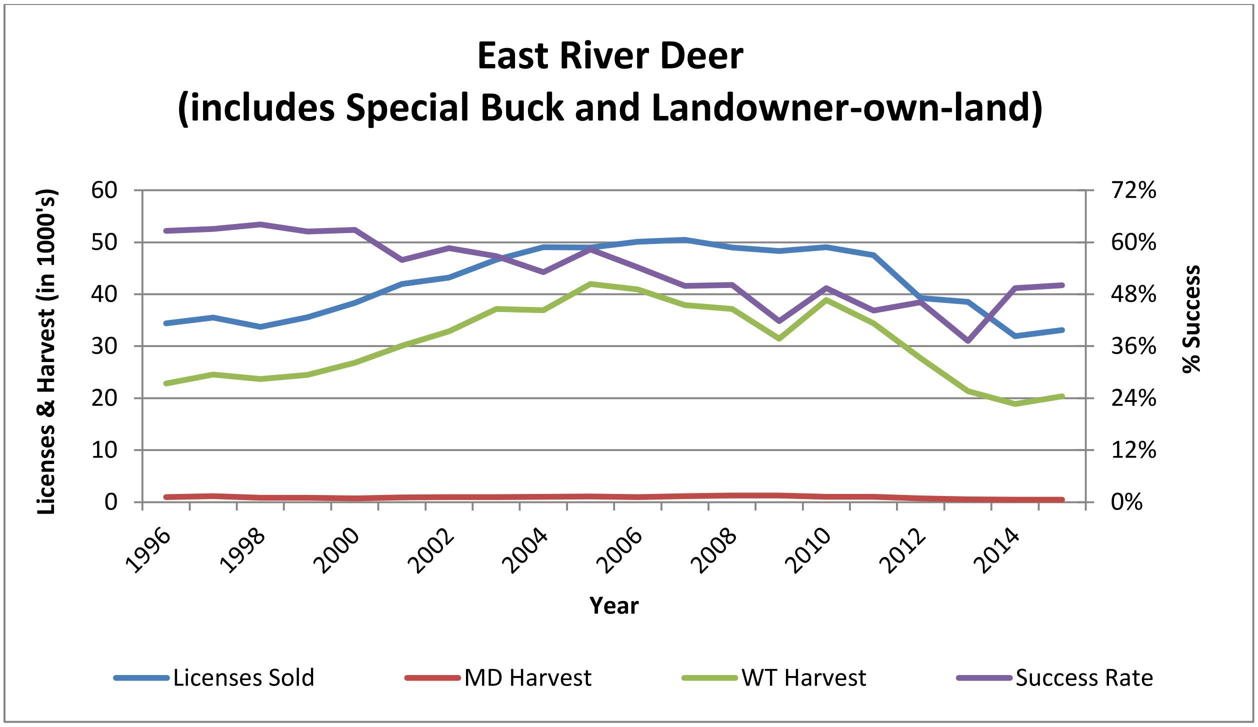



Figure 35. East River deer season license sales and harvest, 1996-2015.

<u>National Wildlife Refuge Deer</u>

Deer hunting is permitted in three USFWS National Wildlife Refuges in South Dakota - Sand Lake Refuge, Lacreek Refuge, and Waubay Refuge. Each refuge has several hunting intervals with specific numbers of licenses available. Each interval has different season dates and may be firearm, muzzleloader only, archery, or antlerless-only for certain time periods. Typical license types include "any deer", "any antlerless" deer, or "antlerless whitetail" deer.

There was a total of 232 licenses issued for the 2015 Wildlife Refuge Deer seasons, which included 165 at Sand Lake (152 residents and 13 nonresidents); 34 at Lacreek (30 residents and 4 nonresidents); and 33 at Waubay (30 residents and 3 nonresidents).

All license holders for each season were surveyed and response rates for Sand Lake, Lacreek, and Waubay refuges were 83 percent, 91 percent, and 88 percent, respectively. Approximately 70% of survey respondents did so through the Internet.

The seasons had different opening dates at each refuge. The average days hunted were 2.89 at Sand Lake, 2.71 at Lacreek and 2.10 at Waubay.

The reported harvest at the refuges consisted of only white-tailed deer. The projected harvest for Sand Lake was 39 bucks and 6 does, for Lacreek was 12 bucks and 0 does, and for Waubay was 8 bucks and 0 does. The projected success rate for Sand Lake was 27%, Lacreek was 35%, and Waubay was 24% (Table 31).

Table 31. Harvest summaries for the National Wildlife Refuge deer seasons, 2011-2015.

**Sand Lake National Wildlife Refuge**

| Year | Licenses | Bucks | Does | Success | Ave Days Hunted |
|---|---|---|---|---|---|
| 2011 | 220 | 30 | 51 | 18% | 3.30 |
| 2012 | 128 | 33 | 10 | 34% | 2.54 |
| 2013 | 132 | 37 | 18 | 41% | 2.48 |
| 2014 | 133 | 44 | 4 | 36% | 2.34 |
| 2015 | 165 | 39 | 6 | 27% | 2.89 |

**Lacreek National Wildlife Refuge**

| Year | Licenses | Bucks | Does | Success | Ave Days Hunted |
|---|---|---|---|---|---|
| 2011 | 45 | 16 | 9 | 45% | 2.93 |
| 2012 | 48 | 14 | 19 | 47% | 2.38 |
| 2013 | 48 | 11 | 4 | 22% | 1.97 |
| 2014 | 34 | 8 | 0 | 24% | 3.10 |
| 2015 | 34 | 12 | 0 | 35% | 2.71 |

**Waubay National Wildlife Refuge**

| Year | Licenses | Bucks | Does | Success | Ave Days Hunted |
|---|---|---|---|---|---|
| 2011 | 64 | 9 | 7 | 25% | 3.82 |
| 2012 | 51 | 17 | 2 | 38% | 1.76 |
| 2013 | 51 | 15 | 1 | 31% | 1.71 |
| 2014 | 33 | 8 | 2 | 32% | 1.54 |
| 2015 | 33 | 8 | 0 | 24% | 2.10 |

## Aerial Surveys

Historically, aerial surveys with fixed wing aircraft have been flown to assess deer populations in South Dakota. Little documentation and published results, however, are available for most aerial surveys except those conducted in the Black Hills region, most of which were conducted near Crow Peak, located southwest of Spearfish (1950s-1970s). For the Crow Peak surveys low-level evening flights were conducted in approximately mid-April, covering about ten square miles (Brady 1971). This area was chosen because it was identified as one of the most critical "deer problem" areas because it included privately owned cropland (Richardson and Petersen 1974). From 1953 through 1973 (excluding 1972) aerial surveys at Crow Peak in the Black Hills were conducted. The number of deer recorded annually ranged from 529 in 1960 to 1,078 in

1967 (Brady 1971, Richardson and Petersen 1974). The value of this survey was also attributed to good public relations (Richardson 1970 or Brady 1971).

Aerial surveys are currently used to estimate the population size of large mammals; however, few surveys accurately count all animals, due mainly to visibility biases. Visibility bias can be defined as "the failure to observe all animals" which causes inaccuracies in aerial survey estimates (Caughley 1974a, 1977). Caughley (1977) reported that aerial surveys failed to detect 12-71% of animals known to be present in a study area with flat and open terrain. Total counts of ungulate populations are not feasible and numerous aerial surveys have documented biases associated with underestimates of population size (Caughley 1974a, LeResche and Rausch 1974, Floyd et al. 1979, DeYoung 1985). One approach used to correct for visibility bias of ungulate populations are sightability models (Samuel et al. 1987).

Sightability models are used to calculate the detection probability of individual groups and correct for groups missed during surveys by documenting factors affecting animal detection (Samuel et al. 1987). Models are developed by flying over groups of animals that include radio-collared individuals and by recording covariates for individual groups both observed and undetected by observers (Samuel et al. 1987). Numerous factors affecting sightability have been documented and include type of aircraft, speed, altitude, strip width, group size, group activity (i.e., bedded, standing, moving), observer experience, vegetative cover, canopy cover (i.e., visual obstruction), topography, and snow cover (Caughley 1974a, Samuel et al. 1987, Otten et al. 1993, Bodie et al. 1995, Anderson et al. 1998, Cogan and Diefenbach 1998, Allen 2005, Jacques 2006, Krueger et al. 2007, Mcintosh et al. 2009, Rice et al. 2009, Walsh et al. 2009, Jarding 2010, Phillips 2011, Robling 2011). Key assumptions of sightability models are: 1) the population is geographically and demographically closed, 2) observations of groups of animals are independent, 3) groups are observed only once and during that observation groups are completely enumerated, 4) the survey design for land units is specified, and 5) probability of observing a group is known or can be estimated (Steinhorst and Samuel 1989).

<u>Mule Deer</u>
The first aerial deer surveys within South Dakota began in the 1950s; however, limited documentation exists pertaining to the frequency and/or occurrence of mule deer aerial surveys pre-2000 throughout South Dakota. Aerial surveys that did occur were non-systematic and did not account for missed individuals which resulted in limited use of data collected for management purposes. In an effort to obtain statistically valid mule deer abundance estimates, sightability model development became a priority for SDGFP in 2010. From January 2010 - February 2012, 128 adult female mule deer and 10 adult male mule deer (*n*=78, Meade and Pennington counties; *n*=60, Fort Pierre National Grasslands (FPNG)) were collared and used to develop sightability models for estimating deer abundance. Twenty-three spring sightability flights were conducted in April within Meade and Pennington counties (*n*=9) and FPNG (*n*=14) study areas when potential color differences between sun-bleached deer and spring green-up of vegetation were present. Variables for which data were collected during flights included: group size, activity, habitat, topography, and visual obstruction. Within the Meade and Pennington counties study area deer were sighted in the spring at a rate of 9.3% (10/107).

Logistic regression analysis indicated that visibility was influenced by canopy cover; however, the best model indicated through information-theoretic methods was not significant. Within the FPNG study area deer were sighted in the spring at a rate of 65.7% (167/254). Logistic regression analysis indicated that visibility was significantly influenced by group size, activity and topography. Twenty-four winter sightability flights were conducted between January – March in the Meade and Pennington counties (*n*=11) and FPNG (*n*=13) study areas when 100% snow cover was present. An additional eight winter flights were flown in the FPNG study area when no snow cover was present. Variables for which data were collected during flights included: group size, activity, habitat, topography, and visual obstruction. Within the Meade and Pennington counties study area deer were sighted in the winter at a rate of 31.2% (34/109). Logistic regression analysis indicated that visibility was influenced by canopy cover and group size; however, the best model indicated through information-theoretic methods was not significant. Within the FPNG study area, deer were sighted in the winter at a rate of 84.6% (252/298) when 100% snow cover was present. Logistic regression analysis indicated that visibility was significantly influenced by group size and topography. Winter sightability rates in the FPNG study area when no snow cover was present were 58.5% (55/94). Logistic regression analysis indicated that visibility was significantly influenced by group size, activity, topography and visual obstruction (Robling et al. 2014).

Fixed-wing aerial surveys are not a feasible method in estimating mule deer abundance in landscapes characterized by extreme canopy cover associated with rugged terrain. However, models developed in the FPNG study have been used to estimate mule deer abundance in areas characterized by open prairie landscapes in central South Dakota. In 2013, three survey flights were conducted in firearm deer Unit 45D when 100% snow cover was present. Aerial survey protocol (Table 32) was followed and the covariates, group size and topography were recorded.

Table 32. Winter mule deer aerial survey protocol.

| | |
|---|---|
| Type of plane | Cessna 172 |
| Ground Speed | 90-110 mph (goal ~ 90 mph) |
| Above Ground Level | 100-200 feet (goal ~150 feet) |
| # Observers | 1 observer plus pilot as observer = 2 |
| Time of day | Sunrise - Sunset |
| Wind conditions | $\leq$ 25 mph, prefer <15 mph |
| Transect width | ½ mile = observe ¼ mile out each side of plane |
| Time of year | January-March. Must have either no snow cover (0-10%) or total snow cover (90-100%; approximately > 4 inches).<br>After hunting seasons close; when deer are on winter range |
| Observing groups of deer | Repeat flyover(s) if necessary to obtain accurate group count.<br>Take pictures on groups >50 individuals.<br>Topography recorded will be where the first individual was detected. |

Abundance estimates were formulated in Program R using the Sightability Model package using the regression equation $\mu = 2.363 + 0.054(\text{group size}) - 0.742(\text{topography})$ (Robling et al. 2014). Results indicated minimal variability among estimates indicating future surveys in open prairie habitats are warranted (Table 33). However, future use of the fixed-wing mule deer sightability model is limited to deer units predominantly characterized by open terrain. This becomes problematic because canopy cover associated with rugged terrain exists in most mule deer units in central and western South Dakota, limiting applicability.

Table 33. Mule deer winter abundance estimates.

| Year | Unit | Population Estimate |
|---|---|---|
| 2013 (Flight 1) | 45D | 447 ; 95 % CI = ( 419 , 560 ) |
| 2013 (Flight 2) | 45D | 388 ; 95 % CI = ( 357 , 494 ) |
| 2013 (Flight 3) | 45D | 431 ; 95 % CI = ( 406 , 546 ) |

White-tailed Deer

Historically, numerous aerial surveys for white-tailed deer have been conducted across South Dakota. However, survey methodology was inconsistent and in most cases estimates were considered minimum count data. Non-systematic flights with no correction coefficient for missed individuals had limited use for management purposes and as a result, sightability model development became a priority for SDGFP in the late 1990s. Between 1998-2000, along the Missouri River breaks in central South Dakota, 103 observations including at least one radio-collared mule deer or white-tailed deer were recorded and logistic regression analysis indicated detection was most influenced by group size and animal activity (Grassel 2000). Species-specific sightability models were still lacking in areas characterized predominately by agricultural row crops and in 2009 a research project was initiated to develop white-tailed deer sightability models that accounted for missed animals in eastern South Dakota.

From February 2009 – February 2010, 43 adult female white-tailed deer and five adult male white-tailed deer were radio-collared and used to develop sightability models for estimating white-tailed deer abundance. In the spring of 2009 and 2010, a total of seven sightability flights were conducted in late April and early May when potential color differences between sun-bleached deer and spring green-up were present. In the winter of 2010 and 2011, a total of eight flights were conducted in January and February when 100% snow cover was present and deer were in large winter herds. Several variables were collected during the flights including: group size, activity, habitat, and canopy cover. Deer were sighted in the winter at a rate of 84.4% (146/173) and spring sightability rate was 54.6% (88/161). Logistic regression analysis indicated that visibility was significantly influenced by group size and canopy cover for both models and the top model (winter) estimated deer sightability as $\mu = 3.06 + 0.044\ (\text{group size}) - 1.13\ (\text{canopy cover})$ (Robling 2011).

The winter model was selected for management purposes because detection probabilities were greatest during winter when 100% snow cover was present, thus limiting variability. In 2013 and 2014, SDGFP conducted winter aerial surveys in numerous East River deer units. Each unit was divided into approximately 36 $mi^2$ low, medium, and high subunits based on knowledge of deer distributions and 100% of the high, ~60% of the medium and ~40% of the low subunits were flown. Transects within subunits were flown north to south or south to north and were preloaded onto a GPS unit to ensure accuracy. Aerial surveying sampling protocol established during model development (Table 34) was followed. Abundance estimates were derived in Program R using the Sightability Model package (Table 35).

Future aerial surveys will be conducted at the DAU level on a scheduled rotation for DAUs 9 and 10 east of the Missouri River when snow conditions exist. Each DAU will be divided into low, medium, and high deer density subunits based on knowledge of deer distributions. Procedure Allocate within program Aerial Survey will be used to determine sample sizes within each stratum of each DAU, or 100% of the area will be flown depending on staffing and funding levels. Abundance estimates will be derived in Program R using the Sightability Model package.

Table 34. Winter white-tailed deer aerial survey protocol.

| | |
|---|---|
| Type of plane | Cessna 172 |
| Ground speed | 80-110 mph (goal ~ 90 mph) |
| Above ground level | 100-200 feet (goal ~150 feet) |
| # Observers | 2 observers, not including pilot |
| Time of day | Sunrise - Sunset |
| Wind conditions | $\leq$ 25 mph, prefer <15 mph |
| Transect width | ½ mile = observe ¼ mile out each side of plane |
| Time of year | January-March. After hunting seasons close; when deer are on winter range.<br>Must have 100% snow cover (approximately > 6 inches) |
| Observing groups of deer | Repeat flyover(s) if necessary to obtain accurate group count.<br>Must count deer only on their side of the plane.<br>Observers will not assist each other with initial detections of deer.<br>Take pictures on groups >50 individuals.<br>Canopy cover will be estimated where the group was first detected. |

Table 35. White-tailed deer winter abundance estimates from aerial surveys.

| Year | Unit | Population Estimate | |
|---|---|---|---|
| 2013 | 18A | 3,555 | 95 % CI = ( 2,722 , 6,397 ) |
| 2013 | 18A | 3,518 | 95 % CI = ( 2,956 , 4,846 ) |
| 2014 | 22A | 3,154 | 95 % CI = ( 2,655 , 4,169 ) |
| 2014 | 32A | 2,976 | 95 % CI = ( 2,475 , 4,256 ) |
| 2014 | 46A | 973 | 95 % CI = ( 879 , 1,278 ) |
| 2014 | 43A | 976 | 95 % CI = ( 834 , 1,319 ) |

**Spotlight Abundance Survey**

In the Missouri Breaks region of central South Dakota on the Lower Brule Sioux Reservation, Grassel (2000) evaluated the effectiveness of spotlight surveys for white-tailed and mule deer. During fall spotlight surveys in the Missouri Breaks region observers detected 88% of reflectors that were planted along the survey route that were intended to mimic deer eye shine in an attempt to estimate visibility bias, violating the first assumption of distance sampling that all deer on the line are detected. Similarly, Jarding (2010) evaluated spotlight surveys of ungulates (including deer) in the Black Hills and noted significant evasive deer movement during spotlight surveys (failure of model assumption #2) and that detection efficiency improved among observers in the back of the truck compared to those in the cab. Other common sources of bias in spotlight surveys include deer avoidance of roads that are used during surveys, skewing the results (Burnham et al. 1980). Despite this behavior, Jarding (2010) recommends that while there is a high density of roads in the Black Hills, they traverse a wide range of vegetation communities that deer utilize; therefore, roads may be a reasonable venue for transect placement.

Beginning in 2016, spotlight road surveys were completed by SDGFP within the boundaries of the Black Hills DAU (i.e., DAU 3), where distance sampling models have recently been developed to estimate white-tailed deer abundance. In distance sampling methods, the data collected are the distances of the objects being surveyed from the observer, and the objective is to estimate the average density of the objects within a region using the concept that objects have a given probability of being detected at different distances (Buckland et al. 2001). Survey crews follow recently established protocols (Cudmore 2017). Sixty transect routes have been selected by General Randomized Tessellation Stratified sampling (Stevens and Olsen 2004), with transect lengths varying from 3.5 km to 16 km (Figure 36). Surveys are conducted during the last two weeks of August, beginning ½ hour after sunset and generally lasting 3-5 hours depending on transect length and the number of deer observed. Surveys are not conducted in rain, fog, or sleet; however, surveying efforts may be stopped (i.e., < 30 minutes) and immediately resumed once the inclement weather passes. Spotlights (two 4-million candle powered spotlights) are used to locate deer on both sides of the transect. Each survey has two observers, with the driver serving as one of the observers. Vehicle speeds do not exceed 15 mph.  Once a deer group is detected, the vehicle is stopped for observers to identify species, sex, age and group size.  The use of binoculars is allowed when necessary and observed distances are recorded with the aid of a range finder at a 90-degree angle from the road transect.  Data are recorded using hand held mobile devices.

Observation data are separated into two habitat categories (i.e., trees and meadows) and analyzed in Program Distance 6.0 (Thomas et al. 2010) using 95% confidence intervals.  Future estimates of abundance using distance sampling from spotlight surveys will be compared with population reconstruction estimates obtained from radio collar monitoring.  Cost: benefit analyses will be completed to evaluate the best survey technique to estimate abundance of white-tailed deer in the Black Hills in the future.

**Herd Composition Surveys**

Vital statistics, such as sex and age ratios, should be known to judge intelligently the welfare of animal populations (Downing 1980).  Herd composition surveys, previously known as pre-hunt classification counts or opportunistic live counts, were originally initiated to provide an estimate of age/gender structure in the Black Hills (Kranz 1974).  This survey was initiated due to concern that the population in the Black Hills was decreasing for three subsequent years since 1973 (as shown by pellet count results), even though hunting was mostly for bucks during this time (Rice 1977).  In the Prairie regions these counts were supposed to show the effects of weather and harvest manipulations on fawns (Rice 1979).  This survey was also developed as the second step in determining the mortality of fawns, paired with reproductive potential (see above), and both data sets were used in population modeling efforts.

Pre-season herd composition surveys of white-tailed deer and mule deer populations have been conducted annually throughout the state of South Dakota since the early 1940s in some areas, but decent records only exist back to the 1970s or 1980s (Appendices D and E).  Historically, random counts were conducted about one month before the start of the fall hunting season using both daylight counts and nocturnal spotlight counts.  It was stressed with management personnel collecting data that “adequate sample size and avoidance of duplication were essential for all data collected” (Wallin and Rice 1987a).  Each fall count had to include a minimum of 25 fawns to ensure a sufficient sample size under conditions of high spring-to-fall mortality.  Researchers stated that nocturnal counts could provide estimates that were lower than true counts though at least one later analysis found no significant difference between both counts (Rice 1977, 1979 and 1984, Hauk and Nash 1987).  See Appendices F and G for spotlight and daylight historical survey data.

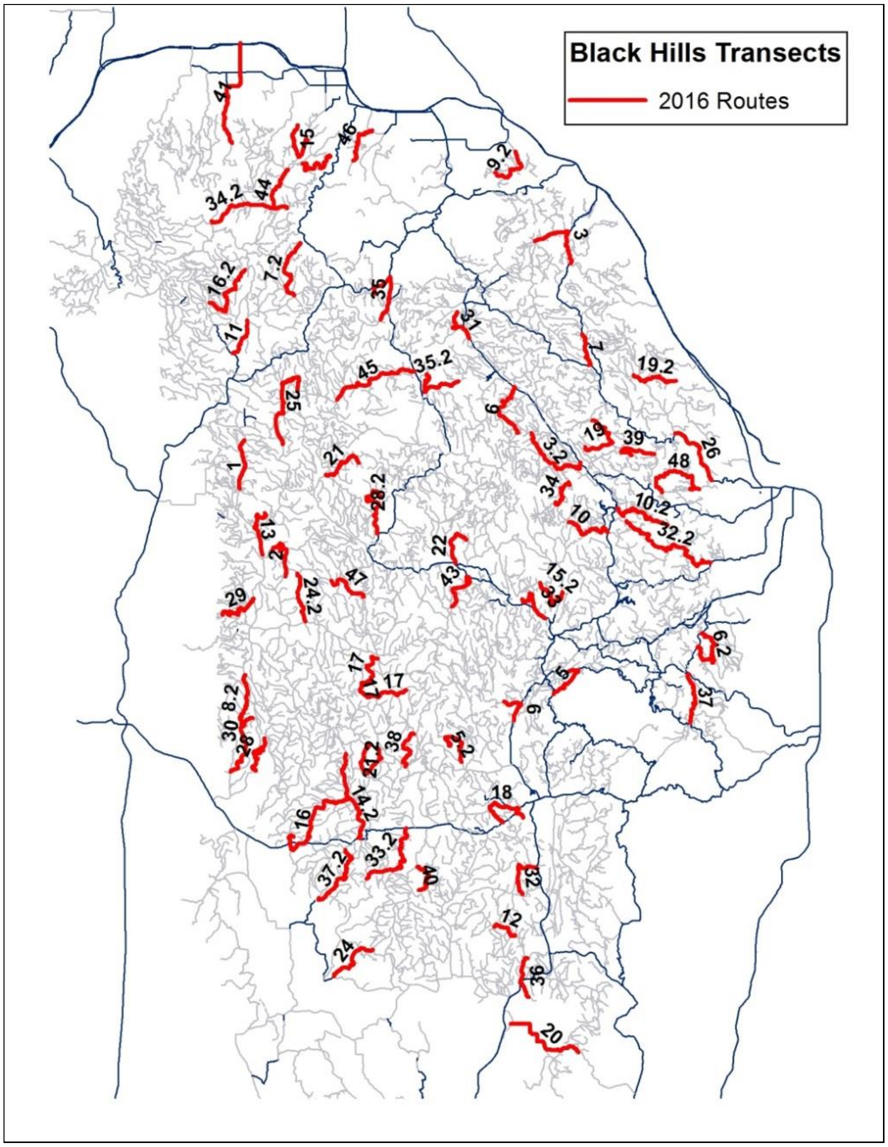



Figure 36. Road transects used for spotlight deer survey in the Black Hills.

Long-term averages for the Black Hills was 25% fawn mortality from 1977-1998. From 1990-1997 the rate was 38% (Schlueter et al. 2000). Mild winters in 1998 to 1999 were credited with lower fawn mortality. Fawn survival over time was much better for West River mule deer calculated at 15% for 1977-1994, although this value was considered too low. The rate for white-tailed deer was not calculated but was assumed to be similar. Long-term data for East River deer suggested fawn mortality below 5% with a long-term average of 140 fawns:100 does for the East River region, indicating high survival for summer fawns (1977-1993; McPhillips et al. 1997). Numbers for the Black Hills were consistently lower than for the Prairie regions (Appendix D). Estimated fawn mortality rates are no longer calculated using herd composition and reproductive datasets.

Current herd composition ground surveys are completed by driving roads or hiking in areas of known deer concentrations in September and October. Surveys are conducted opportunistically and distributed according to where deer observations can be completed, either in day time hours or at night with the use of spotlights. All deer herds that are observed in their entirety are classified to numbers of fawns, does, and bucks. Spatial data are also recorded for each observation in order to reduce double-counting occurrences. A minimum sample size of 200-400 independent group observations per species per DAU is currently obtained to ensure sufficient precision in herd composition estimates.

Herd composition survey data are currently analyzed to assess sex and age ratios at several geographic levels, with estimates and trends evaluated for West River, East River, and DAU areas. Age ratios alone should not be used to evaluate herd trends (Caughley 1974b), rather age and sex ratios are used to allocate herd composition in population models and population projections at the DAU level. Sex ratios are calculated as bucks:100 does, however, estimating accurate sex ratios from count surveys is problematic because of potential biases associated with differential behavior and habitat use of males and females (McCullough 1994) and/or an inability to differentiate large fawns from smaller yearling females. Unfortunately, sex-specific sightability rates are not available to correct for any biases in sex ratio data, so sex ratios warrant cautious interpretation and the greatest utility for these data are in evaluations of trend over time and across areas.

Age ratios are calculated as fawns:100 does and are used as an indicator of fall recruitment into the population. Survival rates of radio-collared fawns from October 1 through September 30 are used in conjunction with fall recruitment ratios in order to estimate annual recruitment rates.

In 2015, 15,028 white-tailed deer and 5,047 mule deer were classified throughout the state during the fall herd composition survey. Age and sex ratios, along with binomial (95%) confidence intervals were calculated for each statistic. Herd composition counts in East River, West River, and Black Hills regions resulted in an average white-tailed deer age ratio of 95 (95% CI: 91-99), 90 (85-96), and 80 (70-90) fawns per 100 does, respectively. For mule deer, fall recruitment estimates for East River, West River, and Black Hills regions were 63 (95% CI: 52-77), 84 (78-89), and 69 (52-92) fawns per 100 does, respectively. Overall, the 10-year average fall recruitment estimate of 78 fawns per 100 does in the Black Hills for white-tailed deer is lower than averages documented in the West River (95 fawns:100 does) and East River (102 fawns:100 does) prairie areas of the state (Figure 37). Small sample sizes of mule deer counted outside of the West River prairie region limit useful comparisons of mule deer recruitment estimates, but trend evaluations do reveal similarities (Figure 37).

Herd composition counts for 2015 in the East River, West River, and Black Hills regions resulted in an average white-tailed deer sex ratio of 32 (95% CI: 30-34), 24 (21-26, and 22 (18-27) bucks per 100 does, respectively. For mule deer, buck ratios for East River, West River, and Black Hills regions were 28 (95% CI: 22-37), 38 (35-41), and 47 (34-65) bucks per 100 does, respectively. Sex ratio datasets tend to have more variability (Figure 38), but overall the 10-year average for white-tailed deer in the East River prairie region of 32 bucks per 100 does has been slightly higher than the West River (24:100) and Black Hills (26:100) regions. Small sample sizes outside of the West River prairie region limit useful comparisons of mule deer sex ratios.

Estimates of sex and age ratios vary both spatially and temporally, as do trends (Figures 37 and 38). Evaluations of age and sex ratios at the DAU level are more useful for modeling purposes and estimating population trends (Table 36).

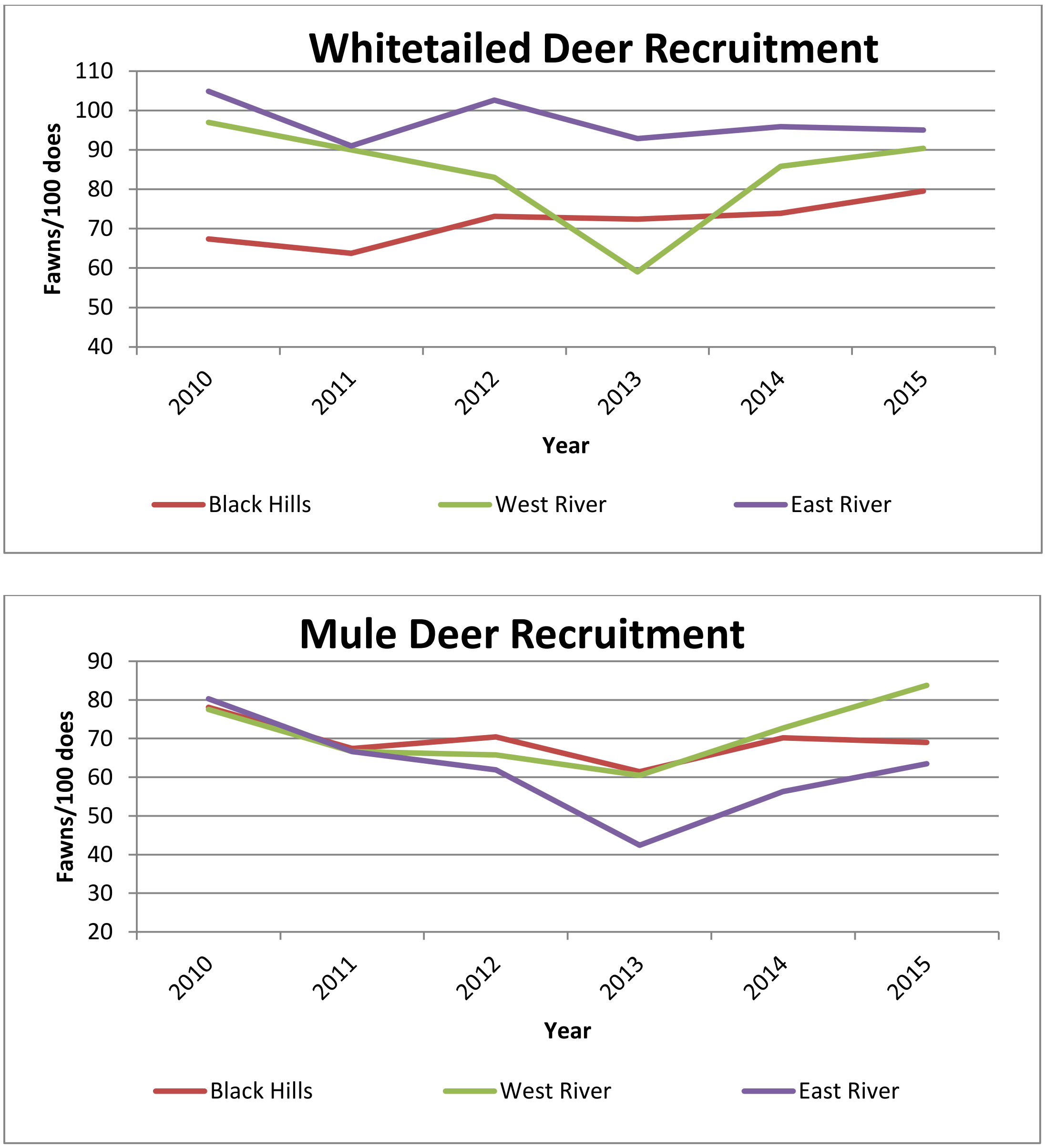
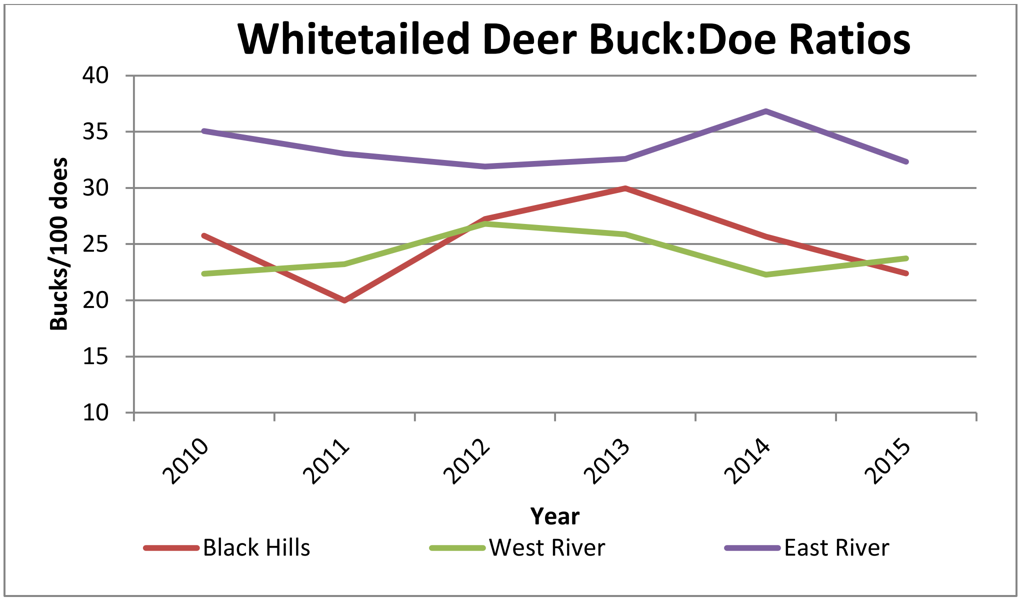



Figure 37. Trends in age ratios and estimates of fall recruitment of white-tailed deer and mule deer in South Dakota, 2010-2015.

Table 36. DAU summaries of white-tailed deer and mule deer sex ratios (fawns per 100 does) and age ratios (bucks per 100 does) collected during fall herd composition surveys in South Dakota, 2014-2016.

| | | White-tailed Deer | | Mule Deer | |
|---|---|---|---|---|---|
| **DAU** | **Year** | **Fawn:100D** | **Buck:100D** | **Fawn:100D** | **Buck:100D** |
| 1 | 2014 | 71 | 19 | 58 | 25 |
| | 2015 | 97 | 23 | 88 | 37 |
| | 2016 | 74 | 19 | 65 | 43 |
| 2 | 2014 | 107 | 16 | 95 | 21 |
| | 2015 | 96 | 24 | 104 | 42 |
| | 2016 | 77 | 33 | 76 | 51 |
| 3 | 2014 | 74 | 27 | 65 | 70 |
| | 2015 | 80 | 23 | 67 | 49 |
| | 2016 | 77 | 26 | 55 | 40 |
| 4 | 2014 | 80 | 32 | 81 | 29 |
| | 2015 | 92 | 26 | 77 | 34 |
| | 2016 | 60 | 28 | 65 | 34 |
| 5 | 2014 | 84 | 18 | 71 | 49 |
| | 2015 | 83 | 20 | 79 | 33 |
| | 2016 | 63 | 15 | 58 | 37 |
| 6 | 2014 | 91 | 18 | 62 | 51 |
| | 2015 | 85 | 28 | 67 | 54 |
| | 2016 | 86 | 25 | 83 | 45 |
| 7 | 2014 | 86 | 34 | 60 | 31 |
| | 2015 | 81 | 23 | 57 | 26 |
| | 2016 | 85 | 18 | 57 | 38 |
| 8 | 2014 | 98 | 38 | 49 | 71 |
| | 2015 | 102 | 38 | 69 | 29 |
| | 2016 | 96 | 26 | 56 | 35 |
| 9 | 2014 | 124 | 32 | | |
| | 2015 | 112 | 24 | | |
| | 2016 | 103 | 19 | | |
| 10 | 2014 | 84 | 37 | | |
| | 2015 | 81 | 32 | | |
| | 2016 | 88 | 30 | | |
| 11 | 2014 | 100 | 43 | | |
| | 2015 | 105 | 37 | | |
| | 2016 | 75 | 25 | | |



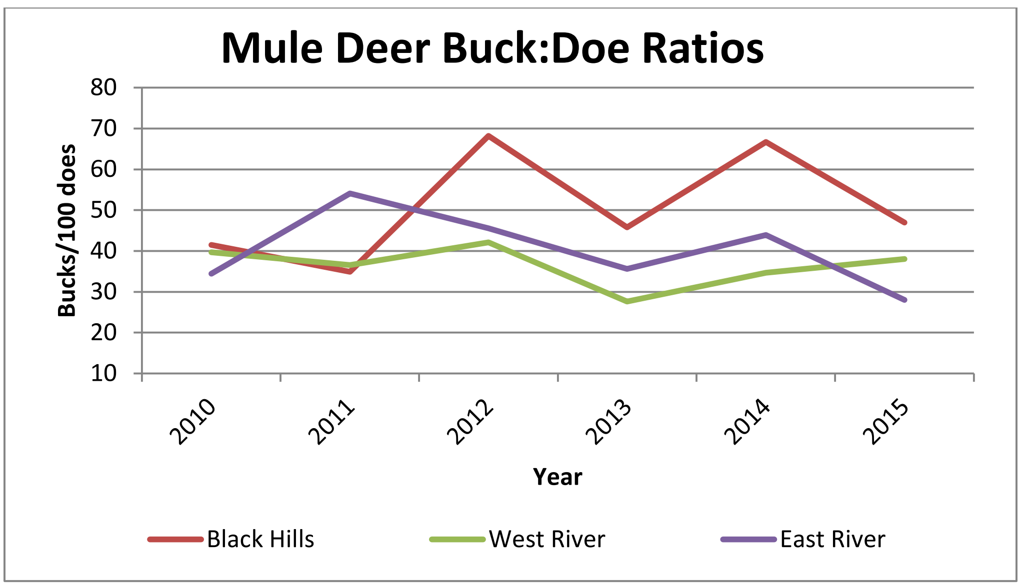




Figure 38. Trends in sex ratios of white-tailed deer and mule deer in South Dakota, 2010-2015.

Current herd composition survey methods in South Dakota allow surveys to be completed over multiple months and using multiple methods, both shown in previous research to provide substantial biases. Progulske and Duerre (1964) conducted experimental route spotlight counts in 1958 in the Black Hills of South Dakota. They reported most observations within the 4-hour period beginning 1 hour after sunset. Temperature appeared to influence spotlight counts the most, and more deer were observed in September than in August or July. McCullough (1982) researched night spotlighting in Michigan and reported that spotlight counts gave strongly biased sex and age ratios except during July for sex ratio and April for fawn:doe ratio. He also recorded a decline in the proportion of males in his spotlight sample from August through October, while Progulske and Duerre (1964) reported a sharp increase from August to September.

Fafarman and DeYoung (1986) evaluated deer spotlight counts in Texas and found that maximum estimates of fawn/doe ratios occurred in October as opposed to August or September. The average monthly buck:doe ratio for August – October was mostly consistent. They also reported that fawns increased markedly in the survey from August – October, as did McCullough (1982). Progulske and Duerre (1964), however, found high numbers of fawns in the summer months, which some attribute to open meadows where they are easily counted.

Downing et al. (1977) studied daylight deer counts from both Texas and Virginia and showed that fawns were always less observable than does in July, August, and September. Bucks and does were usually seen at the same rate in August and November.

McCullough (1993) compared daylight and spotlight counts of black-tailed deer in California and found that sex and age ratios varied between daylight and spotlight counts, and across all seasons. Spotlight counts were less biased than daylight counts. McCullough et al. (1994) compared systematic dawn and night spotlight composition counts of black-tailed deer with a sample of radio-telemetered animals. Differential alarm behavior was the only variable that explained a significant amount of variation with sex ratio. Unless herd composition counts are standardized (by route, season, diel period, habitat conditions, etc.) for deer populations in dense habitats, they concluded that differences obtained may be more a result of those conditions than real changes in composition and abundance of populations. Repetition was reported as the only reasonable solution to the problems of unpredictable deer behavior.

In the summer of 2012, SDGFP began a cooperative project with South Dakota State University to evaluate many of the survey methods used to collect deer herd composition data. Results suggested sample size needed for both species of deer ranged from 60-70 groups of does per study area of interest. Age ratios calculated from daylight counts did not differ between September and October ($P = 0.13$) for white-tailed deer. Comparison of September and October spotlight age ratios counts differed ($P \leq 0.001$) indicating that October ($\bar{x} = 0.85$) had a higher age ratio than did September ($\bar{x} = 0.56$). Sex ratios calculated from daylight counts differed ($P = 0.001$) between September ($\bar{x} = 0.17$) and October ($\bar{x} = 0.21$) for white-tailed deer. Comparison of months for spotlight counts differed ($P = 0.02$) indicating that October ($\bar{x} = 0.27$) had a higher sex ratio than September. Mule deer age ratios calculated from daylight counts did not differ ($P = 0.36$) between September ($\bar{x} = 0.62$) and October ($\bar{x} = 0.66$). Mule deer sex ratios calculated from daylight counts did not differ ($P = 0.05$) between September ($\bar{x} = 0.26$) and October ($\bar{x} = 0.31$). Cudmore (2017) also suggested when quantifying age and sex ratios of deer, habitat types need to be given consideration.

## Reproduction Surveys

This survey was originally developed as a way to provide reproductive information for population models and estimate the effects weather and hunter harvest have on reproduction based on the reproductive rates of vehicle-killed does (Rice 1977). In conjunction with the herd composition counts, reproductive potential helped determine fawn mortality prior to deer harvest (Wallin and Rice 1987a). Each year the numbers of fetuses carried by necropsied vehicle-killed females were counted for each region from March to May. The age of all vehicle-killed does was determined by examination of dental cementum annuli of the incisor teeth. From this the number of fetuses carried per doe, known as reproductive potential, was calculated. Some attention was paid to the age of the doe (doe fawn, meaning it was born the previous year, or adult), because the proportion of doe fawns that reproduced varied by region and was used to adjust the final reproductive value (Rice 1984). Sometimes the sample size was considered too small to provide a regional reproductive rate, especially for mule deer (Richardson and Petersen 1974). This survey was conducted from 1977-1985 and from 1987-1989 in all four regions (Table 37). Due to small sample size, surveys were only continued in the Black Hills from 1990-1996, after which this survey was discontinued altogether and the reproductive rate was based on historic long-term data collected, although these historic values were not provided in the available literature (Smith 2001a).

Reproduction surveys were reinitiated in 2012 and are currently conducted to estimate the growth potential of mule deer and white-tailed deer populations within designated DAUs across South Dakota. Reproductive rates are estimated using pregnancy rates and fetal counts from adult (17+ months) and juvenile (5-16 months) female deer collected during winter months (Table 38). Samples are collected using two methods – 1) necropsy of vehicle-kill deer, and 2) ultrasonography of live-captured deer.

Vehicle-killed deer samples are collected by SDGFP personnel and/or contractors in South Dakota that pick up vehicle-killed deer. The period of sample collection is February 1 – May 15. All salvageable female vehicle-killed deer are field-necropsied to determine the number of fetuses present. Date, species, location, age, and fetal count are collected for each vehicle-killed deer. Incisors from vehicle-killed deer may also be collected to estimate deer to age category (juvenile = 5-16 months of age; adults = 17+ months) based on incisor tooth wear and replacement.

Vehicle-killed sampling efforts are rotated among existing DAUs, such that each administrative region that is able to participate will have at least one sampling unit. A minimum sampling objective is set at 200 does per species in each selected DAU, however minimum sample sizes may be impractical to obtain in some situations. A mobile data collection application is used to collect reproductive data with associated spatial data.

Table 37. The reproductive potential for white-tailed deer (WT) and mule deer (MD) determined for the Black Hills, West River, and East River regions of South Dakota, 1977-1996.

(Note that sample sizes were mostly dependent on the availability of vehicle-killed does and were sometimes very small. Number of fawns per does for adult followed by value for yearling does in parentheses. Reproductive potential was not calculated for mule deer in the East River region.)

| | Black Hills | | West River | | East River | |
|---|---|---|---|---|---|---|
| **Year** | **WT adult (yearling)** | **MD adult** | **WT adult (yearling)** | **MD adult (yearling)** | **WT adult (yearling)** | **Reference** |
| 1977* | 1.92 (1.29) | | 2.00 (1.29) | 2.00 (1.20) | | Rice 1984 |
| 1978* | 1.69 (1.33) | | 2.25 (1.00) | 1.83 | | Rice 1984 |
| 1979* | 1.26 (1.00) | | | 2 | | Rice 1984 |
| 1980* | 1.94 (1.00) | | | | | Rice 1984 |
| 1981* | 1.65 (1.40) | | | | | Rice 1984 |
| 1982 | 1.27 | | 1.80 (0.40) | 2.00 | 1.77 (0.86)** | Wallin & Rice 1987c |
| 1983 | 1.45 | | 1.11 (0.67) | 1.47 | 1.68 (0.53)** | Wallin & Rice 1987d |
| 1984 | 1.20 | | 1.41 (1.25) | 1.62 | 1.88 (0.72)** | Wallin & Nash 1987 |
| 1985 | 1.22 | 1.50 | 1.62 | 1.57 | 1.88 | Hauk & Nash 1987 |
| 1986 | Not done this year | | | | | Hauk 1987 |
| 1987 | 1.52 | na | 2.00 (1.00) | na (1.25) | 1.89 (0.96) | Hauk 1989 |
| 1988 | 1.48 | na | na | na | 1.79 (0.88) | McPhillips 1989 |
| 1989 | 1.11 | na | 1.80 | na | 1.92 (0.75) | McPhillips 1990 |
| 1990 | 1.34 | | | | | McPhillips & Rice 1991a |
| 1991 | 1.39 | | | | | McPhillips & Rice 1991b |
| 1992 | 1.22 | | | | | McPhillips & Rice 1992 |
| 1993 | 1.54 | | | | | McPhillips & Rice 1993 |
| 1994 | 1.54 | | | | | McPhillips & Rice 1995 |
| 1995 | 1.42 | | | | | McPhillips & Rice 1996 |
| 1996 | 1.26 | | | | | McPhillips et al. 1997 |
| No data from 1997 - 2014 | | | | | | |

*Combined values for 1977-1981 were given as 1.63 (1.23 for yearlings), 2.20 (1.50 for yearlings), 1.97 (1.00 for yearlings), and 1.85 (1.35 for yearlings) fetuses per doe for Black Hills white-tailed deer, West River white-tailed deer and mule deer, and East River white-tailed deer (Rice 1984).

Table 38. Recent pregnancy rates and fetal averages of white-tailed deer and mule deer from reproduction surveys in South Dakota from 2012-2016, and historical averages from 1977-1989.

| | **White-tailed Deer** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **Pregnancy Rate** | | | **Fetus average** | | |
| **Years** | **Area** | **Sample** | **Method** | **Juveniles** | **Adults** | **Overall** | **Juveniles** | **Adults** | **Overall** |
| 1977-89 | East River | 977 | vehicle-kill | 57% | 93% | 77% | 0.77 | 1.76 | 1.32 |
| 1977-89 | West River | 143 | vehicle-kill | 39% | 91% | 75% | 0.45 | 1.69 | 1.31 |
| 1977-89 | DAU3 | 373 | vehicle-kill | 0% | 88% | 78% | 0.00 | 1.37 | 1.23 |
| 2012-13 | Reg. 3 and 4 | 176 | vehicle-kill | 33% | 91% | 75% | 0.43 | 1.70 | 1.35 |
| 2015 | DAU 3 | 52 | vehicle-kill | 33% | 80% | 69% | 0.33 | 1.18 | 0.98 |
| 2015 | DAU 3 | 27 | ultrasound | - | 93% | 93% | - | 1.19 | 1.19 |
| 2016 | DAU 3 | 43 | ultrasound | 0% | 86% | 67% | 0 | 1.47 | 1.15 |
| 2015 | DAU 9 | 55 | ultrasound | - | 98% | 98% | - | 1.93 | 1.93 |
| 2016 | DAU 9 | 43 | ultrasound | 43% | 100% | 86% | 0.43 | 1.93 | 1.56 |
| 2016 | DAU 11 | 72 | ultrasound | 11% | 99% | 78% | 0.11 | 1.84 | 1.48 |

| | **Mule Deer** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **Pregnancy Rate** | | | **Fetus average** | | |
| **Years** | **Area** | **Sample** | **Method** | **Juveniles** | **Adults** | **Overall** | **Juveniles** | **Adults** | **Overall** |
| 1977-89 | West River | 125 | vehicle-kill | 0% | 94% | 81% | 0.00 | 1.63 | 1.39 |
| 2015 | DAU 3 | 30 | ultrasound | - | 97% | 97% | - | 1.43 | 1.43 |
| 2016 | DAU 3 | 73 | ultrasound | 23% | 95% | 83% | 0.23 | 1.57 | 1.36 |
| 2015 | DAU 4 | 50 | ultrasound | - | 100% | 100% | - | 1.8 | 1.8 |
| 2016 | DAU 4 | 56 | ultrasound | 0% | 98% | 75% | 0.00 | 1.77 | 1.36 |
| 2015 | DAU 6 | 50 | ultrasound | - | 96% | 96% | - | 1.72 | 1.72 |
| 2016 | DAU 6 | 64 | ultrasound | 29% | 100% | 85% | 0.29 | 1.84 | 1.51 |

Deer live-captured during radio-collaring efforts are also evaluated for reproduction. All heli-captured adult female deer are long-lined back to a processing crew and evaluated for pregnancy status/fetal counts using transabdominal ultrasonography; animals are released at processing station. Deer captured via drop nets or cage traps (Clover 1956) are processed and released at capture site. Blood samples are also collected and analyzed for levels of pregnancy-specific protein B (Wood et al. 1986, Duquette et al. 2012) to confirm pregnancy status on adult deer determined to be non-pregnant during ultrasounds and juvenile deer. Fetal averages for pregnant juveniles are based on vehicle- kill data. Sample sizes collected vary by year and area, but in general 100 adult does and 25 female juveniles will be assessed for reproduction in the first year of capture effort in each DAU where survival monitoring efforts are taking place. Approximately 25 additional female juveniles will be assessed for reproduction in the second and third years of study in each DAU.

Reproductive rate data are used to represent reproductive potential at parturition for mule deer and white-tailed deer across the state. Counts of fetuses in the winter may over-estimate actual live fetuses at parturition, however, as prenatal fetal mortality has been reported in several studies of white-tailed deer productivity (Ransom 1967, Mansell and Cringan 1968, Roseberry and Klimstra 1970). Prenatal mortality is likely a result from nutritional constraints of winter, but the overall impact to the deer herd is usually considered minimal (Verme and Ullrey 1984). Approximately 4% of white-tailed deer examined by Fortin et al. (2015) in New Hampshire had fetuses in various stages of resorption, and Roseberry and Klimstra (1970) in southern Illinois estimated approximately 10% prenatal mortality of fetuses from deer collected in January in southern Illinois. Robinette et al. (1955) examined 527 mule deer does in late winter and estimated prenatal loss from first month to midpoint of gestation period was about 3.26% for mule deer in Utah.

Reproduction data are used in conjunction with summer fawn survival data to estimate fall deer recruitment. This estimate of recruitment will be compared with the fall herd composition recruitment estimate in future years when larger datasets allow statistical analyses. SDGFP will evaluate cost:benefit ratio, survey variability, population model needs, and other variables to determine the most appropriate way to estimate recruitment in deer herds.

Reproductive rates are currently used to update SDGFP deterministic population models, and are incorporated into a Bayesian Integrated Population Modeling program. Because current datasets are limited in quantity (Table 38), comparisons between areas, years, and methods are limited. Data collected in the Black Hills region are currently the most plentiful, and a qualitative comparison between this region and East and West River regions suggests lower reproductive potential in the Black Hills (Figure 39).

Obtaining accurate estimates of deer reproduction is critical as small changes in reproduction rates can have substantial impacts on population modeling and predicted deer herd growth rates. Pregnancy and fetal rates of adults vary the least of all age categories over time. Juvenile does (5-16 months) are susceptible to nutritionally induced variations in fertility and this is significant because under normal conditions, yearling does represent the largest class of breeding-age females (Heffelfinger 2006). Current integrated population model design used by SDGFP uses two age categories [juveniles (5-16 months) and yearling/adults (17+ months)] for reproductive data; therefore the greatest variability exists in pregnancy rates of juveniles for SDGFP modeling purposes.

Mule deer seldom breed their first year as a juvenile (5-16 months) (Connelly 1981), and the preponderance of literature on juvenile pregnancy rates report zero to very low percentages. Heffelfinger (2006) reviewed numerous deer studies in the southwestern US and reported the average number of fetuses per mule deer juvenile (including non-pregnant juveniles) for most studies ranged from 0.0-0.01. Two studies from a public wildlife management area in Texas,

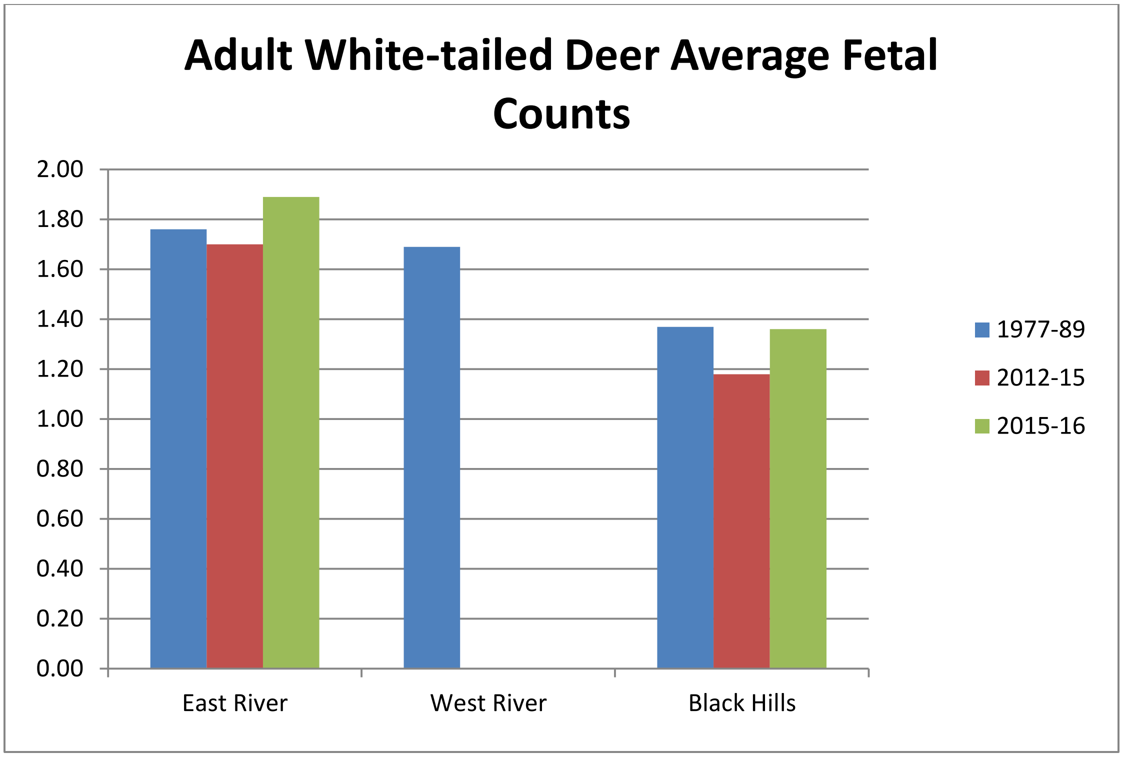



Figure 39. Average number of fetuses per adult white-tailed deer over time and across different geographic areas in South Dakota. Reproductive data illustrated in 1977-1989 and 2012-2015 bars were collected from vehicle-killed inspections, and ultrasonography was used to collect data in 2015-2016.

however, reported higher than normally reported juvenile reproduction rates; Desai (1962) reported 7 of 11 (64%) mule deer juvenile reproductive tracts had corpora lutea, indicating they had undergone estrus; Brownlee (1971) reported that 1 of 5 juvenile reproductive tracts contained a fetus (20%). Bischoff (1958) found no evidence of ovulation in reproductive tracts of 20 mule deer juveniles in California. Robinette et al. (1955) reported that out of 274 animals (107 pregnancy examinations and 167 ovarian analyses), only 2.6% may have conceived fawns. Additionally, only 0.56% of 540 juvenile udder examinations showed evidence of fawn rearing. Robinette et al. (1955) suggested the difference between 2.6% and 0.56% represents a rather high percentage loss *in utero* or very shortly after birth of young from mule deer impregnated as juveniles. Historical vehicle- kill evaluations of mule deer juveniles (n=18) in South Dakota in the 1970s and 1980s detected no pregnant juveniles, but recent blood tests results of winter captured juveniles detected 0% pregnant in DAU 4 (n=17), 23% pregnant in DAU 3 (n=13), and 29% pregnant in DAU 6 (n=17; Table 39). Future evaluation of the reproductive potential of mule deer juveniles will provide essential data to the proper management of this species.

White-tailed deer juveniles (5-16 months), on the other hand, more commonly breed as juveniles and rates can be high. DeYoung (2011) reviewed 12 studies and reported a maximum of 29% pregnancy rate for juveniles, whereas Ozoga (1987) reported about half of doe juveniles breed in supplementally fed white-tailed deer herds in Michigan. Historical reproductive data from vehicle- kill animals in South Dakota from 1977-1989 detected juvenile pregnancy rate averages from 0% to 57% depending on geographical area (Table 39). Current data in South Dakota on white-tailed deer juvenile breeding via blood testing of winter captured juveniles show pregnancy rates can vary from 0-43% (Table 39). Future reproductive rates in South Dakota will be compared between years and between geographical areas to evaluate if temporal or spatial differences exist in mule deer and white-tailed deer herds across the state.

Table 39. Juvenile pregnancy rates from winter juveniles captured January-March of 2016, South Dakota.

| DAU | Species | Sample Size | # Pregnant | Pregnancy Rate |
|---|---|---|---|---|
| 3 | WT | 12 | 0 | 0% |
| 3 | MD | 13 | 3 | 23% |
| 4 | MD | 17 | 0 | 0% |
| 6 | MD | 17 | 5 | 29% |
| 9 | WT | 14 | 6 | 43% |
| 11 | WT | 19 | 2 | 11% |

**Survival Monitoring**

Understanding population dynamics of both white-tailed and mule deer and determining annual rates of population change (λ) requires knowledge of fawn, juvenile, and adult survival rates. Annual rates of change within a deer population are influenced primarily by adult survival and the number of fawns that reach one year of age (see *Population Models* section, Table 44). Mule deer and white-tailed deer survival monitoring has been occurring within South Dakota since the 1960s (Sparrowe and Springer 1970, Steigers et al. 1981). Survival estimates dating back to the early 1990s can be found in Tables 41 and 42. Increased efforts to obtain statistically valid survival estimates within a defined data analysis unit have been occurring since 2013; thus sample sizes of radio-collared mule deer and white-tailed deer have increased significantly.

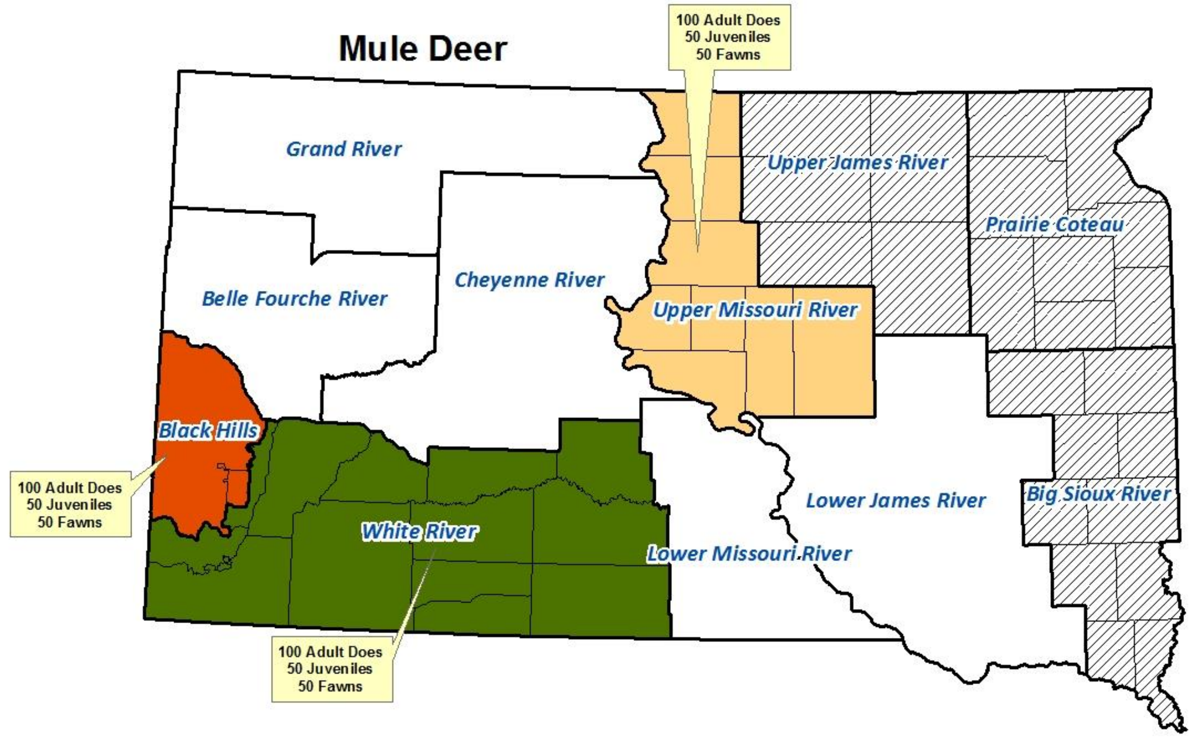
Currently, statistically valid sample sizes (>100 individuals) for adult females exist in 3 of the 9 defined mule deer DAUs and 4 of the 11 defined white-tailed deer DAUs (Figure 40). Monitoring efforts on adult female mule deer and white-tailed deer are still occurring on previously collared animals in DAU 1 and 2; however, sample sizes are not at recommended levels. Within the active monitoring areas, adult females (17+ months) and juveniles (5-16 months) are primarily captured via helicopter net gun, long-lined back to a processing crew (adults only), fitted with a VHF radio collar, evaluated for pregnancy/fetal counts using ultrasonography (adults only), as well as blood sampled to evaluate body condition and to confirm pregnancy status during the winter months.  In addition, survival of adult males is also being monitored in two study areas, and each captured deer is blood sampled and fitted with a VHF radio collar or ear tag transmitter.

Monitoring for a live/dead signal occurs within 16 days post-capture and all mortalities (<16 days post capture) are labeled as capture-related mortalities, with the exception of vehicle mortalities.  Monitoring then occurs one time each month between the 1$^{st}$ -15$^{th}$ for each collared individual (Table 40).  All mortalities are investigated to verify death of the animal via physical evidence.  In most cases, cause-specific mortality is not identifiable with the exception of vehicle collisions and hunter harvest.  Hunter harvest is a very important metric used in the population reconstruction modeling process and collar reporting by hunters is a vital step in obtaining the most accurate and precise data possible.

Table 40.  Monitoring frequency of radio-marked deer for estimating survival.

| **Age** | **Age Category** | **Monitoring Frequency** |
|---|---|---|
| 0-4 months (capture – Sept. 30) | Fawns | 1 per month |
| 5-16 months (Oct. 1 – Sept. 30) | Juveniles | 1 per month |
| 17+ months (Oct. 1 and on) | Adult | 1 per month |

Fawns (0-4 months) are captured opportunistically by observing post-partum behavior of does, grid searching, and/or driving roads within the DAU.  Once an individual is captured, an expandable breakaway VHF radio collar is attached, the fawn is sexed, weighed, and the distance between the front hoof hair-line to growth line is measured to estimate the age of the fawn in approximate days (Sams et al. 1996).  Monitoring occurs within 2-3 days post capture and all intact carcasses found <3 days post capture are labeled as capture related mortalities.  All other mortalities (non-intact carcasses) are labeled according to evidence at the mortality sight and likely recorded as probable predation/scavenged and used in the survival analysis.  After 3 days post-capture, evidence at the mortality sight (e.g., carcass, bone fragments, blood, tooth marks on collar etc.) are used to verify death.  If no evidence of death is present the fawn is censored from the analysis because the collar may have shed prematurely and the animal could still be alive.



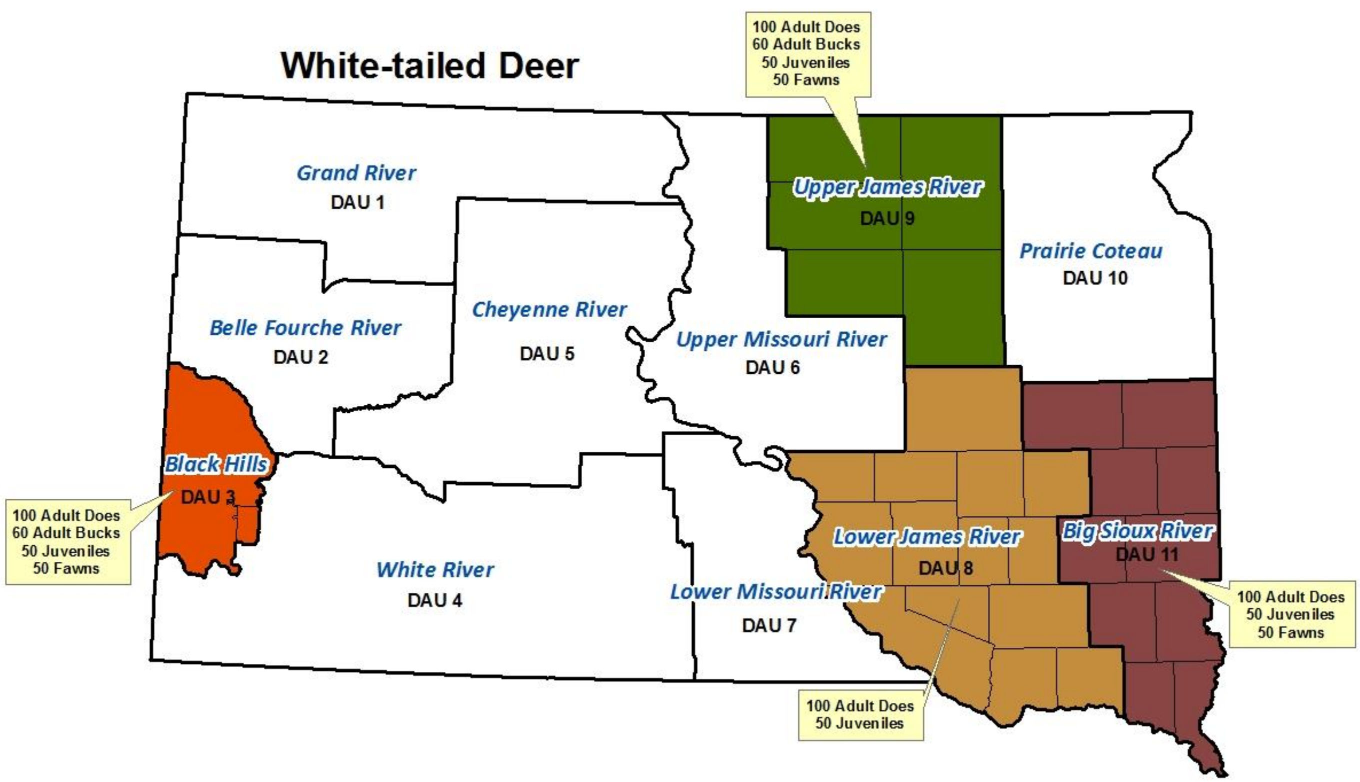




Figure 40. 2017 mule deer and white-tailed deer survival monitoring DAUs.

All capture, monitoring, and mortality data are collected using hand held electronic devices (e.g., Juno units, smartphones and tablets) and data are stored in a sequel server database and transferred through an application program interface (API) connection to a web interface (PopR) created by the University of Montana. Survival rates for each species, sex, and age category are calculated within PopR using a staggered-entry known fate analysis. Annual survival and harvest rates are then used in the integrated population model, resulting in abundance estimates and annual rates of change. Reliable DAU abundance estimates require statistically valid survival estimates. Population models are heavily data driven, so it is imperative continued collaring efforts persist.

Future capture and monitoring efforts of mule deer and white-tailed deer fawns, juveniles, adult does, and/or adult bucks will occur annually. Within 3 of the white-tailed deer monitoring DAUs that currently have statistically valid samples (Figure 41), 55 additional fawns and 55 additional juveniles will be radio-collared in 2017 and 2018 to supplement current sample sizes and monitoring will continue in these DAUs (3, 9, 11) until 2020. In addition, one new white-tailed deer monitoring DAU will be added annually (DAU 8 was added in 2017) until 2024 and will include the collaring of 105 adult females and 55 juveniles. Within the new monitoring DAUs in years two and three, 55 juveniles will be radio-collared to supplement collared animal mortalities. Monitoring efforts will continue within a new monitoring DAU for six years. This rotation monitoring schedule will result in a complete DAU survival dataset by 2029 (Figure 41).

Within the three mule deer DAUs that currently have statistically valid samples (Figure 42), 55 additional fawns and 55 additional juveniles will be radio-collared in 2017 and 2018 to supplement current sample sizes and monitoring will continue in these DAUs until 2020. In 2019, one new mule deer monitoring DAU will be added annually until 2023 and will include the collaring of 105 adult females and 55 juveniles. Within the new monitoring DAUs in years two and three, 55 juveniles will be added to supplement collared animal mortalities. Monitoring efforts will continue within a new monitoring DAU for six years. This monitoring schedule will result in a complete DAU survival dataset for mule deer by 2028 (Figure 42).

| DAU White-tailed Deer Survival Monitoring Schedule | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | DAU 3 | DAU 9 | DAU 11 | DAU 8 | DAU X | DAU X | DAU X | DAU X | DAU X | DAU X | DAU X |
| 2016 | x | x | x | | | | | | | | |
| 2017 | ● | ● | ● | x | | | | | | | |
| 2018 | ● | ● | ● | ● | x | | | | | | |
| 2019 | | | | ● | ● | x | | | | | |
| 2020 | | | | | ● | ● | x | | | | |
| 2021 | | | | | | ● | ● | x | | | |
| 2022 | | | | | | | ● | ● | x | | |
| 2023 | | | | | | | | ● | ● | x | |
| 2024 | | | | | | | | | ● | ● | x |
| 2025 | | | | | | | | | | ● | ● |
| 2026 | | | | | | | | | | | ● |
| 2027 | | | | | | | | | | | |
| 2028 | | | | | | | | | | | |

Figure 41. DAU white-tailed deer survival monitoring schedule (**x** = new monitoring DAU where 105 adult females and 55 juveniles will be radio-collared; ● = supplemental juvenile collaring (55 individuals) in years two and three; [shaded] = monitoring occurring within specified DAU).

| DAU Mule Deer Survival Monitoring Schedule | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year | DAU 3 | DAU 4 | DAU 6 | DAU X | DAU X | DAU X | DAU X | DAU X |
| 2016 | x | x | x | | | | | |
| 2017 | ● | ● | ● | | | | | |
| 2018 | ● | ● | ● | | | | | |
| 2019 | | | | x | | | | |
| 2020 | | | | ● | x | | | |
| 2021 | | | | ● | ● | x | | |
| 2022 | | | | | ● | ● | x | |
| 2023 | | | | | | ● | ● | x |
| 2024 | | | | | | | ● | ● |
| 2025 | | | | | | | | ● |
| 2026 | | | | | | | | |
| 2027 | | | | | | | | |

Figure 42. DAU mule deer survival monitoring schedule (**x** = new monitoring DAU where 105 adult females and 55 juveniles will be radio-collared; ● = supplemental juvenile collaring (55 individuals) in years two and three; [shaded] = monitoring occurring within specified DAU).

Table 41.  Documented mule deer survival by age class.

| (Griffin et al. 2005, Grassel 2000) | | | | |
|---|---|---|---|---|
| **Adult Female Mule Deer Annual Survival** | | | | |
| **Year** | **DAU** | **Survival** | **SE** | **n** |
| 1997-1998 | 7 | 84% | 0.04 | 12 |
| 1998-1999 | 7 | 90% | 0.04 | 11 |
| 1999-2000 | 3 | 71% | 0.12 | 14 |
| 2000-2001 | 3 | 76% | 0.11 | 17 |
| 2001-2002 | 3 | 62% | 0.13 | 13 |

| **All following estimates derived in PopR* | | | | |
|---|---|---|---|---|
| **Fawn (Birth - Sept 30) Mule Deer Survival** | | | | |
| **Year** | **DAU** | **Survival** | **95% CI** | **n** |
| 2013 | 2 | 54% | (37-70) | 33 |
| 2013 | 7 | 66% | (52-78) | 48 |
| 2014 | 2 | 51% | (36-66) | 41 |
| 2014 | 7 | 46% | (32-60) | 47 |
| 2015 | 3 | 59% | (43-73) | 49 |
| 2015 | 4 | 63% | (49-75) | 51 |
| 2015 | 6 | 46% | (32-61) | 48 |
| 2016 | 3 | 60% | (47-73) | 55 |
| 2016 | 4 | 55% | (42-68) | 57 |
| 2016 | 6 | 66% | (53-77) | 59 |
| **Juvenile Mule Deer Annual Survival (Oct 1 - Sept 30)** | | | | |
| **Year** | **DAU** | **Survival** | **95% CI** | **n** |
| 2013-2014 | 2 | 82% | (62-93) | 19 |
| 2013-2014 | 7 | 55% | (36-73) | 32 |
| 2014-2015 | 2 | 75% | (56-89) | 21 |
| 2014-2015 | 7 | 76% | (56-90) | 22 |
| 2015-2016 | 3 | 56% | (41-70) | 61 |
| 2015-2016 | 4 | 89% | (79-96) | 61 |
| 2015-2016 | 6 | 86% | (73-94) | 51 |
| **Adult Female Mule Deer Annual Survival (Oct 1 - Sept 30)** | | | | |
| **Year** | **DAU** | **Survival** | **95% CI** | **n** |
| 2009-2010 | 2 | 78% | (59-90) | 39 |
| 2009-2010 | 7 | 76% | (56-88) | 48 |
| 2010-2011 | 2 | 71% | (57-83) | 44 |
| 2010-2011 | 7 | 66% | (52-78) | 53 |
| 2011-2012 | 2 | 82% | (70-91) | 54 |

| | | | | |
|---|---|---|---|---|
| 2011-2012 | 7 | 80% | (67-89) | 38 |
| 2012-2013 | 2 | 83% | (71-91) | 47 |
| 2012-2013 | 7 | 66% | (49-80) | 32 |
| 2013-2014 | 2 | 83% | (70-92) | 41 |
| 2013-2014 | 7 | 66% | (46-82) | 23 |
| 2014-2015 | 2 | 92% | (83-97) | 39 |
| 2014-2015 | 6 | 85% | (70-94) | 49 |
| 2014-2015 | 3 | 72% | (51-87) | 40 |
| 2014-2015 | 4 | 85% | (70-94) | 50 |
| 2015-2016 | 2 | 86% | (73-94) | 40 |
| 2015-2016 | 6 | 86% | (77-92) | 115 |
| 2015-2016 | 3 | 80% | (76-87) | 108 |
| 2015-2016 | 4 | 88% | (80-94) | 105 |

Table 42. Documented white-tailed deer survival by age class.

| (Griffin et al. 2005, Griffin et al. 1994, DePerno 1998, Grassel 2000, Grovenburg 2007, Burris 2005, Brinkman 2005) | | | | |
|---|---|---|---|---|
| **Adult Female White-tailed Deer Annual Survival** | | | | |
| **Year** | **DAU** | **Survival** | **SE** | **n** |
| 1993-1994 | 3 | 63% | - | 41 |
| 1994-1995 | 3 | 67% | - | 42 |
| 1995-1996 | 3 | 59% | - | 42 |
| 1996-1997 | 3 | 54% | - | 35 |
| 1998-1999 | 3 | 67% | 0.12 | 12 |
| 1998-1999 | 7 | 100% | 0 | 14 |
| 1999-2000 | 3 | 58% | 0.07 | 36 |
| 1999-2000 | 7 | 95% | 0.04 | 17 |
| 2000-2001 | 3 | 69% | 0.17 | 27 |
| 2001-2002 | 3 | 54% | 0.09 | 37 |
| 2002-2003 | 3 | 80% | 0.09 | 20 |
| 2003-2004 | 3 | 88% | 0.08 | 16 |
| 2003-2004 | 11 | 94% | 0.06 | 18 |
| 2004-2005 | 10 | 53% | 0.12 | 17 |
| 2004-2005 | 11 | 67% | 0.1 | 19 |
| 2005-2006 | 9 | 84% | 0.08 | 22 |
| 2006-2007 | 9 | 65% | 0.08 | 40 |

*All following estimates derived in PopR*

**Fawn (Birth - Sept 30) White-tailed Deer Survival**

| Year | DAU | Survival | 95% CI | n |
|---|---|---|---|---|
| 2013 | 10 | 60% | (45-74) | 47 |
| 2013 | 11 | 54% | (38-69) | 38 |
| 2014 | 10 | 56% | (42-69) | 54 |
| 2014 | 11 | 58% | (43-71) | 47 |
| 2014 | 7 | 47% | (32-63) | 39 |
| 2014 | 1 | 63% | (47-78) | 35 |
| 2015 | 9 | 65% | (51-77) | 57 |
| 2015 | 11 | 73% | (60-84) | 52 |
| 2015 | 7 | 58% | (44-72) | 48 |
| 2015 | 1 | 82% | (67-92) | 34 |
| 2015 | 3 | 63% | (49-76) | 53 |
| 2016 | 9 | 68% | (54-80) | 55 |
| 2016 | 11 | 60% | (50-68) | 65 |
| 2016 | 3 | 76% | (64-86) | 56 |

**Juvenile White-tailed Deer Survival (Oct 1 - Sept 30)**

| Year | DAU | Survival | 95% CI | n |
|---|---|---|---|---|
| 2013-2014 | 10 | 63% | (36-84) | 23 |
| 2013-2014 | 11 | 40% | (17-64) | 21 |
| 2014-2015 | 10 | 63% | (38-84) | 23 |
| 2014-2015 | 11 | 57% | (33-78) | 28 |
| 2014-2015 | 1 | 67% | (47-84) | 21 |
| 2015-2016 | 9 | 82% | (70-91) | 63 |
| 2015-2016 | 11 | 60% | (45-74) | 64 |
| 2015-2016 | 7 | 83% | (65-94) | 26 |
| 2015-2016 | 1 | 83% | (65-94) | 27 |
| 2015-2016 | 3 | 69% | (55-82) | 54 |

**Adult Female White-tailed Deer Survival (Oct 1 - Sept 30)**

| Year | DAU | Survival | 95% CI | n |
|---|---|---|---|---|
| 2009-2010 | 10 | 76% | (62-87) | 44 |
| 2009-2010 | 8 | 61% | (44-76) | 41 |
| 2010-2011 | 10 | 57% | (41-71) | 36 |
| 2010-2011 | 8 | 71% | (54-84) | 30 |
| 2011-2012 | 10 | 74% | (60-86) | 43 |

| | | | | |
|---|---|---|---|---|
| 2011-2012 | 8 | 53% | (28-75) | 23 |
| 2012-2013 | 10 | 67% | (54-78) | 65 |
| 2013-2014 | 10 | 74% | (61-84) | 52 |
| 2013-2014 | 11 | 78% | (58-90) | 46 |
| 2014-2015 | 10 | 86% | (73-94) | 36 |
| 2014-2015 | 11 | 80% | (68-89) | 50 |
| 2015-2016 | 9 | 84% | (76-91) | 109 |
| 2015-2016 | 11 | 68% | (53-79) | 117 |
| 2015-2016 | 3 | 82% | (74-89) | 113 |
| 2015-2016 | 1 | 83% | (71-91) | 48 |
| 2015-2016 | 10 | 77% | (59-90) | 23 |

| **Adult Male White-tailed Deer Survival (Oct 1 - Sept 30)** | | | | |
|---|---|---|---|---|
| **Year** | **DAU** | **Survival** | **95% CI** | **n** |
| 2015-2016 | 3 | 63% | (45-78) | 39 |
| 2015-2016 | 9 | 57% | (43-69) | 69 |

**Population Models**

Statistical modeling was initiated in 1989 to facilitate long term management plans for individual management hunting units (McPhillips 1990). Models were used to forecast population-level responses to changes in deer harvest in relation to predicted non-hunt mortality. Data from management units was used to create software-derived models. Data put into the models included hunter harvest numbers (species and sex), deer age harvest structure based on the study of dental cementum annuli of incisor teeth (age structure and estimates of total annual mortality), and the historic reproductive potentials and annual pre-hunt classification counts (reproductive rates and summer fawn losses; McPhillips and Rice 1995). To develop the model, data from the previous ten years (1985-1996) were used to emulate known population parameters and match model output to known outcomes. Severe events, such as harsh winters, were also included in the model as a Mortality Severity Index (McPhillips et al. 1997). Finally, each model was adjusted to make predictions.

The population of white-tailed deer in the Black Hills was in the low 40,000s from 1985-1991 and then dropped to the low 30,000s and high 20,000s from 1992-1996, based on modeling data from 1985-1996. This aligned well with what biologists estimated for population trends, suggesting a growing population that attained carrying capacity and was then reduced by severe winter weather (McPhillips et al. 1997). Similar results were obtained for mule deer in the Black Hills whose population increased from 10,000 to 12,000 during 1985-1991 and fell into the 9,000s from 1992-1995. Selected prairie units were also modeled.

As of 1998, a population model for SDGFP was still being refined (Schlueter 1999). Starting in 2004, a population model was being used to simulate population numbers and trends with results informing hunting season recommendations (Huxoll 2005). In 2010, modeling indicated a 10% population decline in Prairie white-tailed deer, while Prairie mule deer populations were stable as in past years (Huxoll 2011). Both species were in a steady decline in the Black Hills as of 2010. Model methods have evolved over the years and 2012 was the first year that well-developed population reconstruction methods and region-wide population estimates were available.

Population reconstruction methods use annual survival (*s)* and hunter harvest mortality rates [(*hm)*-the proportion of total mortality caused from hunter harvest] obtained through radio-collared individuals. Survival and *hm* rates are quantified separately between species and geographical area. The current year harvest projections *(h)* (including total harvest of all user groups combined) are calculated for each deer unit and then analyzed at the DAU level. The pre-season population estimate (*N)* is then formulated for each DAU and combined for a statewide estimate using the formula: $N=((h)/(hm))/(1-s)$. Pre-season estimates for deer are derived when populations are at their highest before any hunting or other sources of mortality have occurred. Therefore, pre-season estimates for deer do not take into account additional mortality factors that occur on populations over the summer months. The pre-reproduction estimates (*pN*) (remaining population after all mortality factors are taken into account) are then derived for each DAU using the formula: $pN= (N)-((h)/(hm))$.

Confidence intervals for population reconstruction estimates are derived using Markov Chain Monte Carlo (MCMC) simulation methods in Program R. Standard errors are calculated for all survival input variables using the maximum likelihood estimator and sex and age ratio standard errors are calculated using the binomial proportion confidence interval estimator. One million random inputs are generated through MCMC simulations for each input variable from a probability distribution over the domain of each standard error. The results of the simulation are then aggregated to formulate the confidence interval for the population estimate of interest. Lambda (the annual rate of change overtime) is then calculated to indicate if the population of interest is increasing, decreasing or stable. Confidence intervals for lambda are developed using MCMC simulation methods in Program R, incorporating standard errors for all input variables. To predict how different license recommendations may impact λ, change in harvest is assumed to be additive, and the potential number of animals added or removed from the population is derived from the previous 3-year average success rate for that license type.

Statewide results for 2013-2016 indicated increasing populations for both species in the Black Hills while populations decreased by 5-15% and rebounded for both species in the Prairie regions (Table 43).

Table 43. Population size estimated for white-tailed deer (WT) and mule deer (MD) in Black Hills and Prairie regions (East River and West River combined) of South Dakota, 2013-2016 (Huxoll 2013, 2014, 2015).

| | Black Hills | | Prairie | |
|---|---|---|---|---|
| **Year** | **WT** | **MD** | **WT** | **MD** |
| 2013 | 38,050 | 8,250 | 357,170 | 93,170 |
| 2014 | 41,207 | 8,722 | 317,129 | 87,508 |
| 2015 | 45,100 | 9,400 | 370,100 | 94,800 |
| 2016 | 51,000 | 6,500 | 375,000 | 110,000 |

In 2016, through a collaborative effort with the University of Montana, a deer modeling software package currently known as PopR was developed. This web-based application for analysis and management of population data enables managers to bring cutting edge statistical analyses to conservation planning and decision making. PopR includes Bayesian integrated population models (IPMs) combining multiple sources of data into a single population projection model simultaneously fit to all data across time (Johnson et al. 2010). IPMs consider all sources of uncertainty and provide prediction intervals on future population size. In addition, IPMs allow information known about deer population dynamics to be incorporated into the analysis through the use of prior distributions on model parameters.

The current IPM within PopR is divided into a process model and observation model. The process model describes the biological change within a deer population through time, and consists of a three age-class [fawns (0-4 months), juveniles (5-16 months) and adults (17+ months)] matrix model including both males and females. The parameterization of the matrix model is dependent upon the biological conditions and data support. The observation model describes the sampling process and has the flexibility to cope with missing data. To properly handle uncertainty, the process and observation models are separated (Nowak et al., *in review*).

Process model:

$$\begin{aligned}
N_{f,t+1} &= N_{j,t} \cdot P \cdot FC \cdot S_{j,t}^{8/12} + N_{a,t} \cdot P \cdot FC \cdot S_{a,t}^{8/12} + \epsilon_{f,t} \\
N_{j,t+1} &= N_{f,t} \cdot S_{j,t} + \epsilon_{j,t} \\
N_{af,t+1} &= N_{j,t} \cdot S_{af,t} \cdot r + N_{af,t} \cdot S_{af,t} + \epsilon_{af,t} \\
N_{am,t+1} &= N_{j,t} \cdot S_{am,t} \cdot (1-r) + N_{am,t} \cdot S_{am,t} + \epsilon_{am,t}
\end{aligned}$$

where,
$N_{i,j}$ is population size of age class $i$ in year $j$
$S_{i,j}$ is survival probability of age class $i$ in year $j$
$P$ is pregnancy rate

$FC$ is the average fawn count per pregnancy
$r$ is the probability that a juvenile is a female
$\epsilon_{i,j}$ is residual variation for age class $i$ in year $j$. $\epsilon_{i,j} \sim Normal(0, \sigma_i)$

Observation model:

$$\hat{\theta} \sim Normal(\tilde{\theta}, \hat{SE}(\hat{\theta}))$$

where,
$\hat{\theta}$ = field estimate
$\hat{SE}(\hat{\theta})$ = estimated standard error of $\hat{\theta}$
$\tilde{\theta}$ = IPM parameter.

During an IPM model run, estimates of survival, reproduction, and abundance simultaneously are formulated while accounting for uncertainty in the field data and "noise" in the biological process of interest. PopR also fits models and formulates estimates for survival, herd composition ratios and reproductive rates. To predict how different tag recommendations may impact λ (rate of population change), change in harvest is assumed to be additive, and the potential number of animals added or removed from the population is derived from the previous 3-5 year average success rates for that tag type. This function allows wildlife managers to manipulate future harvest strategies to assess potential population-level effects. Once the model of interest is fit the user has multiple options to evaluate results in tabular and plot formats. Lastly, a summary report is generated for each model fit that can be downloaded in HTML and/or PDF formats (Lukacs and Nowak, unpublished).

Population trajectories are an important management tool that enables justification for future harvest strategies dependent upon management objectives (Table 44). Understanding population rates of change allows managers to implement proactive management recommendations while practicing adaptive management techniques.

<u>Winter Severity</u>
Winter severity is an important metric contributing to survival of free ranging mule deer and white-tailed deer (Baccannte and Woods 2010, Verme 1968). Relating how climatic conditions impact deer survival and subsequent recruitment has potential predictive value and can assist managers in determining if severe winter weather impacts population growth rates. Techniques used to relate climatic conditions with physiological demands vary greatly by latitudinal gradients (Chadwick 2002). Based on a winter severity index (WSI) developed by Baccannte and Woods (2010), SDGFP currently utilizes mean monthly temperature and total monthly snowfall data from November through April as covariates for the following linear model that quantifies a WSI:

- Monthly WSI = (Mean monthly temperature * (-0.1) +1) * (Total monthly snowfall)
- Annual WSI Value = Sum [mean monthly WSI values (Nov + Dec + Jan + Feb + Mar +Apr)]

Weather data are obtained through an annual data request via the National Oceanic and Atmospheric Administration (NOAA). Monthly summaries are archived in the Global Historical Climatology Network (GHCN) for weather stations across South Dakota and surrounding states. Monthly summary data from approximately 2,000 weather stations distributed across South Dakota and surrounding states are requested, received and downloaded. Program R, a statistical software package (R Core Team 2015) is used to extrapolate weather data across all deer units using an inverse distance weighted interpolation (IDW) function. This method takes station values and fills in areas between stations using an inverse distance weighted average. The R package (Intamap) attempts to optimize the power value for the weights based on removing stations and cross validating. Program R scripts also allow winter severity indices to be quantified at different hierarchical levels (i.e., statewide, DAU and management units) dependent upon GIS shapefile boundaries (Figure 43). To increase precision and accuracy, interpolation repetitions are currently set at ten. Once weather data have been summarized at the deer harvest unit level, a script developed in Program R then calculates a monthly WSI value for each deer unit. Monthly WSI values are then summed together resulting in the annual WSI.

Data analyses to evaluate how varying degrees of winter severity values impact deer population performance are on-going. The continued compilation of juvenile and adult survival and pregnancy rate data are necessary in order to make sound scientific relationships between WSI values and how those values impact mule deer and white-tailed deer population performance spatially and temporally. The occurrence of a severe winter while statistically valid sample sizes are available is vitally important in formulating robust regression equations that have the ability to predict survival and potential reproductive rates during years with similar winter severity values.

Over the last 13 years, three consecutive winters (2008/09, 2009/10 and 2010/11) produced WSI values substantially greater than the 30-year normal (132.4 index) illustrated by the red line in Figure 44. The winter of 2010/11 was the most severe with a statewide WSI value of 288 and winter mortality events within numerous DAUs across the state were reported. Inferences regarding percent loss were not possible during the winter of 2010/11 because of the limited number of radio-collared deer being monitored, but SDGFP speculates localized deer population performance was negatively impacted by the deep snow and excessive cold temperatures.

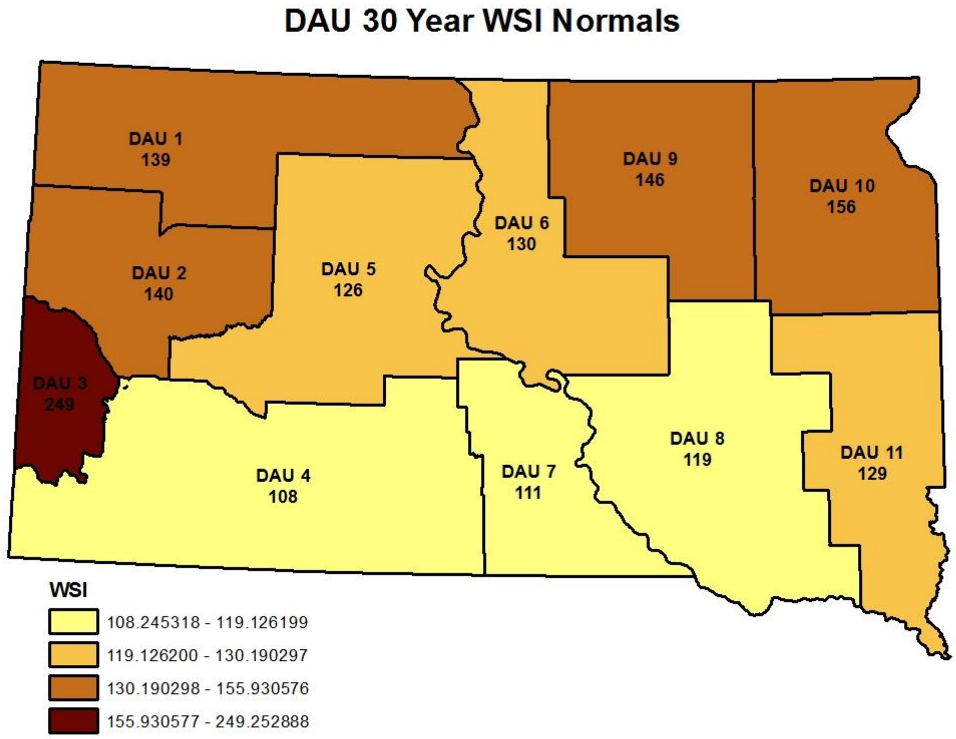



Figure 43. 30-year Winter Severity Index (WSI) average for each Data Analysis Unit (DAU), 1980-2010.

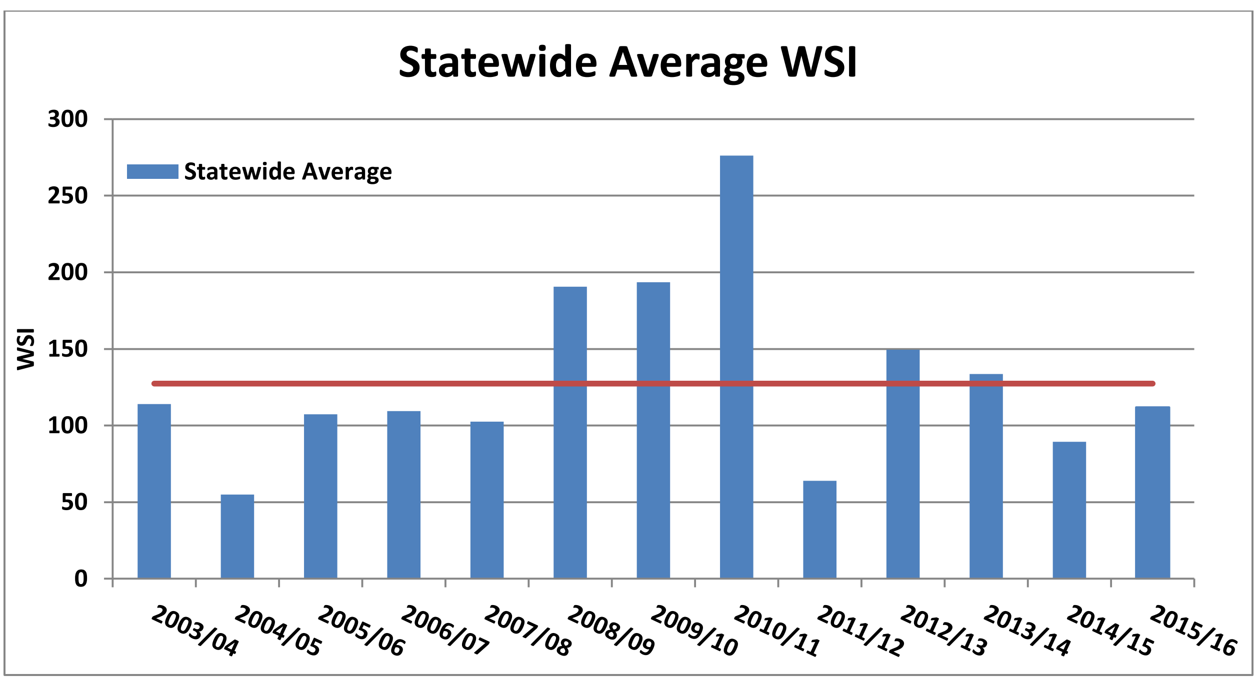



Figure 44. Statewide average winter severity index, 2004-2016.

Table 44. Predicted deer population trends (decrease [↓], stable [●], increase [↑]) based on adult female (>17 months) survival and over-winter (October - May) fawn survival in relation to September - October fawn:doe ratios.

| Fall Herd Composition | 60 Fawns: 100 Does | | 70 Fawns: 100 Does | | 80 Fawns: 100 Does | | 90 Fawns: 100 Does | | 100 Fawns: 100 Does | |
|---|---|---|---|---|---|---|---|---|---|---|
| Over-winter Fawn Survival | 0.6 | 0.8 | 0.6 | 0.8 | 0.6 | 0.8 | 0.6 | 0.8 | 0.6 | 0.8 |
| Annual Adult Female Survival | | | | | | | | | | |
| 0.7 | ↓↓ | ↓ | ↓ | ● | ● | ↑ | ● | ↑ | ↑ | ↑↑ |
| 0.8 | ↓ | ↑ | ● | ↑ | ↑ | ↑↑ | ↑ | ↑↑ | ↑↑ | ↑↑↑ |
| 0.9 | ↑ | ↑↑ | ↑ | ↑↑ | ↑↑ | ↑↑↑ | ↑↑ | ↑↑↑ | ↑↑ | ↑↑↑↑ |

Lambda ↓↓: 0.80 - 0.90 ↓: 0.90 -0.99 ●: 0.99 - 1.01 (Maintain) ↑: 1.01 - 1.10 ↑↑: 1.10 - 1.20 ↑↑↑: 1.20 - 1.30

**Historical Deer Population Surveys**

The following surveys have been conducted in the past to provide data on deer populations within South Dakota. Attempts have been made to list surveys chronologically in order of their first appearance in the literature. When data differ among reports, the most recent values were used in this summary (e.g., the number of deer tagged annually from 1972-1978 in Schenck 1980 versus Wallin and Rice 1987a).

<u>Warden Questionnaires</u>

The first population surveys conducted in South Dakota were questionnaires sent annually each summer to conservation officers to estimate the number of deer in their district in the East River and West River regions. Wardens also provided recommendations for the type/timing of the next deer season and opinions on the effects of last year's deer season as well as other factors on the status of deer populations. No statistics were used to adjust population estimates.

Surveys were conducted from 1949 to 1957. Estimates of East River deer ranged from 5,800 to 12,036 over this time period. East River opinions seemed centered on concerns about crop damage (later referred to as depredation) from deer. Estimates for West River deer ranged from 3,700 to 23,245 during this time period but often lacked data from some counties, particularly Harding County. Of historical interest, in 1949 conservation officers in Lyman and Gregory counties favored an all-inclusive deer season because most of their "deer country," the riparian drainages along the Missouri River, was soon to be flooded with the creation of Fort Randall Dam.

Rancher Questionnaire

Questionnaires were sent in the spring to ranchers in the Black Hills for most years from 1950 to 1971. Questionnaires were mailed to ranchers in April with a stamped return-addressed envelope. Ranchers were asked if deer numbers were higher, about the same, or lower in the current spring compared to previous year. Ranchers were also asked to estimate the number of deer on their land (if they were in the habit of doing so) and the type of hunting season that they would prefer for the following fall (Richardson 1967). The purpose was to determine the population trend in the Black Hills (Brady 1971).

Black hills deer population numbers were reported from 1951-1959, ranging from 864 (1957; Novak 1958b) to 7,835 (1953; Berner 1954) during this time period (Table 45). After 1959 only trend directions were reported, for example, in 1969 27.4% reported higher deer numbers, 22.6% reported lower numbers, and 50.0% reported that numbers were the same as the previous year (Richards 1969; Table 46). From 1962 through 1964 the overall population was reported as being the same as the previous year with a higher population reported for 1965; the Black Hills population was reported as being in excellent condition in 1963-1965 (Richardson 1962a, 1963, 1964, 1965). Hunting season preferences were also reported by ranchers for the duration of the study.

Researchers felt that responses on populations were highly influenced by the severity of the previous winter's snowfall (Berner 1956). For example, deer were in denser groups in the spring if snowfall was severe yet may appear to be in sparser numbers after milder winters since they were more dispersed across the landscape. These surveys provided a comparison to results from state-sponsored biological surveys, and were viewed as an investment in cooperation with the landowners (Novak 1958a). Ranchers were viewed as more likely to respond if they felt that too many deer were present (Richardson 1962a).

Table 45. The total sum of population estimates per year provided by ranchers in the Black Hills, South Dakota, in response to a deer management questionnaire, from 1951-1955 and 1957-1959.

| Year | Current Year Estimate | Estimate Made This Year for Previous Year | Reference |
|---|---|---|---|
| 1951* | na | na | Berner 1951 |
| 1953 | 6,865 | 5,794 | Berner 1953a |
| 1954 | 5,002 | 7,835 | Berner 1954 |
| 1955 | 3,021 | 3,176 | Berner 1956 |
| 1957 | 1,774 | 1,901 | Novak 1958a |
| 1958 | 957 | 864 | Novak 1958b |
| 1959 | 2,260 | 1,699 | Novak 1959b |

* Values not given but reported as higher in 1951 than in 1950 except west of Custer.

Table 46. The percentage of ranchers in the Black Hills, South Dakota, indicating that deer populations were higher, about the same, or lower than last year when responding to a deer management questionnaire, from 1951-1955, 1957-1959, 1962-1965, and 1967-1971.

| | Percentage of Ranchers Reporting Population Changes in Relation to Last Year* | | | |
|---|---|---|---|---|
| Year | Higher | About the Same | Lower | Reference |
| 1951 | 48 | 34 | 18 | Berner 1951 |
| 1952 | 48 | 43 | 7 | Berner 1952b |
| 1953 | 71.4 | 22.9 | 5.7 | Berner 1953a |
| 1954 | 7.3 | 27.0 | 65.7 | Berner 1954 |
| 1955 | 16.8 | 48.8 | 34.4 | Berner 1956 |
| 1957 | 21 | 52 | 27 | Novak 1958a |
| 1958 | 26 | 36 | 32 | Novak 1958b |
| 1959 | 37 | 42 | 21 | Novak 1959b |
| 1962 | 9.7 | 47.3 | 43.0 | Richardson 1962a |
| 1963 | 10.6 | 40.0 | 49.4 | Richardson 1963 |
| 1964 | 24.3 | 49.0 | 26.7 | Richardson 1964 |
| 1965 | 30.9 | 47.2 | 21.9 | Richardson 1965 |
| 1967 | 27.1 | 53.2 | 19.7 | Richardson 1967 |
| 1968 | 32.6 | 51.3 | 16.1 | Richardson 1968 |
| 1969 | 27.4 | 50.0 | 22.6 | Richards 1969 |
| 1970 | 8.3 | 32.5 | 59.2 | Richardson 1970 |
| 1971 | 22.9 | 39.3 | 37.4 | Brady 1971 |

*Percentages may not sum to 100 for any given year.

<u>Roadside Spotlight Survey in Black Hills</u>

Roadside spotlight counts were the first surveys of deer conducted in South Dakota. Two surveyors rode together along designated roads and shined spotlights at night onto adjacent lands to identify deer (gender, age, and species to the extent possible) for a certain number of nights each season. Maximum counts for each route were determined. Methodology for summer surveys was standardized beginning in 1959, including the marking of meadow boundaries and restricting surveys to temperatures at or above 44 degrees Fahrenheit, minimal or no moonlight, and no adverse weather (Hart 1959).

Spotlight surveys were conducted exclusively in the Black Hills region. Spring surveys were considered best for determining overall population numbers and species composition because deer were forced to concentrate in the areas of first green-up in the spring (Kranz 1974).

During fall surveys adult bucks aided in gender identification, but spike bucks, fawns, and does were difficult to separate out in large groups (Davis 1950, Davis 1952, Kranz 1973b). In addition counts could be skewed if the hunting season was already initiated (Kranz 1974). Researchers appreciated that summer was a better time of year to collect data for setting the upcoming fall hunting regulations yet summer meadows could be cut leading decreased use (Robbins 1963, Kranz and Petersen 1972, Kranz 1973a, 1974). All meadows were also subject to land changes such as succession (changing their attractiveness to deer) and were not considered reliable for year-to-year counts (Kranz 1973b).

Researchers found considerable variation both nightly, from area to area, and from year to year (Kranz 1974). Variables affecting this survey type include temperature, moon phase and related darkness (more deer were observed on dark nights), meadow status (green versus dry), activity by bow hunters, route overlap early on, and seasonal timing of surveys in conjunction with weather. Sources of bias in the results from year-to-year for age and gender ratios include survey date, time, and location; population age structure; technique used; and vegetation density (Kranz 1974, Schenck 1980).

Spring surveys were conducted in 1950-1952, 1954-1959, and 1962. Peak numbers recorded ranged from 878 (1956) to 1,353 (1951; Bever 1957b, Davis 1952). For surveys restricted to the central and southern Black Hills peak values ranged from 715 (1960) to 973 (1959; Novak 1960, Richardson 1962b). The north route was discontinued after 1957 because surveyors could not get good peak use values (Novak 1959a). Surveys in the central and southern Black Hills were valued because they showed definite trends and migration patterns, and helped define deer unit boundaries for setting hunting seasons (Richardson 1962b).

Summer spotlighting began annually in 1959, but was discontinued after 1962 because researchers concluded mowing of the observed meadows highly influenced whether deer were present (Robbins 1963). Summer spotlighting was revived for three years beginning in 1970 and standardized to eight 30-mile routes throughout the Black Hills (Kranz and Petersen 1972, Kranz 1973a, 1974). Ratios of bucks to does to fawns were calculated, and for the first time these data underwent statistical analysis (Table 47). The proportion of mule deer to white-tailed deer in the overall count was 8-11 mule deer per 100 white-tailed deer (Kranz and Petersen 1972, Kranz 1973a, Kranz 1973b, Kranz 1974).

Fall surveys occurred from 1949-1956, and as with summer spotlighting, were revived briefly along the same standardized routes as summer surveys from 1970-1973 but the authors recommended that all spotlighting surveys be discontinued (Kranz and Petersen 1972, Kranz 1973a, Kranz 1974). Some fall spotlight surveys were conducted in 1979 as part of a study on fawn mortality but results were not considered statistically accurate (Rice 1980). For the surveys in the 1950s, maximum counts for the entire Black Hills ranged from 1,353 to 3,752 (Davis 1950, 1952) and for the northern Black Hills only, ranged from 756 to 1,702 (Berner 1953b, Berner 1956). The ratio of bucks to does to fawns was calculated as well as the proportion of white-tailed deer and mule deer (Tables 48 and 49).

Table 47. The ratio of bucks to does to fawns determined from summer spotlighting counting surveys in the Black Hills, South Dakota, 1959 and 1970-1972.

| Year | Ratio Buck:Doe:Fawn for All Deer combined | Ratio Mule Deer: White-tailed Deer | Reference |
|---|---|---|---|
| 1959 | 29:100:104 | na | Hart 1959 |
| 1970 | 25:100:12 | 11:100 | Kranz & Petersen 1972, Kranz 1974 |
| 1971 | 18:100:13 | 8:100 | Kranz 1973a, Kranz 1974 |
| 1972 | 13:100:16 | 9:100 | Kranz 1973b, Kranz 1974 |

Table 48. The ratio of bucks to does to fawns and mule deer to white-tailed deer determined from fall spotlighting counting surveys in the Black Hills, South Dakota, 1945-1977.

| Year | Ratio Buck:Doe:Fawn | | | Ratio Mule Deer:White-tailed Deer | Reference |
|---|---|---|---|---|---|
| | All Deer | White-tailed Deer | Mule Deer | | |
| 1945 | 15:100:114 | na | na | na | Davis 1952 |
| 1947 | 28:100:88 | na | na | na | Davis 1952 |
| 1949 | 25:100:99* | na | na | na | Davis 1950 |
| 1950 | 26:100:108 | na | na | na | Davis 1952 |
| 1951 | 42:100:112 | 42:100:109 | 41:100:121 | na | Davis 1952 |
| 1970 | 29:100:60 | na | na | 11:100 | Kranz & Petersen 1972, Kranz 1974 |
| 1971 | 28:100:51 | na | na | 8:100 | Kranz 1973a, Kranz 1974 |
| 1972 | 26:100:64 | na | na | 9:100 | Kranz 1973b, Kranz 1974 Rice 1979 |
| 1977 | na:100:48 | na | na | na | Rice 1980 |

*This value was from October which the report states as most reliable; ratio was 22:100:39 in August and 37:100:52 in September

Table 49. The ratio of bucks to does to fawns for white-tailed deer and mule deer, determined for the northern Black Hills only, from fall spotlighting counting surveys in the Black Hills, South Dakota, 1952-1956.

| | | Ratio Buck:Doe:Fawn | | |
|---|---|---|---|---|
| **Year** | **All Deer** | **White-tailed Deer** | **Mule Deer** | **Reference** |
| 1952 | 25:100:127 | 26:100:125 | 31:100:154 | Berner 1953b |
| 1953 | 14:100:74 | 13:100:81 | 22:100:45 | Berner 1954 |
| 1954 | 53:100:85 | 56:100:85 | 32:100:85 | Priewert 1956a |
| 1955 | 33:100:93 | 34:100:94 | 31:100:81 | Priewert 1956b |
| 1956 | 29:100:104 | 30:100:104 | 18:100:101 | Priewert 1958 |

Beginning in the late 1980s these surveys were discontinued and replaced with opportunistic (random) counts throughout South Dakota referred to as pre-hunt classification counts (see below) which became an important metric for calculating the proportion of fawns born that survived until fall.

Pellet Survey in Black Hills

Pellet counts were counted annually at designated locations in the Black Hills to provide a rough estimate of the number of deer present and show year-to-year changes. In early summer two observers counted the number of pellet groups observed along a transect and marked each group in permanent yellow paint. About one year later the same transect was again surveyed and all new (non-painted) pellet groups were counted. Initially there were 53 transects (one per township) each 2,000 feet in length and 10 feet wide (Bever 1955). Beginning in 1960 106 transects were surveyed, each 1,000 feet in length and six feet wide (Richardson 1959). Methods changed again in 1972 when transect length was reduced to 500 feet and the total number of transects increased to 150 (Hauk and Kranz 1973). In 1985, the last year that this method was employed, only 63 transects were surveyed (Hauk and Nash 1987). Sampling error was calculated by having a second survey conducted at all or a subset of transects immediately after the first survey was completed. Using a defecation rate of 12 and later 13 pellet groups per day per individual, the deer population for the Black Hills was determined (Richardson and Petersen 1974, Figure 45).

These surveys began in 1953 and were conducted through 1970, modified and conducted again in 1972 (though not analyzed) and from 1975 through 1987. Initially these data were extrapolated to 30 unsampled (called marginal) townships in the Black Hills to calculate an overall population value. In several reports researchers noted that pellet detection was affected by timber harvest and slash and development of homesteads and agriculture, suggesting that transects be moved (Schroeder 1979) but reports do not indicate such changes.

The defecation rate of 13 pellet groups per deer per day was not determined in the Black Hills but was one borrowed from other studies in the US. Researchers tried to determine a more accurate rate, as well as refine other features of the survey. For example, the effectiveness of circular versus linear plots, plot shapes, and sampling intensity were studied (Hart 1958). Also for two summers a pregnant female was kept in an enclosure from which researchers studied daily defecation rates, observer error, and aging of pellets (Hart 1960, 1961). While the intention was to also research these variables for the fawn(s) to be born, the ensuing fawns did not survive. This research led to the transect length being shortened from 2,000 to 1,000 feet, but the defecation rate was not changed.

At one point this method was considered the most important survey for identifying population trends in the Black Hills while also providing information on the location of deer concentrations and carrying capacity, and guiding the placement of management unit boundaries (Richardson and Schwarting 1969).

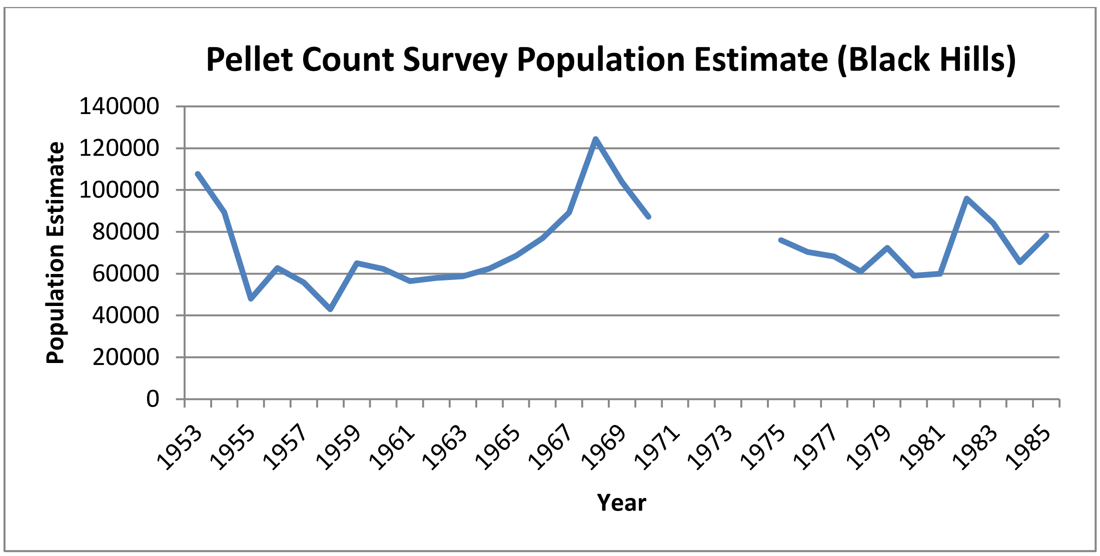



Figure 45. Population of deer in the Black Hills estimated from pellet count surveys, 1953-1970, 1975-1985. From 1953-1960 the estimate included extrapolation to 30 unsampled townships (Richardson and Schallenberger 1962).

## Trapping and Tagging

The goal of the trapping and tagging/radio-telemetry studies documented in the reports of the deer management surveys was to determine movement of white-tailed deer in the northern Black Hills between South Dakota and Wyoming, redefine the winter range of all Black Hills deer, and know the location of tagged deer during the hunting season (Wallin and Rice 1987b).

Clover traps were set in areas of known white-tailed deer concentrations in winter and checked daily. Captured deer were marked with two metal and one plastic ear tag. When deer were subsequently found, whether re-trapped, found dead, or harvested, this location was mapped and analyzed for direction and distance from capture site (Wallin and Rice 1987a).

A total of 1,460 white-tailed deer were tagged (out of 2,584 trapped; Wallin and Rice 1987a) in the Black Hills from 1972-1978 with number of deer tagged each of these years as follows: 43, 240, 328, 420, 284, 76, and 69 (Schenck 1980). Based on the mapping results researchers were able to identify Interstate 90 as a barrier to movement in the northern Black Hills. Re-covered tagged individuals from 1971-1972 to 1973-1974 were mostly from hunter harvest, while some died from unknown causes, vehicle collisions, being killed by dogs or shot illegally. Movements of 2 to 36 miles were reported for mule deer (Richardson and Petersen 1974). More specific results were not available in the literature reviewed.

Incisor Tooth Surveys

Historically, knowledge of deer population age structure was determined to be an essential tool for deer population management (Severinghaus 1949). Age determination of both white-tailed deer (Severinghaus 1949) and mule deer (Robinette et al. 1957) was based on tooth wear and development. Rice (1974) determined that in order to more accurately manage deer herds in South Dakota, a population age structure was needed, so a review of new methodology using dental cementum annuli for obtaining accurate age data for deer in South Dakota was initiated. This technique uses alternating bands of dental cementum annuli laid down annually in deer incisors to determine the age of the animal. The dental cementum annuli method was refined and used for aging of mule deer by Low and Cowan (1963), and white-tailed deer by Ransom (1966), Gilbert (1966), and Lockard (1972).

SDGFP used the cementum annuli aging method to determine specific age structures for white-tailed and mule deer during the 1973-1975 deer harvest seasons (Rice 1974, 1975, 1976). During the first season a total of 377 pairs of incisors were analyzed by visual inspection and using the cementum annuli method (Rice 1974). Errors in aging by visual inspection were found in 9 out of 21 yearlings and 15 out of 241 adults, but this also related to the experience of the observer (Rice 1974). In the 1974 harvest season, tooth envelopes were included in license packets mailed to hunters, ultimately collecting 14,442 usable sets of teeth out of the 30,860 envelopes sent out (Rice 1974). In the 1975 harvest season, 12,186 usable pairs of incisors were acquired from 56,651 envelopes sent out (Rice 1976). These teeth were used to test the accuracy of the visual inspection methods described by Severinghaus (1949) and Robinette et al. (1957) compared to the cementum annuli method. Results showed that visual inspection was a sufficient way to classify deer into fawn, yearling, and adult categories using incisor teeth only. Again, some difficulty was initially experienced with the classification of yearlings, but was believed to be correctable with experience (Rice 1974).

The submission of deer teeth was initially a voluntary program with reminders sent to resident hunters stressing the importance of the teeth submission for deer management. Tooth submissions went through periods of declining submissions with the voluntary designation, and in 1998, the submission of teeth became mandatory through SDGFP Administrative Rule 41:06:02:02, in which non-submission of teeth would result in loss of opportunity to draw a deer license the following year. Although this rule was very difficult to enforce, each time there was a postcard or letter inclusion in the license packets to hunters explaining that tooth submission was vital to the management of South Dakota deer, or that the submission was mandatory, the return of teeth increased. The number of tooth envelopes that were issued to hunters for tooth submission, and the numbers of envelopes returned, is shown in Figure 46. SDGFP also recognizes that all hunters were not successful, thus the discrepancy between envelopes issued and returned is not as large as it appears.

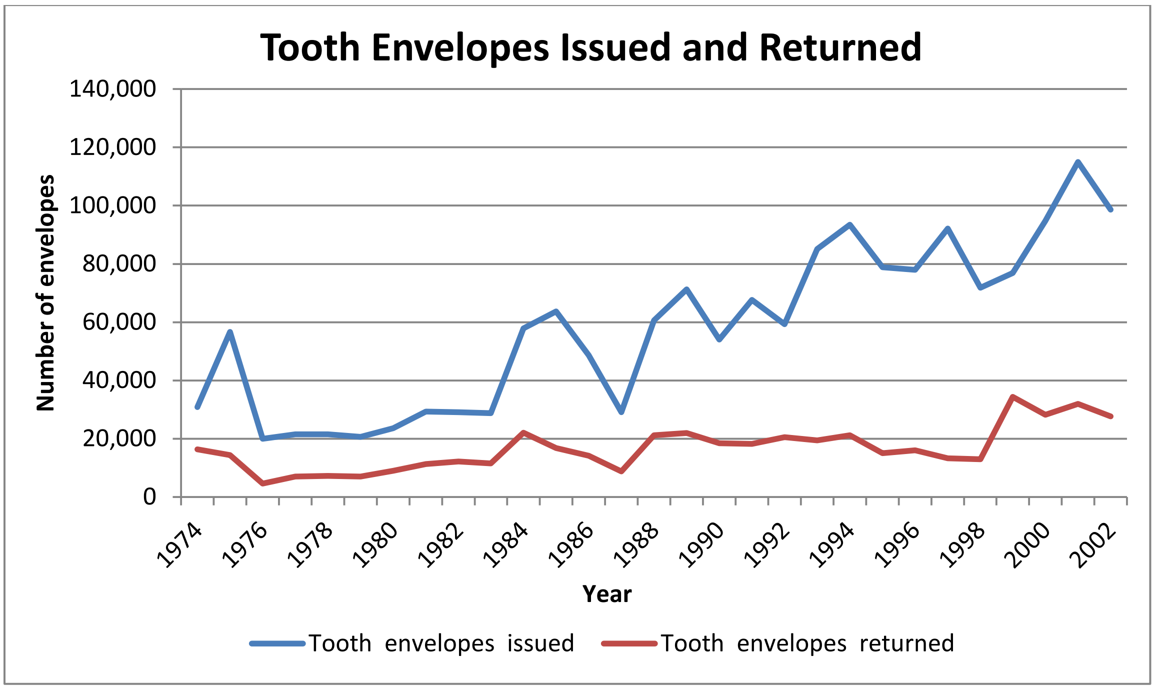



Figure 46. The number of tooth envelopes issued to South Dakota resident deer hunters and returned by resident deer hunters, 1974-2002.

Data analysis methods from 1976-2007 were inconsistent. Some teeth from specific management units were only aged to fawns, yearlings, and adults and other teeth from specific units were aged into individual age categories. Also, there are years (1984-1988) where these data could not be found, and/or the aging of deer teeth was not conducted. Samples of deer teeth were collected from hunter harvested deer during the main hunting seasons including East River, West River, and Black Hills. Teeth were also collected from other seasons including refuge deer, Youth Deer, Archery Deer, and Muzzleloader Deer. All teeth collected were analyzed at the unit level whenever possible. From 1976 to 1999, the majority of deer teeth that were submitted were aged through cementum annuli and most teeth were placed in individual age categories with some classified only to fawn, yearling, and adult (2+) age categories. Hamlin et al. (2000) tested the accuracy of known age mule deer and white-tailed deer against ages assigned by Matson's Laboratory in Montana. Accuracy rates using the laboratory were 92.6% for mule deer through age 14, and 85.1% for white-tailed deer through age 9, whereas the accuracy of aging the same deer by a biologist using eruption-wear criteria was 62.3% and 42.9% for mule deer and white-tailed deer, respectively (Hamlin et al. 2000). Gee et al. (2002) found that aging deer by tooth replacement and wear methodology only allowed confident assignment of ages to the fawn, yearling, and adult categories. Deer teeth were analyzed using visual and cementum annuli techniques, for different levels of age accuracy, in different harvest seasons throughout the next few years. Teeth received in 2000 were aged to fawn, yearling, and adult ages except in the Black Hills, where teeth were sectioned to determine specific ages. In 2001, teeth were aged as fawn, yearling, and adult in East River units, and sectioned to determine specific ages in the Black Hills and West River deer units. During 2002, teeth were sectioned for the Black Hills, and aged to fawn, yearling, and adult in other areas of South Dakota. From 2004-2007, all teeth collected in South Dakota were aged to the fawn, yearling and adult age categories. The collection of deer teeth ended in 2008 due to postal regulations and the inability to ship biological samples through the US Post Office. New methods of tooth collection were discussed, but none were implemented.

Calculated age structures of both mule deer and white-tailed deer and the interpretation of these data collected was analyzed by the senior big game biologist and presented to regional staffs for the upcoming deer season recommendation process. Figures 47-57 show the annual percentages of fawns, yearlings, and adults from tooth submissions for Black Hills deer, West River deer, East River deer, and for each species and sex.

The Black Hills harvest season, up through 1995, allowed for unlimited licenses to be purchased over-the-counter. In 1996, licenses for the Black Hills seasons were available only through an application process. As a comparison, license numbers in 1995 were 11,311 residents, and in 1996, only 6,000 resident licenses were allotted. In 1995, harvest of white-tailed deer bucks was estimated at 3,105 and was reduced to 2,342 in 1996. This reduction in harvest of Black Hills white-tailed deer males allowed for the increase of older aged bucks. Figure 47 illustrates an increasing trend in the percentage of adult bucks being harvested in the Black Hills starting in 1996. Figure 47 also shows a decreasing trend in the number of yearling males being harvested on an annual basis. Figure 48 shows the percentage of fawns, yearlings, and adults that were harvested in the Black Hills for white-tailed deer females from 1978-2007, demonstrating little change over the years of data provided.

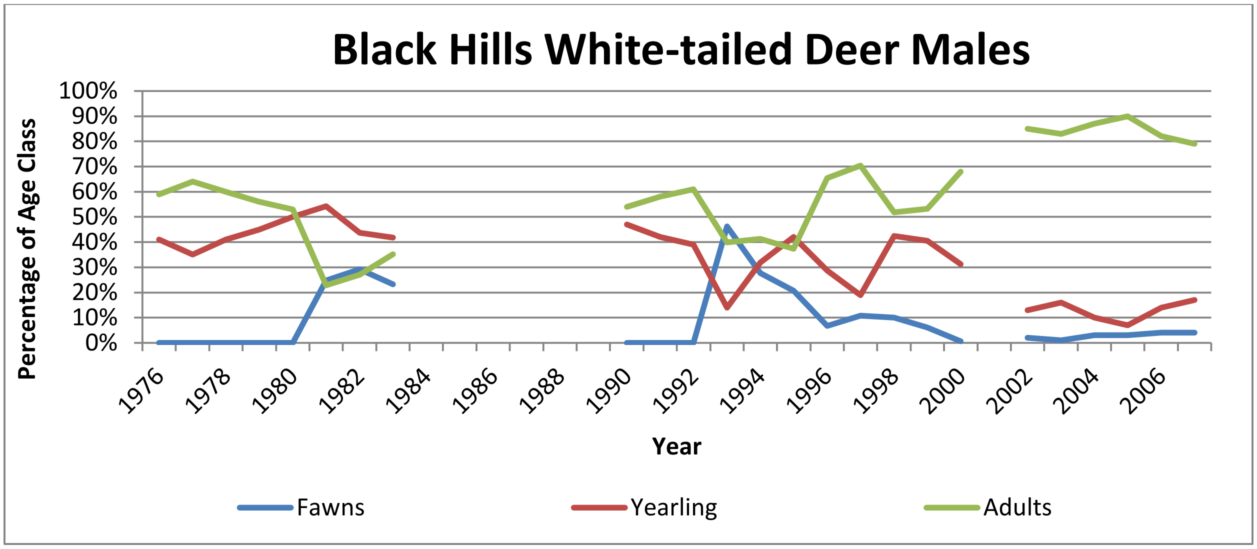



Figure 47. Percentage of fawns, yearlings, and adults in the harvest of Black Hills white-tailed deer males, 1976-2007.

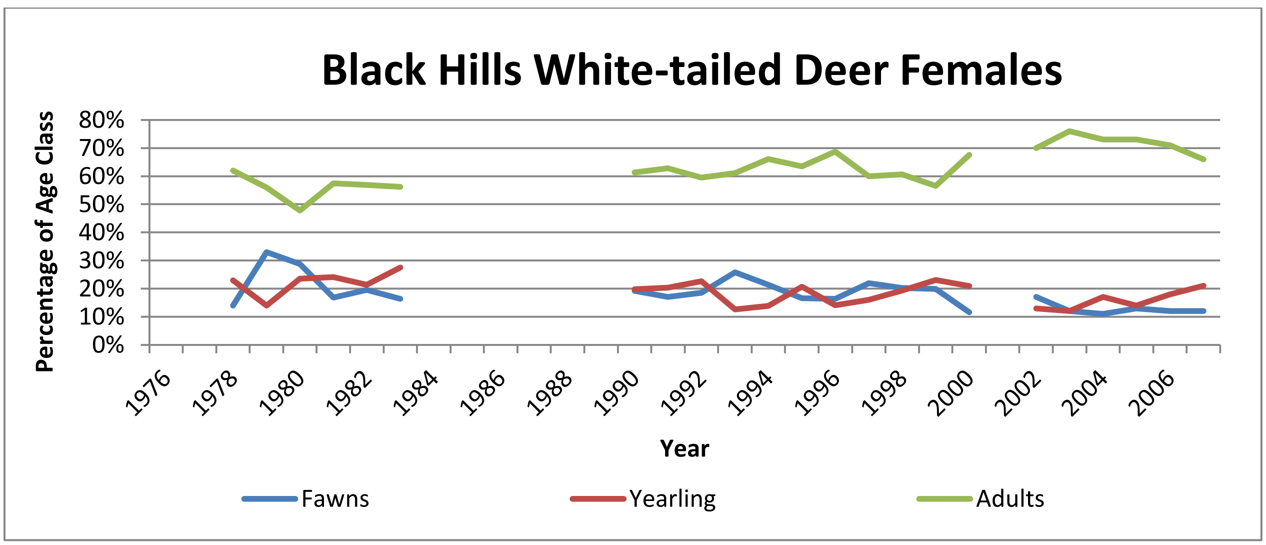



Figure 48. Percentage of fawns, yearlings, and adults in the harvest of Black Hills white-tailed deer females, 1978-2007.

Age structure of mule deer in the Black Hills follows a similar pattern to white-tailed deer. Figure 49 illustrates the age structure of mule deer males harvested during the years of 1976-2007 showing yearling mule deer males made up the majority of the harvest from 1976-1996. In 1996, as management of the Black Hills deer was changed to allow fewer licenses to be purchased, the number of adult mule deer males in the harvest increased. Collection of mule deer female samples in the Black Hills was insufficient during 1976-2007.

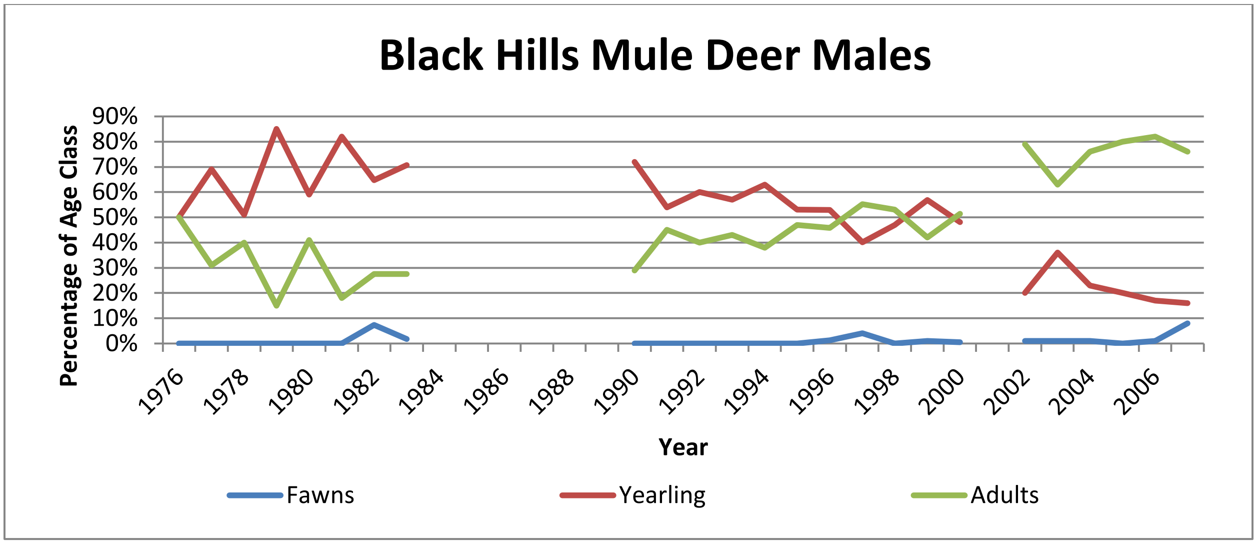



Figure 49. Percentage of fawns, yearlings, and adults in the harvest of Black Hills mule deer males, 1976-2007.

The trend in age structures for the West River white-tailed deer males shows an increase in the number of adults in the harvest, and a decrease in the number of yearlings in the harvest. There is no trend change in the amount of fawns in the harvest (Figure 50). The trend for the age structure for West River white-tailed females has been relatively consistent from 1976 through 2007 (Figure 51).

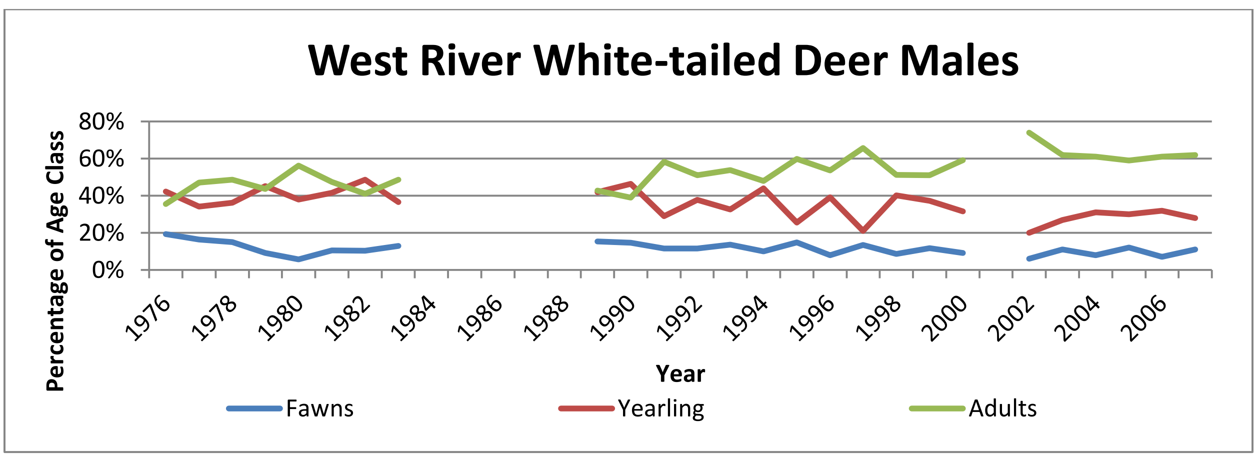



Figure 50. Percentage of fawns, yearlings, and adults in the harvest of West River white-tailed deer males, 1976-2007.

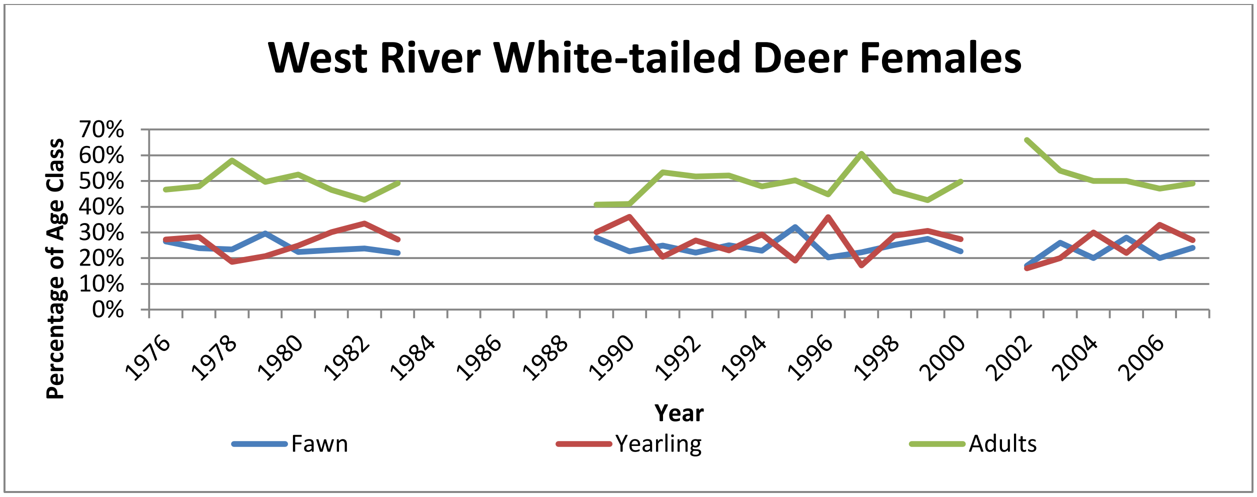



Figure 51.  Percentage of fawns, yearlings, and adults in the harvest of West River white-tailed deer females, 1976-2007.

Age structure data for West River mule deer males shows an overall increasing trend of the number of adults in the harvest, and a trending decrease in the number of yearlings in the harvest.  There is no change in the percentage of fawns in the harvest over the years of data provided (Figure 52).  The trend for the age structure for West River mule deer females appears to be consistent from 1976 through 2007 (Figure 53).

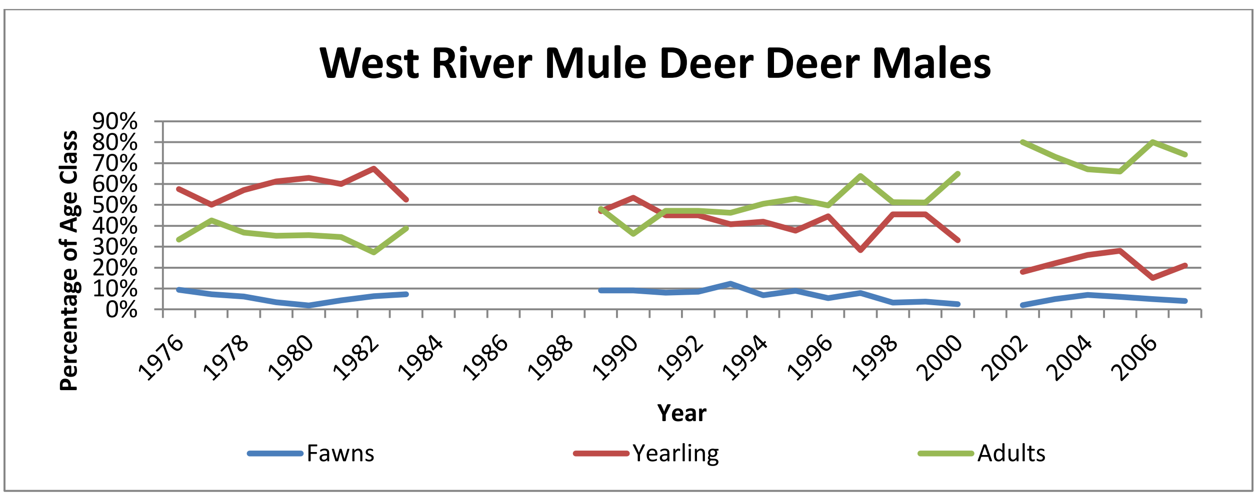



Figure 52.  Percentage of fawns, yearlings, and adults in the harvest of West River mule deer males, 1976-2007.

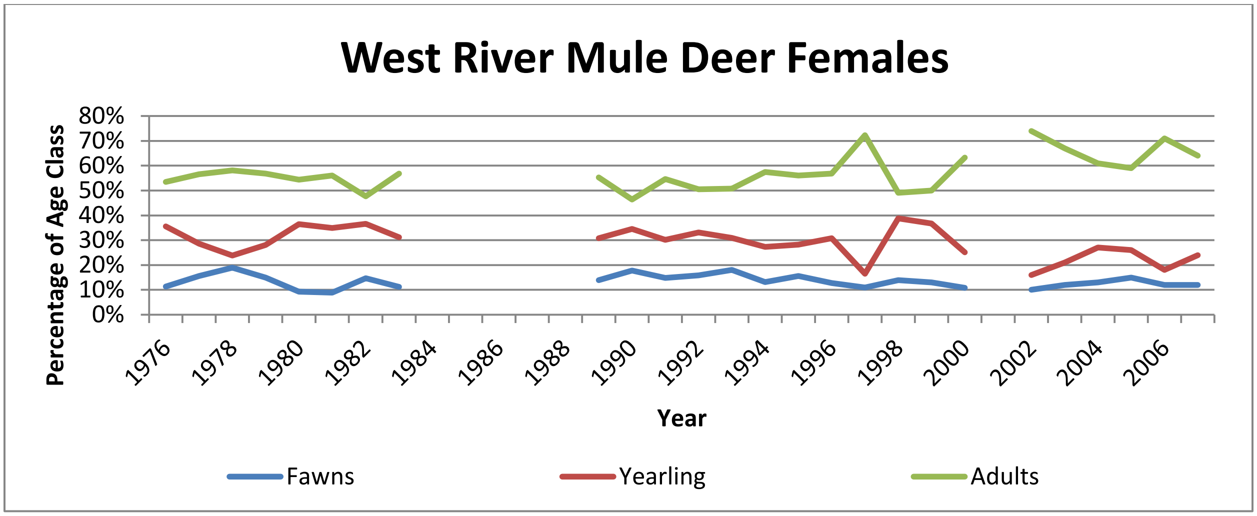



Figure 53. Percentage of fawns, yearlings, and adults in the harvest of West River mule deer females, 1976-2007.

Tooth data collected from 1976 through 2007 during the East River deer seasons shows male fawns were similar throughout all years (Figure 54). The age structures of the yearling and adult age classes collected from white-tailed males was variable with no defined trend observed (Figure 54). East River white-tailed females age structures were very consistent from 1976 to 2007 (Figure 55).

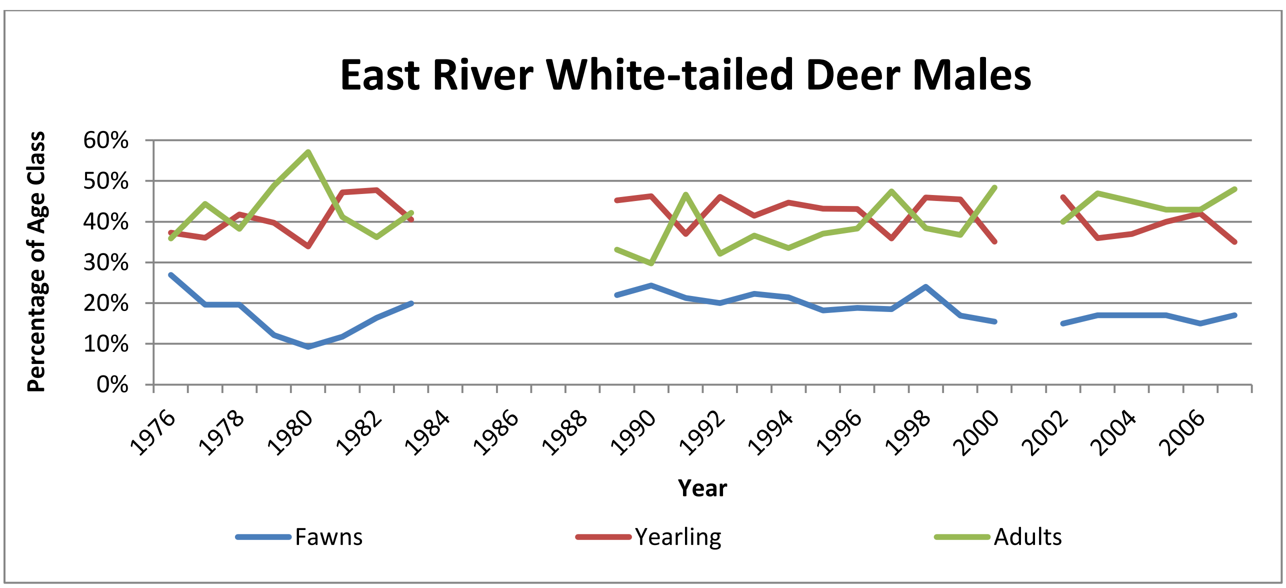



Figure 54. Percentage of fawns, yearlings, and adults in the harvest of East River white-tailed deer males, 1976-2007.

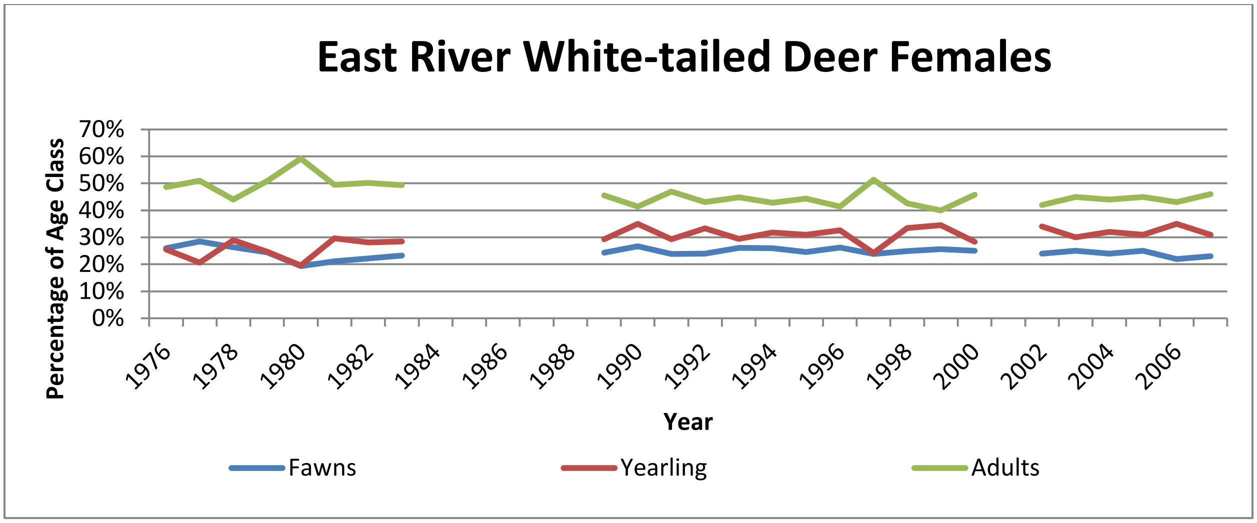



Figure 55. Percentage of fawns, yearlings, and adults in the harvest of East River white-tailed deer females, 1976-2007.

As was observed in the West River mule deer males in Figure 52, the age structure for East River mule deer males shows an overall increasing trend of the number of adults in the harvest, and a trending decrease in the number of yearlings in the harvest. There was no change in the percentage of fawns in the harvest over the years of data provided (Figure 56). Limited data were available for female mule deer in the East River areas of South Dakota from 1976 through 1989 and age structure trends showed little variation from 1990 through 2007 (Figure 57).

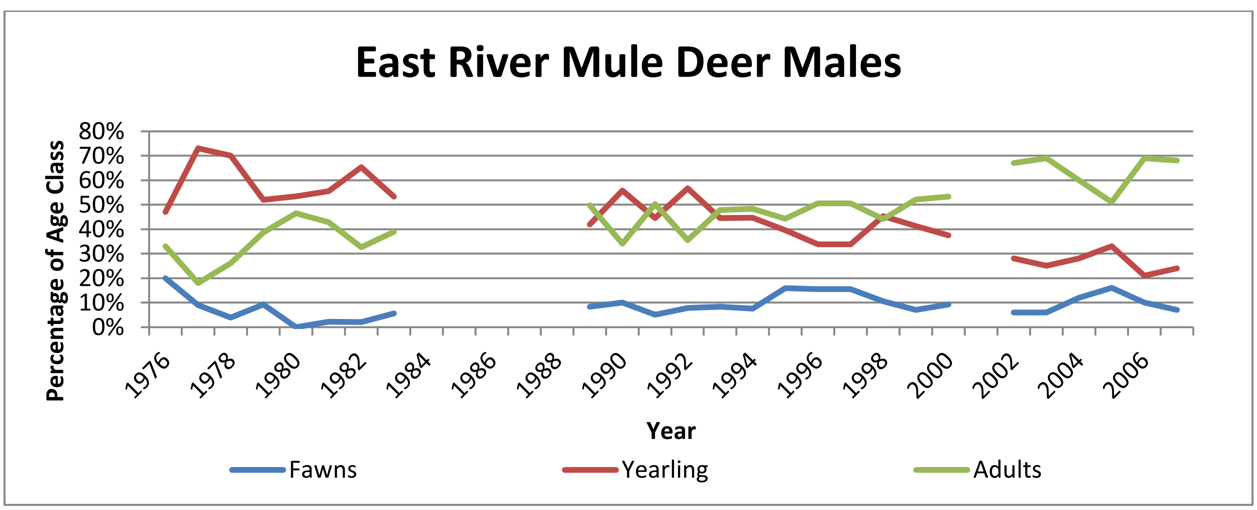



Figure 56. Percentage of fawns, yearlings, and adults in the harvest of East River mule deer males, 1976-2007.

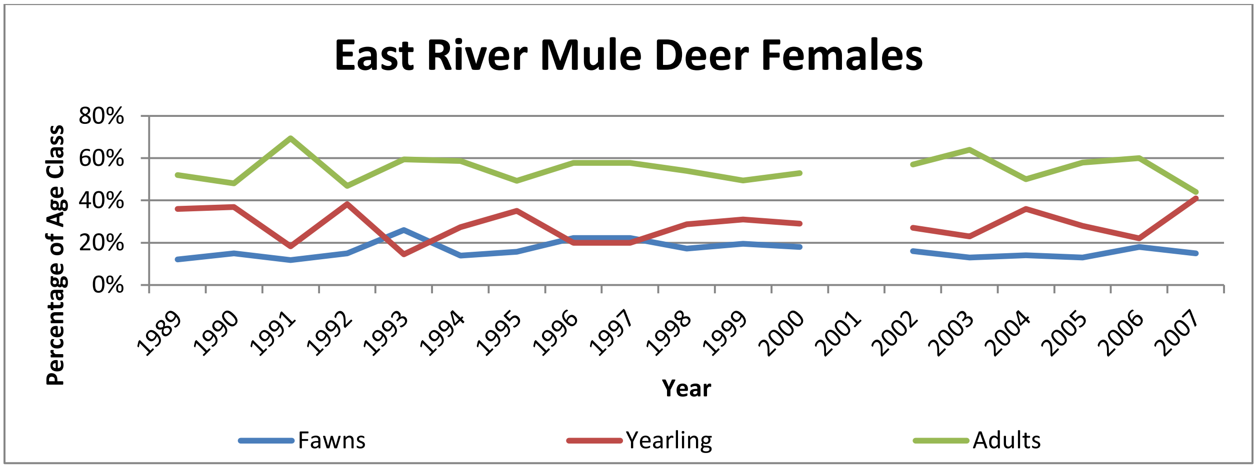



Figure 57. Percentage of fawns, yearlings, and adults in the harvest of East River mule deer females, 1976-2007.

Overall, the tooth survey data that were analyzed in South Dakota from 1976-2007 revealed useful trend information demonstrating how different harvest strategies impact overall age structure. Trend information for white-tailed deer and mule deer showed that older aged males were more represented in the harvest as data were collected through the years. Trend information obtained demonstrated a high level of consistency for female white-tailed deer and mule deer fawns, yearlings, and adults in the Black Hills, East River and West River management areas. Factors to consider if future deer tooth aging is a management priority again include; the level of accuracy desired ultimately determining the sampling method, and the ability to collect teeth through a voluntary system.

<u>Horseback surveys</u>

Surveys by horseback were completed in 1953 and focused on wooded ravines and rough terrain in the West Prairie area to count white-tailed deer that may otherwise be overlooked by conservation officers. Representative habitats of 3 survey areas were surveyed by various combinations of riders and observers in order to estimate deer density and total deer population size. Estimates for the Cheyenne River area were 33 deer per square mile, or 8,250 deer, with similar densities of 35 deer per square mile observed for the Slim Buttes area (6,500 total deer estimate). The Indian Creek survey was documented to be inadequate, but 9.2 deer per square mile were observed for a total estimate of 193 deer.

<u>County Assessments</u>

Conservation officers of South Dakota estimated population sizes of several game species by county for their district from 1991 to 2001, as part of pre-season surveys as described in the SDGFP Wildlife Survey Manual (as cited in Smith 2002a; Table 50). The author cautioned that these values should not be used as absolute abundance measures but as relative measurements for trends over time, due to inherent biases.

Table 50. Statewide pre-hunting season totals of population estimates for white-tailed deer and mule deer based on county-specific estimates by conservation officers in South Dakota, 1991-2001 (Smith 2001b).

| Year | White-tailed Deer | Mule Deer |
|---|---|---|
| 1991 | 165,748 | 66,025 |
| 1992 | 181,901 | 76,411 |
| 1993 | - | - |
| 1994 | 184,808 | 77,655 |
| 1995 | 165,478 | 75,813 |
| 1996 | 182,029 | 74,996 |
| 1997 | 156,643 | 54,278 |
| 1998 | 164,266 | 53,426 |
| 1999 | 176,411 | 60,108 |
| 2000 | 198,893 | 68,102 |
| 2001 | 214,093 | 71,730 |
| overall average | 179,027 | 67,854 |
| 2000 reproduction (young/adult) | 1.66 | 1.14 |
| 2001 reproduction (young/adult) | 0.98 | 0.72 |

***Black Hills***

The majority of census work from the 1950s to early 1970s was conducted in the Black Hills, the part of South Dakota with the most deer (Richardson and Petersen 1974). Hunting seasons were set based on surveys consisting of rancher questionnaires (indicating tolerance of deer), counts of spotlighted deer, pellet counts, and browse surveys. Using the pellet count data as an index of population trends over time shows that numbers were variable in the 1950s and increased steadily in the 1960s. No population data were calculated from 1971-1974, but from 1975 through 1985, the last year of the survey, numbers declined steadily until a spike in 1982 followed by another decline. Harvest numbers reflect this trend as well (McPhillips 1990).

In the 1950s and 1960s browse surveys, although not discussed in detail in this report, indicated that deer over-browsed four areas during normal or severe winters, depending on the amount of snowfall at higher elevations: 1) the area west of Spearfish to the Wyoming state line, 2) the area west and north of Piedmont, 3) the McVey burn area, and 4) some areas of mountain mahogany shrub west of Custer (Richardson and Petersen 1974).

Deer in the Black Hills underwent a decline in the 1970s based on aging and pellet count data, with harvest data also showing a slight but steady decline. At the time researchers suspected malnutrition in does resulting in fewer fawns being born, although browse survey results were not adequate for corroboration (Rice unpublished, "1970's Population Dynamics of Black Hills Deer Herd").

Deer management reports indicated deer populations were still under stress into the 1980s (and through 1999) which was attributed to limited availability of quality forage (McPhillips 1990). The winters of 1984-85 and 1985-86 were particularly severe and caused reproduction to drop statewide (Hauk and Nash 1987). However, modeling data (see *Population Models* section) showed a larger population in the late 1980s than in the early 1990s.

In the 1990s the Black Hills population continued to be under stress according to deer management reports, meaning reproduction and fawn survival was considered poor even though most winters were mild. In several reports this was attributed to habitat management practices in the forest (e.g., McPhillips et al. 1997, McPhillips and Rice 1991a). At this point in time available reports provide more details about population changes than previously. For example, in 1991 a herd increase was noted and attributed to recent mild winters and lower than normal fawn mortality (McPhillips and Rice 1991b). In 1992, the population increased due to mild winters, lower than normal fawn mortality, and average reproduction (McPhillips and Rice 1992). The number of antlerless tags available in 1992 was increased 250% from 1991 with the goal of controlling white-tailed deer numbers and reducing hunting pressure on bucks. However, by 1993 the population was determined to be declining due to low fawn survival in the winter of 1992-93 (McPhillips and Rice 1992). Harvest in 1999 shows populations still recovering from a severe winter in 1996-97 (Schlueter 2000).

In 2000, a slow population increase was noted, but "numbers were nowhere near what they were a decade ago" (Smith 2001a). From about 2000 to about 2006 the population was slowly rebuilding but not to historic highs, with the rate of growth less for mule deer than for white-tailed deer (Huxoll 2004, 2007). Population numbers were high enough to be concerned with depredation in the northern Black Hills and to adjust license numbers to increase the harvest of does to slow population growth (Huxoll 2004). Beginning in 2007, population increases in the Black Hills stopped and the populations were considered down through 2012 (Huxoll 2013). Potential causes included habitat quality and competition for forage with elk (Huxoll 2004) as well as unintended increased hunting pressure due to statewide seasons (Huxoll 2009, 2010, 2011). Also, large wildfires were reported in the Black Hills for most years in the 2000s (Huxoll 2009). For example, the Jasper fire burned 84,000 acres in 2000 (Smith 2001a). These events were anticipated to increase available deer habitat in the future (e.g., Huxoll 2009). As of 2013 and 2014, population modeling indicated the numbers of both species in the Black Hills as stable and/or slightly increasing (Huxoll 2013, 2014).

### *Prairie Regions*

In the 1950s and 1960s only game warden questionnaires and harvest success were used to inform deer management in the Prairie regions. In the 1970s dental cementum annuli, reproductive potentials, and pre-hunt classification counts were added and modeling efforts in the 1990s brought these sets of data together.

The size of deer populations in the Prairie regions was considered mostly a function of landowner tolerance to crop field damage (Richardson and Petersen 1974), although disease outbreak has occurred. Outbreaks of epizootic hemorrhagic disease (EHD) were occasionally mentioned in the deer management reports, and in the early 2000s chronic wasting disease was reported (Huxoll et al. 2003). For example, in 1989 die-off of white-tailed deer was attributed to localized chronic EHD outbreaks which were greater than expected (McPhillips 1990). Testing for chronic wasting disease was first mentioned in 2002, but was discontinued in the fall of 2011 (Huxoll 2013).

***West River***

Based on the narratives in the Deer Management Reports from 1990-2012, deer populations appeared to have a cyclical nature in the West River region. Several years of mild winters, during which deer herds would grow, would be followed by one or two severe winters coupled with EHD outbreaks which would set back numbers. Population growth would be coupled with an increase in depredation, followed by increases in the number and proportion of antlerless licenses to slow the growth. In some years there was concern that there were too few hunters available to harvest enough deer for targeted population control.

Harvest success including buck-doe ratios, amount of roadkill, and population estimates based on conservation officer questionnaires were the metrics used to inform deer management in the 1950s through about 1973 in the West River region (Richardson and Petersen 1974). Harvest numbers were variable in the 1960s, then were higher from the mid-1960s to mid-1970s, down briefly in the late 1970s, before rising again for most of the 1980s (McPhillips 1990).

Based on the Deer Management Reports, severe winters in 1984-85 and 1985-86 caused reproduction to drop statewide for two years in a row such that two age classes were missing (Hauk and Nash 1987). For example, the ratio of white-tailed deer fawns to does in the East River region was 135:100, and the West River the ratio was 77:100 for mule deer and 107:100 for white-tailed deer. Die-offs from EHD in late 1989 were attributed to a warm dry fall and considered “annually expected” (McPhillips 1990).

The late 1980s were marked with several mild winters and population size of both species began to increase again, especially for mule deer, even though drought affected isolated areas. From 1990-1994 the population was considered high. Overall hunter success was at a high of 70-72% in 1990-91, even though most licenses were for antlerless deer (McPhillips and Rice 1991a, b). By 1994 the West River population was at an all-time high and a record harvest ensued (McPhillips and Rice 1995). This was followed, however, by a large reduction in white-tailed deer numbers in 1995 from EHD, but the number of licenses issued was not decreased until fall of 1996. This was followed by a very severe winter in 1996-97 which offset any growth from decreased licenses (McPhillips et al. 1997). In addition, there were depredation problems during that winter which resulted in several hundred deer killed for management. The 1997 season was set to decrease the population of white-tailed deer, yet maintain the mule deer population. Deer numbers were relatively stable in the late 1990s (Smith 2002b) and harvests from 1998 to 2000 were set to allow deer numbers to increase (Schlueter 1999, 2000).

The early 2000s were marked by increasing populations, which recovered after the winter of 1996-97, and peaked in 2008. Growth was offset by the issuance of more antlerless licenses (e.g., Huxoll 2003, 2004). Some EHD die-off occurred in 2003-2005 while record levels were recorded in 2012 (Huxoll 2004, 2005, 2006, 2012). From 2004-2008, concern was expressed that there were not enough hunters available to use antlerless tags, so other licenses were changed to antlerless licenses (Huxoll. 2006). From 2009-2011, in most hunting units numbers of white-tailed deer were considered stabilized and mule deer numbers were stable to slightly decreasing, and biologists responded by maintaining or reducing the number of licenses issued (Huxoll 2010). By 2012 populations of both species were considered decreasing with a greater impact on mule deer, which was attributed to the increased severity of winters of 2008-09 through 2010-11 and aggressive antlerless harvest strategies (Huxoll 2012, 2013). As of 2013 and 2014 populations were thought to be increasing (Huxoll 2014, 2015).

***East River***

In the East River region, mule deer comprise only approximately 3% of the overall deer population (Huxoll 2013), so management is mostly focused on white-tailed deer. Disease did not seem to affect populations as much as with West River deer. Management appears largely focused on reports of crop depredation (e.g., on standing corn or in farm yards, a function of severe winters with much snow cover) and the quantity of antlerless licenses issued. Fawn mortality was the lowest here of all three regions, typically less than 5% (McPhillips and Rice 1996).

As with the West River region, harvest success, roadkill quantity, and conservation officer questionnaires were the basis of setting hunting regulations in the East River region from the 1950s to early 1970s (Richardson and Petersen 1974). Records show about 3,000 East River deer were harvested annually in the early 1960s after which these numbers grew steadily to a peak of about 12,000 in 1974-1976. Numbers were lower by a third in the late 1970s but increased even more in the 1980s, culminating in yearly harvests of around 30,000 deer by 1989 (McPhillips 1990).

Deer management reports provide more details beginning in the 1980s. After the severe winters of 1984-85 and 1985-86 the East River deer population was stable or increasing until the mid-1990s (McPhillips 1990).The winter of 1996-97 was very severe and some deer were killed due to depredation complaints (McPhillips et al. 1997). From 1999 to 2008, deer numbers were steady to increasing, and beginning in 2001, biologists shifted hunting emphasis towards keeping the population under control by issuing a larger proportion of antlerless licenses (Schlueter 2000, Huxoll 2008, Huxoll 2009). This continued until the severe winters of 2009-2010 and 2010-11, which resulted in a lower fall fawn recruitment rate of 101 fawns per 100 does in 2010 and 91 fawns per 100 does in 2011 (Huxoll 2010). The highest ever levels of EHD were also reported in 2012 and were accompanied by record losses in the southeast of at least 1,300 deer (Huxoll 2013). East River population objectives at this time were a mix of decreasing, stable, and increasing depending on location. Population levels were considered below management objectives through 2013, but were thought to be increasing again in 2014 (Huxoll 2013, 2014, 2015).

## DEER RESEARCH IN SOUTH DAKOTA

### Movements and Home Range

Home Range

The term "home range" is often used to refer to an area that an individual or herd of animals occupy for a defined period of time. Sanderson (1966) suggested that the home range for a given species is only as large as the area needed to meet all of its biological requirements. Powell and Mitchell (2012) proposed that an animal's home range is the part of its cognitive map of its environment that it chooses to keep updated based on environmental conditions including favorable climate, available resources, desirable habitat, population density, and other factors. This definition highlights the biological aspect of a home range as opposed to the strictly statistical representations that are commonly used. Because deer home range size vary by season (Kammermeyer and Marchinton 1976), habitat quality and quantity (Kernohan et al. 2002), deer sex and age, and animal density (Nixon et al. 1991), home range selection has significant implications for deer management strategies.

Numerous studies have been conducted on the home range size and seasonal movements of white-tailed and mule deer in South Dakota: Naugle (1994), Kernohan (1994, 2002) on the Sand Lake National Wildlife Refuge; Griffin et al. (1994, 1999, 2005) in the Black Hills; Sparrowe and Springer (1970), Burris (2005), Grovenburg (2007), Robling (2011), and Haffley (2013) in eastern South Dakota; Robling et al. (2014) and Grovenburg et al. (2009) in central and western South Dakota; Nixon et al. (1991), VerCauteren and Hygnstrom (1998), Brinkman et al. (2005) in agriculture-dominated landscapes (Table 51). Individual studies in South Dakota have reported significant differences in deer home range sizes between summer and winter (Robling 2011); male and female; yearling and adult; and species (Grassel 2000, Griffin et al. 2005, Grovenburg et al. 2009); however, a meta-analysis of compiled data for the northern Great Plains suggests that differences in home range size are more likely due to environmental factors such as range quality, degree of habitat fragmentation, population density, and breeding competition (Sparrowe and Springer 1970, Nixon et al. 1991, Nelson 1998, Sabine et al. 2002). For example, Robling (2011) reported significantly smaller summer and winter ranges of white-tailed deer in Clark County, eastern South Dakota, compared to a separate study in a different region of eastern South Dakota by Grovenburg et al. (2009), to which Robling (2011) attributed the presence of wetlands that provide escape and thermal cover. Another study by Relyea et al. (2000) reported that male mule deer home range sizes decreased with increased habitat productivity in a desert landscape, while female mule deer home range size showed no relationship with habitat productivity. In an intensively farmed region in Illinois, Nixon et al. (1991) noted that as population density of female white-tailed deer increases, the average home range size of females declined to a threshold value of around 30 to 50 hectares (74-124 acres), beyond which the home range size did not decrease, suggesting that there may be a minimum home range size for postpartum females. Additionally, behavioral patterns common among breeding-age males (e.g., inbreeding avoidance, breeding competition, and "wandering") can contribute to a perceived increase in home range size (Grassel 2000).

Anthropogenic factors such as agricultural practices (Kernohan et al. 2002), hunting (VerCauteren and Hygnstrom 1998), and development (Nicholson et al. 1997) affect home range size. In the Sierra Nevada mountain range of California, Nicholson et al. (1997) reported that mule deer home range size was associated positively with proximity to human development (non-agriculture) and to the amount of avoided (use was less than availability) habitat in the home range, noting that deer avoided human development in all seasons. On the other hand, white-tailed deer home range centers moved closer to cornfields leading up to harvest and shifted away from cornfields after harvest into areas of permanent cover, and the size of home ranges tended to increase after crop harvest because deer were forced to find and use other sources of cover and food (VarCauteren and Hygnstrom 1998). Grassel (2000) documented that winter ranges in central South Dakota were characterized by topographic breaks and draws that were adjacent to agricultural crop fields, while Griffin et al. (1994, 1999) suggested that larger winter home ranges for white-tailed deer in the Black Hills was due to movements between forage resources and cover in order to meet daily nutritional requirements. Grassel (2000) also speculated that interference and competition from grazing cattle may be a possible explanation for large summer home ranges of mule deer in the Missouri River Breaks Region. Other anthropogenic activities that can impact deer home range include timber management, roadway construction, and recreation (Griffin et al. 2005).

Site fidelity refers to the tendency for deer to continually use the same home range and can be measured in terms of seasonal home range use year after year (inter-annual) or continual home range use after seasonal changes in the environment (inter-seasonal). Kernohan et al. (2002) observed a moderate degree (34-67% home range overlap) of inter-annual and inter-seasonal site fidelity among white-tailed deer in the Sand Lake National Wildlife Refuge. Their results indicated that individual white-tailed deer were capable of obtaining all life requisites within one confined area throughout winter and spring, because home range size did not differ by season. They concluded that enhanced shelterbelts and river bottomlands provided sufficient cover throughout the refuge, but constantly revolving forage associated with the shifting agricultural landscape (i.e., crop rotation and differential growth rates) surrounding the refuge prevented the establishment of a stable home range. On the other hand, Griffin et al. (1994,1999,2005) observed a high degree of inter-annual site fidelity among migrating white-tailed and mule deer in the Black Hills for several consecutive years, except in fall 2000 following the Jasper Fire which burned approximately 34,000 hectares (84,015 acres) in the summer of 2000 (Griffin et al. 2005).

Table 51. Summer and winter home range size of deer occupying South Dakota.

**Home Range Size of White-Tailed Deer in South Dakota**

| | Summer Female | Male | Winter Female | Male | |
|---|---|---|---|---|---|
| DAU 3 | 0.73 mi² (n=33) | N/A | 1.45 mi² (n=34) | N/A | Griffin et al. 1994 |
| DAU 3 | 0.51 mi² (n=48) | 2.31 mi² (n=8) | 0.78 mi² (n=45) | 1.07 mi² (n=5) | Griffin et al. 1999 |
| DAU 3 | 0.79 mi² (n=38) | 2.08 mi² (n=3) | 1.34 mi² (n=36) | 1.22 mi² (n=4) | Griffin et al. 2005 |
| DAU 5 & 7 | 1.27 mi² (n=17) | 2.33 mi² (n=7) | 2.38 mi² (n=17) | 4.32 mi² (n=7) | Grassel 2000 |
| DAU 8 | 0.79 mi² (n=52) | N/A | 0.89 mi² (n=30) | N/A | Haffley 2013 |
| DAU $9_1$ | 2.74 mi² (n=51) | N/A | 2.51 mi² (n=32) | N/A | Grovenburg 2007 |
| DAU $9_2$ | 1.73 mi² (n=31) | 2.28 mi² (n=11) | 1.36 mi² (n=28) | 1.82 mi² (n=11) | Kernohan 1994 |
| DAU 10 | 0.58 mi² (n=61) | N/A | 1.14 mi² (n=59) | N/A | Robling 2011 |
| DAU 11 | 0.40 - 1.39 mi² (n=77) | N/A | 0.60 - 1.83 mi² (n=36) | N/A | Burris 2005 |

DAU $9_1$ represents Grovenburg 2007 conducted in Brown, Edmunds, Faulk, and McPherson counties in South Dakota.
DAU $9_2$ represents Kernohan 1994 conducted in the Sand Lake National Wildlife Refuge in Brown County, South Dakota.

**Home Range Size of Mule Deer in South Dakota**

| | Summer Female | Male | Winter Female | Male | |
|---|---|---|---|---|---|
| DAU 2 & $4_1$ | 6.99 mi² (n=28) | 8.20 mi² (n=4) | 6.99 mi² (n=28) | 8.20 mi² (n=4) | Robling et al. 2014 |
| DAU 3 | 1.37 mi² (n=15) | 2.40 mi² (n=8) | 1.97 mi² (n=12) | 2.44 mi² (n=5) | Griffin et al. 2005 |
| DAU 5 & 7 | 2.41 mi² (n=13) | 4.68 mi² (n=5) | 1.66 mi² (n=13) | 1.65 mi² (n=5) | Grassel 2000 |
| DAU $7_2$ | 8.02-9.36 mi² (n=79) | N/A | 7.43-9.36 mi² (n=79) | N/A | Robling et al. 2014 |

DAU 2 & $4_1$ represents Robling et al. 2014 conducted in Meade and Pennington counties, South Dakota as an annual home range.
DAU $7_2$ represents an annual home range by Robling et al. 2014 in Fort Pierre National Grasslands, South Dakota.

Movements

White-tailed deer and mule deer in South Dakota exhibit a mixture of movement strategies (Sparrowe and Springer 1970, Kernohan et al. 2002, Grovenburg 2007, Grovenburg et al. 2009, Robling et al. 2014), which Brinkman et al. (2005) classified as obligate migrators, conditional migrators, residents, or dispersers. Dispersal is defined as permanent movement of individual deer away from established annual home ranges to new annual home ranges with no overlap of the previous home range. Deer migration is defined as seasonal movement between non-overlapping winter and summer ranges. Deer are considered obligate migrators if they migrate during every migratory period (Sabine et al. 2002), while deer that fail to migrate, migrate briefly to a winter range, or make several migrations between seasonal ranges during a single winter are conditional (or facultative) migrators (Nelson 1995). Deer that do not migrate are considered to be residents (VerCauteren and Hyngstrom 1998). Most deer populations are partially migratory (i.e., some individuals migrate and others do not (Nelson and Mech 1992, Sabine et al. 2002), and Kaitala et al. (1993) argued that partial migration is related to density-dependent overwintering survival, regardless of any uncertainty in winter severity in some cases. Among migratory dispersers, white-tailed deer can display plasticity in their migratory behavior, meaning that some white-tailed deer keep the same winter ranges they first used with their mothers, while others find new winter ranges; conversely, deer may reverse natal movement patterns after dispersal, changing from migratory to resident or vice versa (Nelson 1998). On the other hand, mule deer display a high degree of fidelity to seasonal ranges for life (Sawyer et al. 2009a), which is a key distinction between white-tailed and mule deer.

Migration

Annual migration between summer and winter ranges is not a ubiquitous behavior, and differences in deer movement strategies between regions and years can be influenced by colder temperatures (Grovenburg 2007, Grovenburg et al. 2009), fluctuation and depth of snow (Nelson 1998, Nixon et al. 1991), changing weather (Verme 1973), photoperiod, and changes in vegetation (Nicholson et al. 1997, Grovenburg et al. 2011a, Bischof et al. 2012). Fawns learn migration behavior through matriarchal group association while accompanying their mothers during migration to winter ranges for upwards of three years (Nelson 1998). During migration some deer pass over suitable habitat on their way to previous seasonal home ranges, displaying a high degree of inter-seasonal site fidelity, while others will stop at alternative winter ranges if conditions are suitable (Nelson 1995, Sabine et al. 2002). Seasonal movements that do not involve significant changes in home range boundaries usually occur in regions where seasonal weather changes are mild (Nelson 1998, Sabine et al. 2002) and are related to food and cover availability (Kernohan et al. 2002), the energetic tradeoffs associated with remaining sedentary versus migrating (Garrott et al. 1987), or hunting pressure (Grovenburg 2007). Nelson (1995) reported that during mild winters with below average snowfall, deer may occupy the same range year round or become conditional migrators.

Brinkman et al. (2005) concluded that increasingly severe winters encouraged a higher percentage of the white-tailed deer population to migrate in fall, while Nicholson et al. (1997) observed a similar response in mule deer. Several studies have identified the onset of cold ambient temperatures and depth of snow as the primary influences on seasonal movement between summer and winter ranges (Nelson 1995, Brinkman et al. 2005), while other studies have concluded that ambient temperature is the primary driver behind fall migration initiation and snow depth has a minimal effect on deer movement (Grovenburg 2007). In north-central South Dakota initiation of fall deer migration is strongly correlated with the amount of time at freezing ambient temperatures (<0 °C), while snow depth was not significantly correlated (Grovenburg et al. 2009). As a result, Brinkman et al. (2005) derived a deer winter severity index to correlate temperature and snow depth with migration response in deer populations that may be used to approximate the percentage of a deer population that is likely to migrate in a given winter. Conversely, onset of spring migration may be initiated by rising temperatures and decreasing snow cover that releases restrictions on food supply to newly available spring forage (Nelson and Mech 1981). DePerno et al. (2003) also observed that pregnant female white-tailed deer will initiate spring migration just prior to parturition to give birth in areas that provide thermal cover, maximum forage, and concealment for fawns.

The forage-maturation hypothesis (FMH) states that herbivores migrate along a phenological gradient of plant development in order to maximize energy intake (Bischof et al. 2012). Decisions regarding when to migrate, however, may be affected by differences in life-history characteristics of individuals (Monteith et al. 2011). Hurley et al. (2014) observed that mule deer fawns responded strongly to remotely sensed measures of primary productivity; whereas, Monteith et al. (2011) reported that old females and those in good nutritional condition risked encountering severe weather by delaying autumn migration, and were thus risk-prone with respect to the potential loss of foraging opportunities in deep snow compared with young females and those in poor nutritional condition. These results led Monteith et al. (2011) to conclude that plasticity in timing of migration in response to climatic conditions and plant phenology is likely an adaptive behavioral strategy to reduce the detrimental effects of trophic mismatches between resources and other life-history events of mule deer.

Migration of White-tailed Deer in South Dakota

White-tailed deer in the northern Great Plains generally depart for winter range during November and December (Sparrowe and Springer 1970, Brinkman 2003, Brinkman et al. 2005), while fall migration initiation commonly begins around late September in the Black Hills (Griffin et al. 1994, 1999, 2005). On average, migratory white-tailed deer in eastern South Dakota occupied their summer range for approximately 7 months, arriving from winter range during mid-April and departing to winter range during late November (Brinkman 2003), with their migration pattern generally directed along physiographic features of the landscape (Sparrowe and Springer 1970, Kernohan et al. 1994, Burris 2005). Winter concentration areas typically consist of trail systems that allow greater access to forage and thermal cover and enhance the likelihood of escape predation (Nelson 1998). Spring migration generally occurs during March and April in eastern South Dakota (Sparrowe and Springer 1970, Brinkman 2003, Brinkman et al. 2005, Burris 2005).

White-tailed deer in east-central South Dakota (Grovenburg 2007) commonly migrate distances in excess of 6.2 miles, consistent with other studies of white-tailed deer migration in the northern Great Plains (Sparrowe and Springer 1970, Nixon et al. 1991, Kernohan et al. 1994, Sabine et al. 2002). In east-central South Dakota, Grovenburg (2007) reported that female white-tailed deer migrated an average distance of 12 miles, which is longer than migration distances reported in other studies done in eastern South Dakota (6 miles, Burris 2005; 3 miles, Robling 2011; 6.5 miles, Haffley 2013) and neighboring southwestern Minnesota (6 miles, Brinkman 2003; 9 miles, Swanson 2005). In the Clark County region of eastern South Dakota, white-tailed deer may have demonstrated shorter migration distances because of the high abundance of suitable habitat (i.e., wetlands and CRP grasslands) available (Robling 2011). Median fall migration dates occurred in late November, with no significant correlation to corn and soybean harvest completion dates, while median spring migration dates ranged from mid- to late April (Grovenburg 2007). Total amount of time spent in transit during migration ranged from 1 to 16 days (Grovenburg 2007).

In north-central South Dakota, Grovenburg et al. (2009) reported a mean migration distance of 12 miles for all sampled deer between their summer and winter home ranges, and found ambient temperature to have the strongest correlation to median migration date for the start of both spring and fall migrations. Grovenburg et al. (2009) hypothesized that white-tailed deer migration distance was likely influenced by a highly fragmented landscape dominated by agriculture or grasslands, because deer may need to travel longer distances to find suitable patches of habitat for thermal cover, escape shelter, and forage in areas with sparse tree cover (Long et al. 2005). However, other studies (Brinkman et al. 2005) have concluded that fluctuations in temperature and snow depth more likely determine the distance of migration.

Griffin et al. (1994) found that white-tailed does in the northern Black Hills migrated in a southern direction from low elevation winter ranges to higher elevation summer ranges and reversed this direction in fall migration from summer to winter ranges. Average migration distance for female white-tailed deer was 9.7 miles (ranging from 3.5-24.6 miles). In the central Black Hills region, Griffin et al. (1999) found that white-tailed deer migrated from lower elevational winter ranges to higher elevational summer ranges in a west to northwest direction. Returning migrations to winter ranges followed an opposite direction to the east and southeast. Average migration distance for female white-tailed deer was 20.3 miles (ranging from 3.30-35.2 miles). Male white-tailed deer average migration in the central Black Hills was 16.2 miles (ranging from 5.3-25.4 miles). Griffin et al. (2005) reported that white-tailed deer in the southern Black Hills region most commonly migrate from the winter ranges in a north to north west direction toward higher elevation summer ranges during spring migration, and they migrate in the opposite direction during fall migration toward lower elevation winter ranges, with an average migration distance for females and males of 14.5 miles (ranging from 1.2-33.5 miles) and 9.8 miles (ranging from 3.6-14.3 miles), respectively.

Bever (1957a) likened the seasonal migration pattern of white-tailed deer in the Black Hills to a wagon wheel where the hub is the summer range, the spokes are lines of migration, and the rim is the winter range around the Black Hills. In this region, fall migration is triggered by heavy snowfall restricting deer movement and food availability, so deer migrate to lower elevations along migration lines until they are at the "rim" which is typically defined by the snowline. The spring return migration for white-tailed deer in the Black Hills corresponds to rising temperatures and a receding snowline, and peak spring migration occurs around mid to late-May (Griffin et al. 2005).

Migration of Mule Deer in South Dakota

Robling et al. (2014) assessed mule deer home ranges in western (Meade and Pennington Counties) and central (Fort Pierre National Grasslands [FPNG]) South Dakota between January 2010 and March 2012 by fitting radio collars to 128 adult female and 10 adult male mule deer. The majority of mule deer (72%) in the Meade-Pennington study area were residents, while in the FPNG study area 45% of mule deer were residents, 35% conditional migrators, and 20% obligate migrators. In the Meade-Pennington study area high-quality habitat composed of topographic breaks and draws adjacent to crop fields met all essential life requirements of mule deer allowing them to maintain resident home ranges during summer and winter. Agricultural lands and more pronounced phenological changes among crops and native vegetation may have triggered migratory behavior in the FPNG study area.

Grassel (2000) surveyed the seasonal movements of mule deer in the Missouri Breaks region over a 3 year study period (1997-1999). In 1997, all spring migratory deer in the sample population (13 female and 5 male) had migrated by May 15; the mean date of spring migration in 1998 for female and male mule deer was April 10 and April 15, respectively; and spring migration in 1999 was slightly earlier than previous years, with a mean date of March 29. Fall migration was a bit more variable among radio-collared deer during the survey, because a fraction of migratory deer established mid-summer staging areas between summer and winter ranges as part of fall migration, sometimes residing in these temporary ranges for up to 10 weeks. In 1997, the mean date of fall migration for female and male mule deer was October 3 and September 25, respectively; in 1998, the mean date of fall migration for female and male mule deer was September 30 and October 27, respectively; and, in 1999, the mean date of fall migration for female mule deer was October 11, while the only migratory male mule deer this year completed migration on October 29.

In the Black Hills region, Griffin et al. (2005) reported that initiation of fall mule deer migration generally occurred from October through the end of December, with some deer staying on summer ranges well into January and February, while spring migration followed a more regular pattern and was initiated between mid- to late May, approximately two to three weeks prior to parturition. All recorded fall and spring migrations were completed within five days of initiation, with an overall average migration distance of 9.2 miles (ranging from 0.5 to 35 miles) with similar average migration distances for female and male mule deer of 10 and 8 miles, respectively.

Dispersal

Deer dispersal from natal home ranges and the subsequent establishment of new home ranges where does occur is important because of its potential role in the colonization of new or vacant habitats, gene flow among populations, and range expansion of the species (Nelson and Mech 1992). The most widely used definition of dispersal is that by Howard (1960): Dispersal of an individual vertebrate is the movement the animal makes from its point of origin to the place where it reproduces or would have reproduced if it had survived and found a mate.

Nelson and Mech (1987) speculated that while male white-tailed deer dispersal may be a mechanism to avoid inbreeding, in many cases the average dispersal distance of males would not be far enough to escape breeding with genetically similar females associated with their natal home ranges. However, dispersal distances likely differ according to ultimate cause of dispersal (Long et al. 2008). Relatively short movements (e.g., outside immediate home range or territory) may be sufficient for escaping local mate competition, but when opposite-sex relatives are philopatric, longer dispersal distances (e.g., outside social group) may be necessary to escape inbreeding (Nelson and Mech 1987). Long et al. (2008) observed that the distance of spring dispersal was on average 76% longer than fall dispersal. In agriculture-dominated landscapes dispersing deer may need to travel longer distances to locate unoccupied suitable habitat (Grovenburg et al. 2009), which may be an explanation for dispersal distances upwards of 100 miles that have been reported for male white-tailed deer in the northern Great Plains (132 miles in northeastern South Dakota, Kernohan et al. [1994]; 100 miles in eastern South Dakota, Sparrowe and Singer [1970]; 104 miles in northeastern Minnesota, Nelson [1993]; 127 miles between southwestern Minnesota and southeastern South Dakota, Brinkman [2003]).

Dispersing deer display more erratic behavior prior to departure than the predictable patterns of migrating individuals, and dispersers commonly migrate to pre-dispersal home ranges before dispersing to new permanent ranges (Brinkman 2003). Natural and anthropogenic landscape features, such as rivers, mountain ranges, and roads can alter animal dispersal paths and movement patterns, influencing ecological processes associated with dispersal, including disease transmission, invasion dynamics, and gene flow (Long et al. 2010). As a result, dispersal and seasonal movements across management unit boundaries should be considered when wildlife managers develop local-specific deer management strategies in South Dakota.

**Resource Selection**

Resource selection among white-tailed and mule deer can be influenced by sex, reproductive stage, forage availability, seasonality, human activity, and predator avoidance. Sexual segregation is prevalent among deer in that the two sexes tend to use different areas and habitats separately (Barboza and Bowyer 2000), and reproductive stages influence resource selection differently for each sex (Main et al. 1996). Seasonality also plays a role in resource selection, especially during the winter when forage and cover can be heavily restricted by snow cover (Nixon et al. 1991, Masse’ and Cote’ 2012). Deer are influenced by a variety of human activities including agricultural practices, development, and hunting. Pierce et al. (2004) postulated that changes in migratory deer diets across seasons can lead to individuals experiencing changing predation risk to forage benefit ratios throughout the year. Manly et al. (2002) contains an in depth explanation of the various methods for developing resource selection functions that involve quantifying characteristics for resource units such that the value for a unit is proportional to the probability of that unit being used.

Seasonal Habitat Selection
Prior to parturition, male mule deer (Geist 1981) and white-tailed deer (Marchinton and Hirth 1984) commonly unite into male-only groups and leave areas occupied by females. Additionally, male white-tailed deer establish their spring-summer domain well before females select their fawning grounds which are defended tenaciously after parturition (Ozoga and Verme 1982).

During winter, deer in South Dakota are less likely to use open habitat due to snow accumulation, and depending on the severity of winter weather and availability of cover, deer may be compelled to migrate to more suitable habitat or seek out cover with ample forage available locally (Brinkman et al. 2005). In open prairie grasslands, mule deer use of juniper for cover increases as winter progresses (Dusek 1975). Pauley et al. (1993) observed that white-tailed deer in forested regions tend to select pine forests that provide the greatest availability of preferred forage species during early and late winter when metabolic rates are still elevated and snow depths are shallow, while they select old growth forests characterized by sparse understories, dense canopy, and low snow accumulation during midwinter when metabolic rates are depressed and basal snow depths are high. This result was consistent with a study conducted by Klaver et al. (2008) which showed that white-tailed deer winter survival was higher in areas with greater tree cover and slash that had less grass and forb cover; furthermore, female deer showed high site fidelity to winter home ranges and were tolerant of other individuals during winter, regardless of deer density. White-tailed deer winter habitat selection in the northern Great Plains region is influenced by large annual fluctuations in climate and the highly fragmented landscape dominated by row-crop agriculture (Brinkman et al. 2005). For example, white-tailed deer in north-central South Dakota showed a stronger selection for late season standing corn than for traditional winter cover habitats; however it is not clear whether or not corn fields satisfy deer needs for cover and forage simultaneously (Grovenburg et al. 2010a). In the prairie-pothole region of eastern South Dakota, Robling (2011) documented that white-tailed deer use exceeded availability for CRP grasslands, standing corn and tree cover during winter in significantly higher proportions than agriculture, pasture, wetlands, and road/development cover types.

Agriculture Dominated Habitat
A large central section of mid-western white-tailed deer range consists of the Midwest Agricultural Sub-region as defined by Gladfelter (1984), which consists of extensive croplands interspersed by oak-hickory and other forest types that are mostly limited to stream bottoms or steep slopes. Agricultural crops are nearly unlimited and make up the majority of the diets of white-tailed deer in the region (Nixon et al. 1991). Primary crops produced include corn and soybeans although winter wheat, sorghum, alfalfa, and oats are also grown (VerCauteren and Hygnstrom 2011). Permanent cover is extensively fragmented and deer must adapt to the dramatic seasonal changes in available cover and food associated with harvest of crops (Nixon et al. 1991).

White-tailed deer and mule deer are impacted to varying degrees by rural landscapes dominated by human activity including agriculture, natural resource extraction, infrastructure, and development by modifying their resource selection strategies. For example, Loft and Menke (1984) observed that transmission line clearings may create more favorable wintering habitat in heavily forested regions. On the other hand, Sawyer et al. (2006, 2009b) found that mule deer use of high quality habitat immediately declined following the development of natural gas fields in western Wyoming and deer showed no signs of acclimation to the site up to three years later. In terms of agricultural operations, deer and cattle can compete for food and cover where there is overlap, while crops can provide an important source of food for deer. In the Black Hills, grasses, forbs, and shrubs are important to both cattle and deer (Sieg and Severson 1996), but Loft et al. (1991) suggested that the areas of greatest overlap and, hence, competition are meadow-riparian habitat, especially in late summer when forage and cover are at a minimum. In north-central South Dakota, Grovenburg et al. (2010a) found that deer disproportionately increased use of standing corn and reclaimed grasslands as habitat availability increased, while deer used wetlands and forested habitat in proportion to availability. Several studies have found that deer prefer habitat in close proximity to agricultural fields prior to harvest (Nixon et al. 1991, Kernohan et al. 2002, Grovenburg et al. 2010a), while deer avoid foraging in pastures during late summer when heavy grazing can deplete forage in otherwise desirable habitat (Loft et al. 1991). Robling (2011) reported that white-tailed deer avoided cut corn (resource selection ratio $\hat{w}$ =0.609, CI = 0.338 - 0.879), soybean stubble ($\hat{w}$ =0.528, CI = 0.122 - 0.934) and rye (Secale cereal) ($\hat{w}$ = 0.265, CI = 0.000 - 0.738). Wetlands ($\hat{w}$ = 0.968, CI = 0.635 - 1.30), pasture land ($\hat{w}$ = 0.761, CI = 0.16 - 1.363), wheat stubble ($\hat{w}$ = 1.034, CI = 0.187 - 1.88), short grass ($\hat{w}$ =0.82, CI = 0.067 - 1.574), standing corn ($\hat{w}$ =0.907, CI = 0.000 - 2.025), tall grass ($\hat{w}$ = 1.303, CI = 0.000 - 2.995), and roads/development ($\hat{w}$ =0.492, CI = 0.000 - 1.139) were used in proportion to their availability by deer. Other studies have found that deer tend to avoid development in non-agricultural areas (Nicholson et al. 1997).

The Conservation Reserve Program (CRP), a provision of the 1985 Food Security Act, subsidizes landowners to take highly erodible lands out of cultivation and seed them to perennial cover for 10+ years. Previous studies pre-dating CRP emphasized the importance of woodlands, wetlands, and riparian areas as key fawning areas of white-tailed deer in east-central South Dakota, and agricultural fields as key late-summer foraging and security areas (Sparrowe and Springer 1970). Luttschwager and Higgins (1992) recognized the potential benefits to wildlife from CRP and estimated that it takes approximately five years for land enrolled in the program to produce these benefits. Gould and Jenkins (1993) found that deer used CRP lands diurnally for bedding or active periods, with increased use during spring and early summer. Furthermore, CRP lands also provide important bedding habitat to fawning does (Grovenburg et al. 2010b). White-tailed deer tend to shift use from CRP lands to corn fields during late-summer to take advantage of greater cover and forage availability (Grovenburg et al. 2010a); however drought can reduce the quality of these artificial habitats (Grovenburg et al. 2011b).

Gould and Jenkins (1993) claimed that seasonal use patterns of CRP lands by white-tailed deer suggest that management of cover and forage on CRP land could help achieve deer and land management objectives jointly. For example, landowners can selectively mow portions of CRP fields to promote high-quality regrowth during growing season for foraging deer to divert them away from crops.

Prairie and Riparian Habitat

A large section of the white-tailed deer range in South Dakota consists of the Northern Plains Sub-region as defined by Petersen (1984), which was once primarily made up of mixed- and tall-grass prairie ecosystems. Currently, the land is mostly privately owned with over 75% currently in crop production (VerCauteren and Hygnstrom 2011). Petersen (1984) claims that the most important deer habitat in the Northern Plains consist of draws, swales, and lowlands; followed by river floodplains, marshes and sloughs. While mule deer tend to avoid human landscapes (Nicholson et al. 1997), white-tailed deer have better adapted to agriculture-dominated landscapes. As a result, in the Northern Plains region white-tailed deer have increased in abundance, while mule deer populations have declined (Volk et al. 2007).

Historically, white-tailed deer were uncommon in the Northern Plains and were mostly associated with riparian zones (Cook 1945). Mule deer, like white-tailed deer, are most commonly observed in riparian areas near creeks, drainages, and floodplains (Dusek 1975). In eastern Montana, white-tailed and mule deer were observed more often in riparian areas than in ponderosa pine stands or sagebrush grasslands, even though riparian stands occupied only 14% of the land area in the study area (Dusek 1975, MacCracken and Uresk 1984). During summer, Kamps (1969) found that mule deer preferred grasslands to sagebrush, while Martinka (1968) observed a decrease in use of bunchgrass with an increase in use of riparian habitat. Riparian woodlands and wooded uplands provide cover year round that is especially vital during autumn and winter after crop harvest (VerCauteren and Hygnstrom 2011). Riparian habitat usually constitutes an important component of white-tailed deer range in the Rocky Mountains (Peek 1984).

In western and central South Dakota, deep wooded draws with scattered agriculture on upslope flat land areas makes ideal winter and summer habitat for resident deer (Robling et al. 2014). Grassel (2000) also documented that winter ranges in central South Dakota were characterized by topographic breaks and draws that were adjacent to agricultural crop fields. In tallgrass prairie habitat in eastern Kansas, Volk et al. (2007) noted that at a coarse scale white-tailed deer appeared to prefer woody vegetation while avoiding habitats dominated by grassy vegetation. In contrast, at a fine scale, groups of deer most often were observed foraging in the immediate vicinity of grassland vegetation, rather than in or by woody vegetation.

Black Hills Habitat

Dense ponderosa pine (*Pinus ponderosa*) stands with limited shrub understory dominated approximately 70% of the land area in the Black Hills (Sieg and Severson 1996) before the early 2000s. Recent fires, mountain pine beetles, and forest management practices have opened up pine stands, increasing the overall acreage of earlier successional stages and potential ungulate forages. During summer, white-tailed deer and mule deer in the region tend to prefer early successional vegetation communities associated with recent disturbance (Bever 1952), while high survival during winter is associated with the greater tree density and cover provided by ponderosa stands (Klaver et al. 2008). Ideal summer habitat that can support high densities of deer contains a mixture of over and understory that provides both cover and forage (Griffin et al. 2005), while preferred fawning sites are open stands of ponderosa pine characterized by relatively greater vegetation cover, taller average vegetation height, and low levels of timber harvest (Benzon 1995, Benzon 1998, Uresk et al. 1999).

Ponderosa pine stands that have been recently disturbed by non-commercial thinning (Gibbs et al. 2004) or wildfire (Sieg and Severson 1996) produce more grasses and forbs during the summer compared to undisturbed stands. Zimmerman (2004) found that total cover of forbs and grasses in lightly to severely burned habitat in the southern Black Hills of South Dakota increased approximately 60% and 80%, respectively, a year after burning. In addition, these disturbances can prevent or reduce the rate at which ponderosa pine invades meadows and aspen stands (Griffin et al. 2005). Furthermore, early successional pine forests were preferred during spring through fall because forage species (e.g., bearberry, snowberry, and juniper) important to deer are essentially absent in the dominant unburned pine communities of the central Black Hills (DePerno et al. 2002).

White-tailed and mule deer have coexisted in the Black Hills for millennia, and current estimates place the relative proportions at 80% white-tailed deer and 20% mule deer (Wallin and Rice 1980). Similarity of food habits and some overlap in habitat use where these species occur together indicate potential competition in local areas (Mackie 1981), and dominance between these two species is assumed to be a function of size based on observations of interspecific encounters (Anthony and Smith 1977). However, white-tailed deer are found in relatively more dense habitats such as pine and aspen stands and riparian areas, whereas mule deer tend to occupy more open habitats with rough topography (Sieg and Severson 1996). As a result mule deer are more abundant in the southern Black Hills, while white-tailed deer are abundant throughout the entire Black Hills. Therefore, their continued coexistence is probably based on differences in habitat use.

DePerno et al. (2001) compared cover type use data obtained from radio-collared white-tailed deer with existing United States Department of Agriculture (USDA) Forest Service cover type data to determine if Geographical Information System (GIS) data used in forest management was compatible for game management. Winter range cover types included ponderosa pine stands, pine-deciduous stands, aspen, aspen-coniferous, burned pine, and meadows. Summer range cover types included pine, pine-deciduous, aspen, aspen-coniferous, white spruce (*Picea glauca*), white spruce-deciduous, and meadows. However, cover types used in USFS data did not contain variables such as understory and cover-type mixes, and the authors' data for summer and winter ranges only resulted in 42% and 62% agreement with USFS summer and winter range data, respectively. This led the authors to recommend including mixed cover types in their cover type classification system so as not to overestimate deer use of ponderosa pine and aspen habitats.

## Diet and Nutrition

One important aspect of managing species is to be familiar with its food source, which is particularly true of deer because they are dependent upon limited habitat during winter and can easily deplete forage species. Outside of intensively farmed regions with late-standing crops, the availability of winter forage is controlled by the duration and severity of weather and has been considered the primary factor limiting deer populations in the West (Wallmo et al. 1977); consequently, more information is available on the nutritional quality of forages during this season. However, food quality and abundance on summer and fall ranges is also critical for lactating females, weaned fawns, and mature males after breeding in order for them to store adequate subcutaneous fat for the upcoming winter (Mautz 1978). Game managers should consider the characteristics of both summer and winter ranges, because of the tendency for deer populations to migrate in South Dakota.

Deer are primarily browsers, with a majority of their diet comprised of forbs and browse. Deer digestive tracts differ from cattle and elk in that they have a smaller rumen in relation to their body size, so they must be more selective in their feeding. Instead of eating large quantities of low-quality forage like grass, deer must select the most nutritious plants and parts of plants. Because of this, deer have more specific forage requirements than larger ruminants.

### Diet

Deer have adapted to seasonal change in forage availability by timing their activities so that major nutrient demands occur in the summer, when high-quality food is available in abundance. Ozoga and Verme (1982) evaluated the seasonal availability of wild forage by providing supplemental feed to a deer population ad libitum and found that seasonal feed consumption was lowest at spring green-up, increased in late summer as natural forage matured, and was highest in autumn and winter, indicating the potential presence of a natural food shortage during late summer and winter in the absence of rations. White-tailed deer and mule deer have adapted to the seasonal food restrictions through seasonal rhythms in heart rates, activities, and metabolism, with the lowest ecological metabolism occurring in the winter and highest in the summer (Moen 1978). Furthermore, deer accumulate deposits of subcutaneous fat during late summer and fall, change to an efficient winter coat, feed more during warmer daylight hours and seek shelter under dense conifers (Sieg and Severson 1996). However, new research suggests that for female mule deer most fat accretion and depletion is state-dependent and primarily influenced by reproductive status, so lactating females enter winter undernourished, regardless of summer nutrition (Monteith et al. 2013).

During winter, deer in South Dakota must cope with high energetic costs related to locomotion in deep snow and reduced forage abundance and quality. In response to severe weather conditions, deer minimize movement to conserve energy (Moen 1976). Taillon et al. (2006) noted that while body mass of white-tailed deer decreased over the winter, they did not observe any significant effects of diet quality on body mass loss, likely because overall activity decreased in cold weather and diets were flexible. Depending on the severity of winter weather and competition for browse, deer may seek out alternative, low-quality forage including woody browse, litterfall and windblown trees (Masse and Cote 2012). Generally, quality of forage tends to decline over winter as preferred species become scarce either due to phenological changes (Sieg and Severson 1996), over-browsing (Burrell 1982, Brown and Doucet 1991), or snow cover (Carpenter et al. 1979).

The abundance and diversity of forage plants available during the summer provides deer the opportunity for a feeding strategy that optimizes a nutritionally balanced diet (Westoby 1974). Deer highly prefer forbs during summer to meet minimum requirements for lactation and for growth of fawns after weaning because of the high protein content (Verme and Ullrey 1984). Lower quality summer range is reflected in lower productivity and can contribute to a gradual population decline indirectly through malnutrition. For example, Julander et al. (1961) and Pederson and Harper (1978) documented notable differences in doe to fawn ratios and percentage of does with twins on good versus poor condition summer ranges for migratory mule deer in Utah. Forage quality of summer ranges can be limited by drought (Grovenburg et al. 2011b), competition from wildlife or livestock (Loft et al. 1991, Sieg and Severson 1996), natural succession (Walter et al. 2009), or climate change (Bischof et al. 2012).

Zimmerman et al. (2006) studied differences in gastrointestinal morphology of female white-tailed deer and mule deer between burned and unburned landscapes. They reported that the alteration of the southern Black Hills by burning had effects on papillae morphology and digesta weight in white-tailed deer and mule deer within three years post-fire. This led them to conclude that papillary morphology likely represents a useful indicator of forage quality, because the response of papillae to changes in diet quality was rapid (e.g., 2 weeks).

<u>Nutrition</u>

Deer nutrition is both directly and indirectly associated with deer mortality. Malnutrition can directly lead to starvation, but indirect effects can be more insidious and difficult to separate from other environmental factors. The indirect effects of malnutrition include an increased incidence of parasitism and disease, an increased susceptibility to predation, an increase in resorption of fetuses or stillborn fawns, a lower conception rate, and impairment of rumen functions (Workman and Low 1976). Studies have demonstrated that the offspring of malnourished parents have lower body mass on average and reduced survival rates which were attributed to an increased vulnerability to predation (Mech et al. 1991, Bishop et al. 2009, Monteith et al. 2014). On the other hand, Ozoga and Verme (1982) observed that enhanced nutrition provided through supplemental feeding led to accelerated deer body growth and shortened the time to physical maturity; furthermore, antler development improved and casting dates were delayed, except among yearling males, while in utero productivity of yearling does doubled and significantly increased among other age classes.

Longer winters can be especially dangerous to deer populations by reducing the nutrients available to deer while their metabolic rates are still high during fall or spring transitions (Workman and Low 1976). Wallmo et al. (1977) concluded that winter range quality is best evaluated according to quantity of nutrients in forage rather than gross availability of forage. Protein requirements for white-tailed deer maintenance have been estimated to be 11% of daily intake of digestible dry matter for yearlings and 6-10% for adults, calcium requirements for growth and antler development are about 0.45%, and phosphorus requirements are less than 0.28% (Verme and Ullrey 1984). Dean (1976) suggested that seasonal requirements should be emphasized for wild animals, and that nutrient intake should be sufficient to allow young to survive the winter and females to reproduce successfully; whether or not animals receive maintenance rations each day is of secondary importance.

Different digestive characteristics between white-tailed and mule deer also determine the relative quality of available forage. For example, tannin contents in white-tailed deer forages can impede digestion, while mule deer generate salivary proteins that preferentially bind tannins and reduce tannin toxicity, allowing them to more efficiently digest similar forage (Sieg and Severson 1996). Walter et al. (2009) studied the differences in foraging habits of sympatric white-tailed and mule deer populations on previously burned and unburned habitat and found that mule deer appeared to benefit from fire significantly more than white-tailed deer in terms of forage quantity and quality. Regardless, both species appear to compensate for the poor nutrition found in low-quality forages by consuming greater quantities than they would consume of high-quality forage. Jenks et al. (1994) noted increased digesta in white-tailed deer from ranges with reduced digestibility of diets because of competitive interactions with cattle. Heavier mass of rumen digesta was also reported in mule deer with consumption of low-quality diets compared with high-quality diets (Baker and Hobbs 1987). Zimmerman et al. (2006) reported reduced ruminal fill and greater intestinal fill in white-tailed deer on higher-quality diets compared with those occurring sympatrically with mule deer in the southern Black Hills that consumed a lower-quality diet.

Adult female deer consistently select a higher quality diet than adult males (Beier 1987). This may be in part because smaller-bodied females are better suited to post-ruminal digestion of food, especially when intake increases alongside requirements for energy and protein during reproduction (Monteith et al. 2014). High demands for absorption of nutrients during lactation and growth stimulate investment in intestinal and hepatic tissue in females, increasing the cost of maintenance (Barboza and Bowyer 2000). To meet differential nutritional demands associated with reproductive status, deer have been observed consuming soil from natural salt and mineral licks to obtain sodium (Weeks and Kirkpatrick 1976), sulfur, calcium or magnesium (Atwood and Weeks 2003) during critical periods. Use of mineral licks by deer tends to be highest in spring and early summer coinciding with gestation, parturition and lactation, while mineral licks were not used by deer in winter (Atwood and Weeks 2003). Mineral licks are primarily used by adult females, but occasionally fawns and adult males will use them too (Kennedy et al. 1995). Zimmerman et al. (2008) hypothesized that hepatic mineral content would be different between white-tailed and mule deer as a result of different feeding strategies and morphologies, but they were unable to attribute any mineral composition to a specific group because mineral content varied with age, sex, species, maturity, season, and reproductive condition.

## Important Forage Species in South Dakota

Schenck et al. (1972) studied seasonal diets of white-tailed and mule deer in the southern Black Hills and determined that food habits for each species indicated that both species had similar diets within a given portion of the study area. In fall, bearberry, grasses, Oregon grape, western snowberry, and forbs were determined to be the most important food sources. The most important winter food sources were ponderosa pine, mountain mahogany, and common juniper. Other important winter food sources were bearberry, western snowberry, Rocky Mountain juniper, forbs, and grasses. The most important summer food sources in rumen samples of nine deer were alfalfa, clover, grasses, and forbs.

As part of the same study, Schneeweis et al. (1972) also studied food habits of white-tailed deer in the northern Black Hills and found that Oregon grape was the most important food item during the fall and winter. However, because of its low growth form in northern regions, its availability decreased with increasing snow depth. During periods of heavy snow cover, common juniper replaced Oregon grape as the most important species. Bearberry was also highly preferred and important during periods of little or no snow cover. Ponderosa pine, lichens, and bur oak were eaten in moderate amounts but were of secondary importance as winter food items. White-tailed deer in the northern Black Hills tend to select plants higher in crude protein and phosphorus, such as yellow vetchling, wild spirea, and western wild rose, compared to plants that were more available during summer; however, many of the primary species consumed by deer on Black Hills winter ranges (Schneeweis et al. 1972, Schenck et al. 1972) have insufficient crude protein contents to meet maintenance requirements. One particular concern is the amount of ponderosa pine needles that occur in the deer diets in the Black Hills. Schneeweis et al. (1972) and Schenck et al. (1972) determined pine to be moderately important and important in winter diets, respectively.

The majority of South Dakota habitat was once made up of mixed- and tall-grass prairie ecosystems, but now 75% of that habitat has been converted to agriculture (VerCauteren and Hygnstrom 2011). In western and central South Dakota, deep wooded draws surrounded by scattered agriculture on upslope flat land areas makes ideal winter and summer habitat for resident mule deer (Robling et al. 2014). Topographic draws can be interspersed with ash, elm, or juniper as the main cover and natural vegetation species including blue grama (*Bouteloua gracilis*), western wheatgrass (*Agropyron smithii*) and buffalo grass (*Buchloe dactyloides*) as forage. Important forage species associated with native prairie landscapes are chokecherry, serviceberry, skunkbush sumac, common snowberry, and dogwood (Petersen 1984). However, agricultural crops are nearly unlimited and make up the majority of the diets of white-tailed deer in the region (Nixon et al. 1991), which gives them a foraging advantage over mule deer that prefer native woodland, shrubland, and grassland vegetation in the agriculture-dominated regions of South Dakota (Sawyer and Lindzey 2000). Primary crops used by white-tailed deer that are produced in South Dakota include corn and soybeans and to a lesser extent because of availability winter wheat, sorghum, alfalfa, and oats (Gladfelter 1984).

## Survival

Knowledge of age-specific survival of deer and the underlying causes of mortality are essential to understanding deer population dynamics. White-tailed and mule deer can live upwards of 10 years of age, but most do not live past 4-5 years of age. Common causes of mortality include human-related factors (e.g., legal hunting, poaching, vehicle collisions; Matschke et al. 1984, Nixon et al. 1991), weather conditions (e.g., winter severity; DelGiudice et al. 2002, Brinkman et al. 2003), predation (Mech 1984, Bartmann et al. 1992), and disease (Matschke et al. 1984). Males tend to die at higher rates than females because of hunter preference for antlered males and because their seasonal movements are extensive (Nixon et al. 1991, Robling et al. 2014). The relative importance of any single cause of mortality is dependent not only on its rate, but on the rate of other mortality sources and their impact on the overall surviving population. For example, if hunting pressure is low for a given season, then there is a greater chance for more deer to succumb to predation or winter weather.

### Survival Strategies

In northern environments extreme winter conditions can extend beyond the physiological limits of deer, and winter is typically the season when most natural deaths occur (Mautz 1978). The length of winter (Pauley et al. 1993) and snow depths (Carpenter et al. 1979) can restrict access to forage to the point where deer are unable to meet their nutritional needs and they die (Karns 1980). Under these severe conditions, deer may forage on alternative food sources likely independent of browsing pressure, such as litterfall or windblown trees (Masse and Cote 2012). Klaver et al. (2008) reported that survivorship of white-tailed deer on winter ranges increased with tree and slash density, while higher survivorship was reported in areas with less relative grass and forb cover. Griffin et al. (2005) speculated that the Jasper Fire of 2000, which burned over 83,000 acres in the southern Black Hills, reduced winter ranges, leading to an immediate increase in winter deaths the first year from natural causes that gradually declined over subsequent winters as habitat regenerated. Zimmerman (2004) found that forb cover in burned habitat in the southern Black Hills had surpassed that in unburned habitats within the first 2 years post fire. Also, grasses followed the same pattern and increased through the first 3 years after the Jasper Fire, and had surpassed grass cover in unburned areas within 2 years post fire.

Deer have adapted physiological mechanisms that reduce their fasting metabolic rate during winter months, which in turn allows them to exist on reduced rations (Silver et al. 1969, 1971). When winter fat stores are depleted, as may be the case during an extended winter, deer catabolize stored fat and muscle protein during starvation, and increased catabolism of muscle protein (as fat stores are depleted) results in impaired gluconeogenesis and deer in this hypoglycemic state can succumb to starvation (deCalesta et al. 1977). However, recent work by Monteith et al. (2013) suggests that in contrast to current notions of summer accretion and winter catabolism of body reserves, some individuals deposited reserves over winter and catabolized reserves over summer, mainly because regulation of individual condition was state-dependent.

Doe nutrition throughout gestation and during the early postpartum period is correlated with fawn survival (Verme 1977), and fawn weight is the best predictor of overwinter survival (White et al. 1987). Stored body fat of lactating does is reported to be lowest in late summer and highest around December, because female mammals do not appear to accumulate energy reserves prior to breeding but support the energy demands of their offspring by increased feeding (Cothran et al. 1987). Pregnant does lose body fat during gestation, and does with multiple fetuses lose more fat than does carrying a single fawn. The fat levels of non-pregnant and non-lactating females increased significantly from September through December (Cothran et al. 1987). Verme and Ullrey (1984) suggested that productivity declines after seven years and winter malnutrition inhibits productivity in older females. As a result, Nelson and Mech (1990) predicted that old females would weigh less, be in poorer condition, produce fewer fawns, be more susceptible to predation, and have lower survival rates than younger females; however, they recognize that most deer populations are heavily hunted, so few deer live ≥10 years, making it difficult to study older age classes of deer.

Deer have evolved unique behavioral and biological adaptations to threats posed by humans and the environment including predator and hunter avoidance, as well as disease resistance. However, these topics are covered in more detail in other sections of this document.

<u>Survival Rates</u>

White-tailed deer are ubiquitous throughout the state of South Dakota, and are the most studied game species in the state, while mule deer in South Dakota are largely restricted to areas west of the Missouri River. Several studies have estimated the survival rates of white-tailed deer (DePerno et al. 2000, Grassel 2000, Brinkman et al. 2004, Burris 2005, Griffin et al. 2005, Grovenburg 2007, Grovenburg et al. 2009, Robling 2011, Grovenburg et al. 2011c, Grovenburg et al. 2011d, Grovenburg 2012a, Haffley 2013) and mule deer (Grassel 2000, Griffin et al. 2005, Robling et al. 2014) in South Dakota.

An increasing number of radio telemetry studies of northern white-tailed and mule deer have demonstrated that survival and cause-specific mortality rates may fluctuate regionally and seasonally with sex, age, and density of deer. Plotting the risk of mortality against deer age produces a U-shaped curve, indicating an elevated risk of mortality at ≤0.6 years old, declining progressively until 5 years old, and then increasing steadily again with the highest age-specific risk of death for deer ≥10 years old (DelGiudice et al. 2002); however, there is some debate as to rate of risk increase for older deer. Some studies suggest that the survival rate for does >2 years old is constant (Nelson and Mech 1986, White et al. 1987, Van Deelen et al. 1997). Regardless, it is commonly accepted that the risk of mortality increases as deer age (Nelson and Mech 1990).

<u>Agriculture Dominated Habitats</u>

Deer in the Midwest Agriculture Region may be characterized as well-fed, healthy, fertile, and short lived in hunted ranges (Gladfelter 1984). Nixon et al. (1991) observed that mature does in the region experience a relatively high incidence of polytocous (more than one fawn) conceptions in successive years, indicating superior nutrition provided by agricultural crops.

High neonate survival rates are not uncommon in agriculture-dominated regions with low predator density, quality vegetation structure at neonate bed sites, and high nutritional condition of does (Brinkman et al. 2004, Burris 2005, Grovenburg et al. 2011d).

Anthropogenic mortality (hunting, vehicle collisions, etc.) contributes much more to deer mortality in intensively farmed regions, while natural causes of mortality associated with malnutrition are nearly nonexistent given the abundance of food provided by agricultural crops (Gladfelter 1984, Nixon et al. 1991). High seasonal survival of northern white-tailed deer outside of the hunting season has been well documented (Nelson and Mech 1986, Van Deelen et al. 1997, Brinkman et al. 2004). In a highly fragmented, agriculture-dominated area in eastern South Dakota, Burris (2005) reported that the majority of adult deer mortality (76%) was a result of human-related causes (i.e., hunting and vehicle collisions), while natural causes of death (i.e., predation, disease) only contributed to 8% of total mortality. Annual survival rates of deer in agricultural-dominated landscapes are highly variable, and lengthy hunting seasons (Burris 2005), lack of escape cover (Nixon et al. 1991), and a well-established road network (Brinkman et al. 2004) have been cited as the reason for high susceptibility of white-tailed deer to human-induced mortality.

Grovenburg et al. (2011c) documented and compared survival and cause-specific mortality of adult female white-tailed deer in grassland habitats across four distinct ecoregions in Minnesota and South Dakota. Survival of female white-tailed deer did not vary regionally throughout the study areas. Annual survival was similar to survival rates reported elsewhere for northern populations (65-80%; Nixon et al. 1991, DePerno et al. 2000, Brinkman et al. 2004). Hunting accounted for 70% of all mortalities and vehicle collisions accounted for an additional 15%. Natural causes of mortality were minor compared to human-related causes (e.g., hunting, vehicle collisions). High human-related mortality was likely associated with limited permanent cover, extensive road networks and high hunter density.

Grovenburg et al. (2011d) compared the mortality rates of different fawn age classes (<2 weeks, 2-8 weeks, and >8 weeks) across different macro-habitats (wetland, water, cropland, grassland, and forest) in the grasslands of eastern South Dakota and found that mortality decreased as fawns aged but land cover did not further affect survival. In this study coyote (*Canis latrans*) predation accounted for 80% of fawn mortality, starvation accounted for the remaining 20%, and 100% of neonate (<1 month of age) mortality was due to coyote predation. Grovenburg et al. (2012b) investigated fawn survival and mortality in the grasslands of north-central South Dakota: coyote predation accounted for the majority of fawn mortality (52%), while the remainder were attributed to human-related mortality (hunting, vehicle collision, and farm accident; 26%) and hypothermia (22%). Contradicting previous research findings, they determined that fawn survival in the Great Plains is influenced by patch density of cover habitat, with greater densities of grasslands and wetlands and lower densities of forested patches increasing survival of fawns (Grovenburg et al. 2012b). Furthermore, summer survival markedly decreased over the three years of the study, which the authors speculated may be a function of lack of alternate coyote food sources, predator densities, landscape composition, and ground cover density. Grovenburg et al. (2012b) reported greater mortality at >8 weeks of age than during 2-8 weeks, counter to the conclusion of Grovenburg et al. (2011d), which saw a decrease in risk over time. These two studies produced nearly opposite results, indicating a need for the development of regional models (north-central vs eastern South Dakota), as well as larger sample sizes (Grovenburg et al. 2012b).

Prairie and Riparian Habitats

On the Lower Brule Sioux Reservation in central South Dakota, Grassel (2000) reported that seven out of nine radio-collared mule deer (four male and three female) died during the winter, and the other two died during the summer; furthermore, all of the males were harvested by hunters, while all of the females died of natural causes. Over the three-year study period, the annual survival rates for male mule deer ranged from 0 to 50%, while female annual survival rates ranged from 83 to 90%. The disparity in survival rates between the two sexes is likely due to hunting pressure almost exclusively targeting male deer. Robling et al. (2014) conducted a 3-year (2010-2012) survey of mule deer survival rates in two study areas in west and central South Dakota: the first area was in the Cheyenne River breaks region in Meade and Pennington counties which are characterized by cedar timbered breaks and deciduous timber-bottoms surrounded by grassy hills and scattered agricultural croplands, and the other study area was in the Fort Pierre National Grasslands (FPNG) characterized by rolling grasslands with very few wooded draws interspersed by grazing operations and croplands. Annual survival rates for female mule deer averaged 83% and 78% for the Meade-Pennington and FPNG study areas, respectively. They speculated that increased hunting pressure resulted in a slightly lower survival rate for FPNG compared to the Meade-Pennington study area, because, while harvest densities (harvest/km$^2$) were the same for both areas, there was nearly double the amount of public land open for hunting with fewer wooded draws for cover on the FPNG compared to the Meade-Pennington study area. Furthermore, significantly higher mortality during winter of 2011 at both study areas was likely a result of severe winter weather, while there was no significant difference in mortality rates between the other two years of mild winters, lending support to the importance of stochastic events in deer survival rates. Robling et al. (2014) also noted that the survival rates for male mule deer in the Meade-Pennington study area were lower (2010: 56%; 2011: 60%) than female deer, and hunting was the primary cause of mortality (57%); however, they admit that the small sample size in their study ($n$ = 7) warrants further research to develop more accurate estimates of male mule deer survival in prairie landscapes.

Stiegers (1981) radio-collared 66 newborn mule deer fawns in the Badlands of South Dakota and monitored their survival rates between May 1978 and May 1981. Coyotes killed, or were involved in the deaths of 90, 78, and 89% of fawns that died during 1978-1980, respectively. Total annual fawn mortality was 59% ($n$=10), 56% ($n$=9), and 36% ($n$=9) for 1978-1980, respectively.

Black Hills Habitat

Female white-tailed and mule deer may be sensitive to physical alterations of habitats within or near their home ranges. As was noted with the Jasper Fire, large-scale alterations of habitat may displace deer from traditional areas and decrease survival. Dubreuil (2003) found that after the Jasper fire, white-tailed deer females showed strong avoidance of burned habitats and selected unburned habitats for feeding and bedding. Timber harvest, cattle grazing, mining activities, and recreational use in the Black Hills all have the potential to affect deer behavior within these small home ranges (Griffin et al. 2005).

Griffin et al. (1994) reported annual survival rates of white-tailed females in the northern Black Hills of 81%, 79%, and 64% in 1990, 1991, and 1992, respectively. In the central Black Hills, DePerno et al. (2000) reported annual survival rates for female white-tailed deer between 50 and 62% over a 3-year period with an average annual survival rate of 57%, and natural causes (coyotes, dogs, malnutrition, sickness, and unknown) accounted for the majority (71%) of mortality, followed by harvest (23%), and accidental deaths (drownings and vehicle collisions; 6%). In the southern Black Hills, Griffin et al. (2005) reported a 69% average annual survival rate for female white-tailed deer, and mortality resulted primarily from natural causes (72%), followed by accidental deaths (18%), and harvest (10%). Both studies (Deperno et al. 2000, Griffin et al. 2005) found the highest incidence of female white-tailed deer mortality to occur during spring, claiming around 50% of the natural mortality in both areas.

In the southern Black Hills, Griffin et al. (2005) reported annual survival rates for male white-tailed deer between 0.3-1.0 over the course of a 5-year study, with an average annual survival rate of 73%. Hunting in the fall (50%) was the leading contributor to annual mortality, followed by natural mortality in the spring (33%). In the central Black Hills, DePerno (1998) reported an average annual survival rate for male white-tailed deer of around 80% to which 67% of mortality resulted from harvest and natural causes accounted for 33%.

Reproductive potentials of South Dakota white-tailed and mule deer populations are defined as number of fawn/doe at parturition. Management personnel collect fetal samples in the Black Hills during March through May to approximate parturition rates. In 1995, McPhillips and Rice (1995) reported 31 out of 36 sampled does were adult does with an 86% pregnancy rate. Among the adult does, there were 44 fetuses total (2 with 0, 14 with 1, and 15 with 2), which corresponds to an adult fetal fawn/doe ratio of 1.42 fetus/doe. The remaining 5 does were coming 2-year-olds. Three had no fetuses and 2 had 1 fetus each (0.4 fetus/doe). In 1996, McPhillips et al. (1996) reported 53 out of 65 sampled does were adult does with a 91% pregnancy rate. Among the adult does, there were 68 fetuses total (5 with 0, 28 with 1, and 20 with 2), which corresponds to an adult fetal fawn/doe ratio of 1.28 fetus/doe. The remaining 12 does were coming 2-year-olds. One had no fetuses, 8 had 1 fetus, and 3 had 2 fetuses (1.17 fetus/doe). In 1997, Schlueter et al. (1997) reported that reproductive potentials continued to indicate population stress with no significant differences ($P>0.05$) detected from the long term average of 1.36 fawn/doe (1977-1996). At the time of the survey, the long-term average summer fawn mortality was 25%, while the 1997 rate was estimated at 46%. In 1998, Schleuter et al. (1998) again reported that summer fawn mortality was not significantly different and increased ($P<0.05$) from the long-term average (1977-1997). At the time of the survey, the long-term summer fawn mortality was 25%, while the 1998 rate was estimated at 24%.

In the southern Black Hills, Griffin et al. (2005) documented the annual survival rates of mule deer (n = 31) between 1998 and 2003, which were 77% and 23% for females and males, respectively. Among radio-collared deer included in the study, female mortality was almost exclusively due to natural causes, while all male deer mortalities were a result of hunting. The majority of mortality among radio-collared female mule deer occurred during the winter and spring with mountain lion predation as the leading cause (43%); further, the annual mortality due to mountain lion predation was estimated at 18-23% of female deer in the southern Black Hills between 1999 and 2001. The survival rate of male mule deer reported in the southern Black Hills (23%) was lower than numbers reported for other regions (50% - 61%: Wood et al. 1989, Carrel et al. 1999, McCorquodale 1999). Consistent with the results of the Griffin et al. (2005) study, other studies document hunter harvest as the leading cause of male mule deer mortality (Carpenter et al. 1979, Wood et al. 1989). As this was the first study (Griffin et al. 2005) ever to document mule deer mortality in the Black Hills, more research is needed to accurately quantify survival rates and identify the major causes of mule deer mortality in the region; however, this study as well as research from other areas, suggests that hunting is a leading cause of mortality among male mule deer in the Black Hills, while predation accounts for a majority of the female mortality.

## PUBLIC LANDS

### South Dakota Game, Fish and Parks

#### Game Production Areas

South Dakota Game, Fish and Parks owns and/or manages 717 game production areas (GPAs) across the state totaling approximately 295,774 acres, or 0.6% of the total land area in South Dakota; of which, all GPAs owned by SDGFP are subject to property taxes and are paid for by the Department. Deer likely utilize various habitats on nearly all GPAs across the state at some time during the year, with certain larger GPAs and adjoining public lands likely providing habitat of a quantity or quality enough to sustain significant local populations. Statewide, habitat composition on GPAs consists of approximately 50% grassland, 30% wetland, 10% annually cropped farm land, and 10% trees and shrubs.

Specific habitat management objectives for individual GPAs are generally designed to benefit a wide array of wildlife species and public uses. Many GPAs located in central and eastern South Dakota are managed with a strong emphasis on upland game habitat, while providing deer habitat and deer hunting opportunities as a co-equal or secondary management objective. However, GPA specific management objectives and primary species of management concern are dictated by many factors, including but not limited to ecoregional location, local input from GFP biologists and public land users, existing habitat composition, and fiscal limitations. Management practices such as prescribed burning, prescribed grazing, and haying are used to manage grassland habitats; and annual cropping is used to produce food habitat plots for resident wildlife and as a seedbed preparation for the establishment of grassland habitats.

The primary goal of the Wildlife Division's habitat management activities on GPAs is to provide a diversity of habitat types in order to benefit a wide variety of wildlife species.  On certain GPAs where deer habitat needs have been identified by GFP managers and biologists, specific management activities occur that involves development of habitats identified as necessary to meet seasonal life-cycle needs of deer.  However, these habitat development and management activities generally do not result in significant negative impacts to other wildlife and their habitat needs.

The habitat management approach on existing GPAs is centered on operating and maintaining existing habitat conditions, while taking advantage of every opportunity to make improvements for both wildlife and people through various habitat and public use development activities.  On newly acquired GPAs, developments and habitat improvement projects are carefully planned and implemented over an appropriate and practical period of time.  Depending on current land use practices and habitat conditions at the time of purchase, these habitat developments and improvements may include continued use of agricultural fields as food plots, establishing tree plots, reestablishing grassland vegetation, implementing managed grazing and haying practices, fence construction, and other practices that support public use such as parking areas and access roads.

GPA acquisition efforts across the state focus on securing in fee-title native habitat types that support resident and migratory wildlife species while providing various wildlife related recreational opportunities.  In August of 2016, the SDGFP Commission adopted a set of Land Acquisition Priorities and Guidelines to aid the department in its efforts to provide diverse and sustainable outdoor recreational opportunities for current and future generations (http://gfp.sd.gov/land-acquisition.pdf).  The adopted priorities and guidelines both reaffirmed the department's existing land acquisition priorities and practices, but also showed SDGFP's commitment to addressing public recreation needs by incorporating a significant amount of public input into identifying priority recreation opportunities for which land acquisition is an appropriate tool.

This approach to GPA acquisition has resulted in a widely distributed land inventory of high quality habitat types that is both biologically sound and publicly acceptable.  Land acquisition priorities include additions to existing GPAs, parcels that enhance or facilitate public access to existing GPAs and other public lands, in-holding and round-out parcels that consolidate or connect existing GPAs, and parcels that provide buffers or are necessary for maintaining or enhancing the integrity of existing GPAs and other public lands.

State Parks and Recreation Areas

The South Dakota State Park system includes 13 state parks, 43 recreation areas, 5 nature areas, 1 historic prairie, and 69 lakeside use areas.  State parks encompass a total of 102,558 acres.  Custer State Park is the largest state park with 70,840 acres.  Per its mission, the State Park system strives to provide diverse outdoor recreation opportunities, including some limited hunting.  Although highly developed to facilitate diverse public uses, most lands within the State Parks system contain suitable habitat for deer.

Custer State Park

Custer State Park (CSP) was established after action by the state legislature in 1919. CSP encompasses 70,750 acres of forests and grasslands in the southern Black Hills of South Dakota (Figure 58). Geography varies from steep granitic spires in the northwest part of the park, forested rolling topography in the main body and grading eventually into grasslands on the eastern and southern boundaries. Elevation ranges from 3,760 to 6,700 feet above sea level. Vegetation is dominated by white spruce/ponderosa pine mix on north slopes at higher elevations, pure ponderosa pine on most forestlands, and mixed-grass prairie on grasslands. Both white-tailed deer and mule deer are native to CSP. The population objectives for deer based on forage allocation include managing for 800 white-tailed deer and 200 mule deer (CSP Resource Management Plan 2010-2025; Table 52). The white-tailed deer herd was estimated at approximately 850 deer (95% CI 670-1,162), and the mule deer herd was estimated at approximately 320 (95% CI 152-998) in 2003 (Woeck 2003). Abundance estimates have not been conducted since 2003, and road transects specified by Woeck (2003) are driven in November annually to collect trend data for deer in CSP. Trend data include buck:doe and fawn:doe ratios (ratios are calculated as number of animals counted) for white-tailed deer.

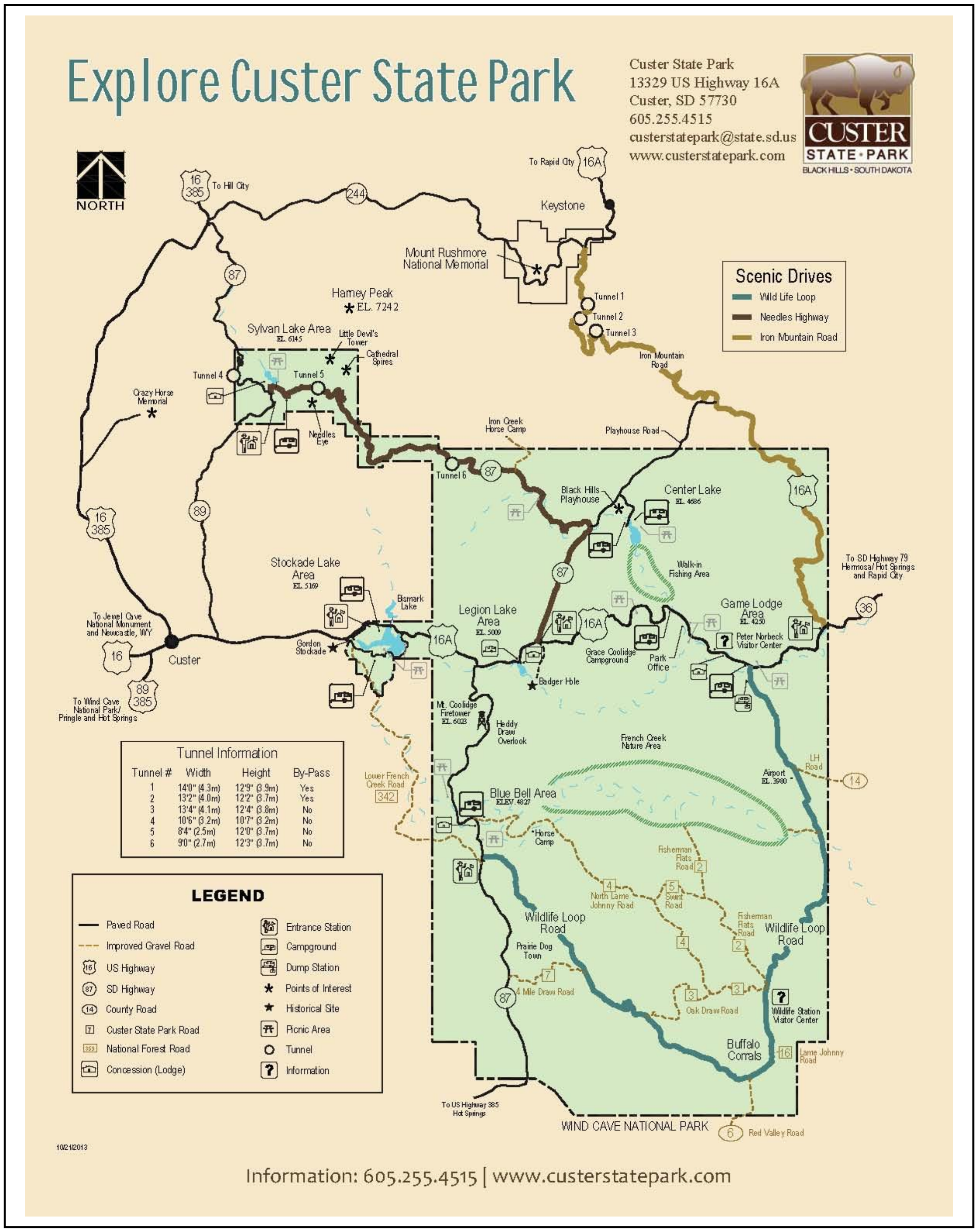



Figure 58. Location of Custer State Park in the southern Black Hills, South Dakota.

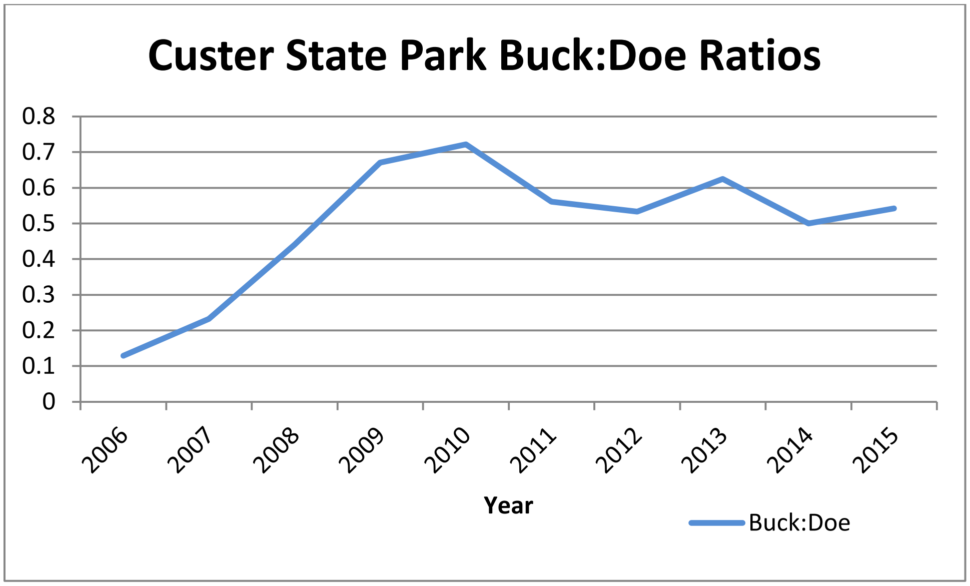
Table 52. Utilization and allocation of range and forest forage for Custer State Park with range and forest producing 90% potential forage[1].

| | Lbs. dry forage | Range | Forest | Total |
|---|---|---|---|---|
| | Total | 30,418,656 | 32,411,360 | 62,830,016 |
| | 25% Allocation | 7,604,664 | 8,102,840 | 15,707,504 |

| | Species | Objective | Lbs./day equivalent | Lbs. consumed annually |
|---|---|---|---|---|
| | Bison | 960 | 22.4 | 7,837,092 |
| | Elk | 800 | 12.3 | 3,590,647 |
| | White-tail | 800 | 3.1 | 918,740 |
| | Mule deer | 200 | 3.6 | 260,508 |
| | Pronghorn | 350 | 2.2 | 284,824 |
| | Bighorn | 200 | 5.2 | 381,257 |

| Species | Lbs. dry forage consumed annually | Range% - Forest% | Range | Forest |
|---|---|---|---|---|
| Available | 15,707,504 | 48%-52% | 7,604,664 | 8,102,840 |
| Bison | 7,837,092 | 75%-25% | 5,877,819 | 1,959,273 |
| Elk | 3,590,647 | 21%-79% | 754,036 | 2,839,611 |
| Pronghorn | 918,740 | 80%-20% | 734,992 | 183,748 |
| Mule Deer | 260,508 | 60%-40% | 156,305 | 104,203 |
| White-tail | 284,824 | 15%-85% | 42,724 | 242,100 |
| Bighorn | 381,257 | 10%-90% | 38,126 | 343,131 |
| Consumed | 13,273,068 | | 7,604,001 | 5,669,067 |
| % used | 85% | | 100% | 70% |

[1]Custer State Park Resource Management Plan 2010-2025. Production for a normal precipitation year with 25% forage production allocated to these grazers. Utilization based on daily intake rates and herd sex/age composition. Populations represent overwinter herd size after reductions.



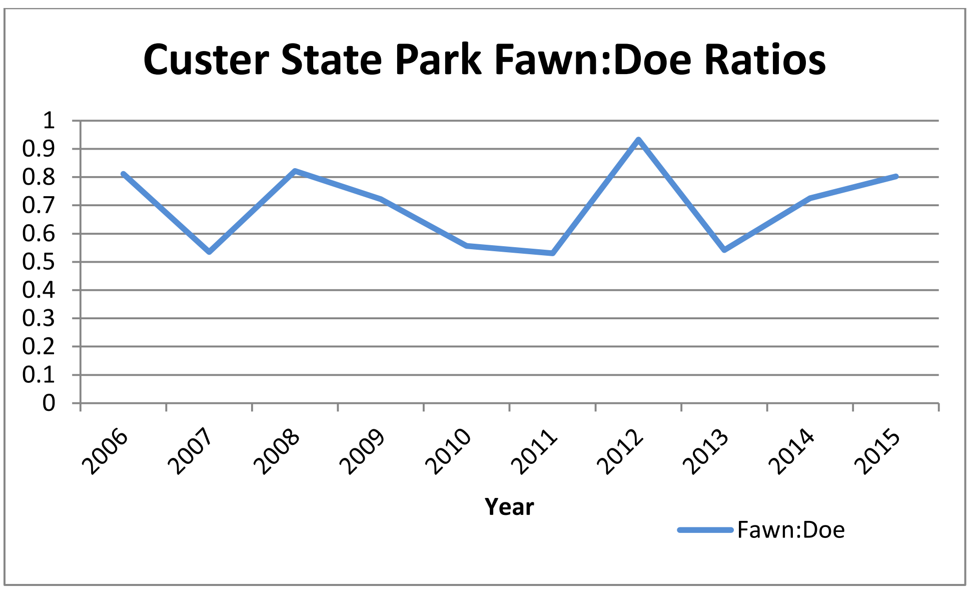




Figure 59. Trend data for white-tailed deer in Custer State Park, Black Hills, South Dakota, 2006-2015.

**South Dakota School and Public Lands**

The Office of School and Public Lands (SDSPL) manages over 765,000 surface acres across South Dakota, issuing and maintaining over 2,880 grazing and agricultural leases. Information regarding management of surface leases, and location of lands administered through the SDSPL can be found at: http://www.sdpubliclands.com/. Grassland leases are the most widely utilized activity on SDSPL lands, with 75% of SPL holdings in western South Dakota.  SDSPL land holdings consist of 98% grassland land and 2% cropland.  School Lands are leased at public auctions with lease terms of five years with a renewable five-year option.

**Federal Lands in South Dakota**

There are a number of federally managed public lands that exist within the state of South Dakota including lands managed by the Bureau of Land Management (BLM), the US Forest Service (USFS) National Forests, USFS National Grasslands, US Fish and Wildlife Service (USFWS) National Wildlife Refuges (NWR) and Waterfowl Production Areas, and the National Park Service (NPS; Figure 60).  This section provides a brief overview of the federally managed public lands within the state of South Dakota and summarizes the identified management goals and/or objectives as they relate to big game and specifically to mule deer and white-tailed deer populations.

Federal agencies prepare and follow management plans that provide broad objectives, goals, and direction on how to manage resources on their respective lands.  Management plans commonly include some level of monitoring or evaluation of the resources with periodically required reporting to identify qualitative and quantitative impacts, both positive and negative, that have resulted from following prescribed management plans.  Monitoring reports generally follow a five-year cycle to allow management strategies, either as originally posed in the management plan or changes instituted through adaptive management, an opportunity to take effect.  Several of the plans reviewed for this section were not instituted until 2012 or later, therefore quantifiable actions, for example acres of land used for timber harvest or acres of land utilized under grazing allotments, have not been reported by several of the agencies.

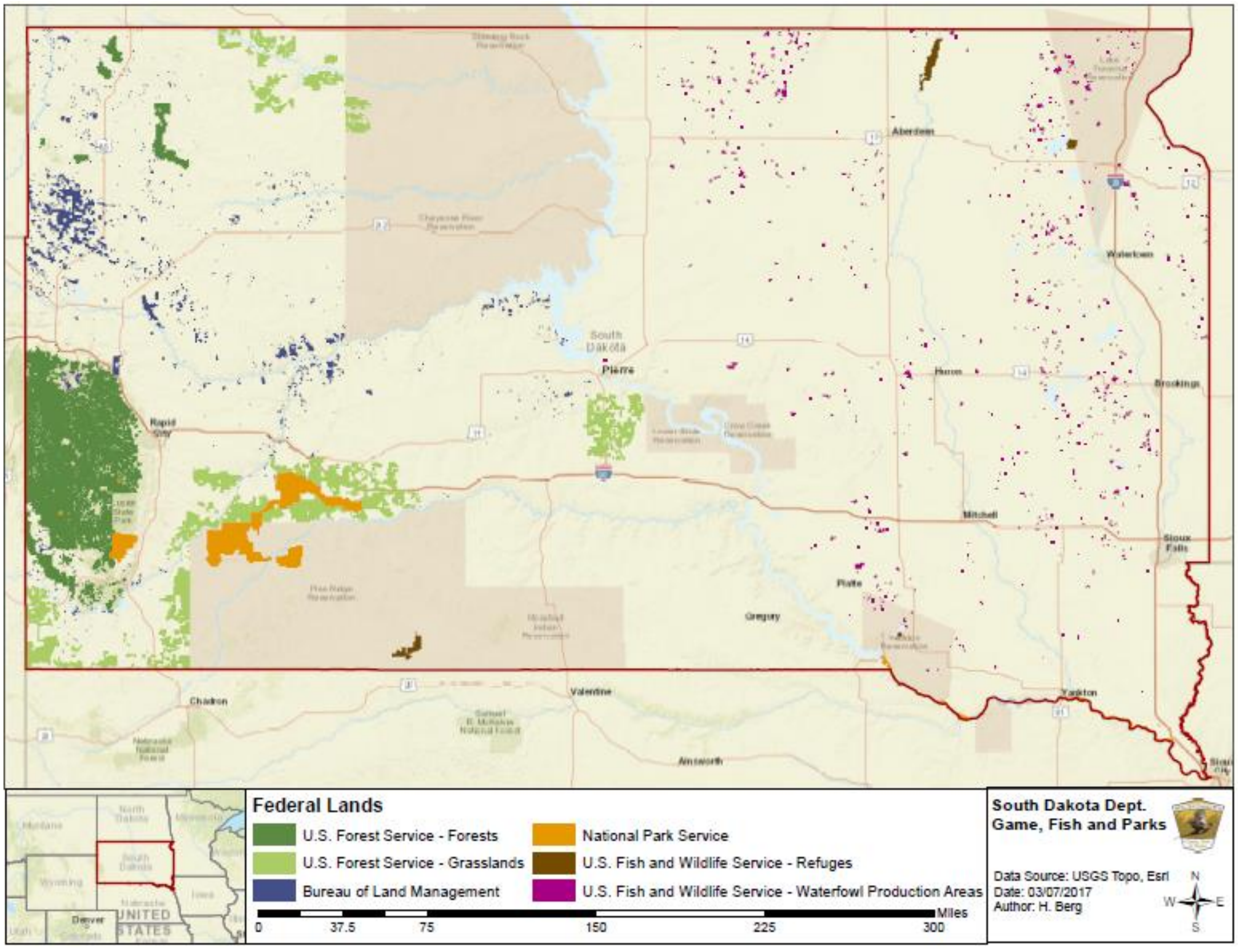



Figure 60. Federally managed public lands in South Dakota.

## Bureau of Land Management

The BLM South Dakota Field Office (SDFO) manages approximately 274,000 acres in South Dakota (BLM 2015a). Over 98% of the BLM administered lands in South Dakota are in the western portion of the state in Custer, Fall River, Harding, Butte, Lawrence, Meade, Pennington, Perkins, and Stanley counties (Figure 60). The BLM's mission is to manage and conserve the public lands for the use and enjoyment of present and future generations under a mandate of multiple-use and sustained yield.

The majority of the BLM-administered lands in South Dakota contain gentle rolling plains, with an annual precipitation ranging from 13 to 18 inches on the prairie and 18 to 30 inches in the Black Hills. Grassland communities, indicative of the climate, are the most prevalent of all vegetation community types across the SDFO management area (BLM 2015b). Sagebrush steppe is at the easternmost edge of its range in western South Dakota with mid-grass prairie in the western and central parts of the SDFO planning area transitioning to tallgrass prairie in the east. River breaks, badlands, buttes, and the Black Hills provide topographical diversity in the landscape (BLM 2015b). For management purposes, BLM has generalized habitat types on SDFO administered lands to three categories: grasslands, shrublands, and forest/woodlands (Table 53).

Table 53. General Habitat types on BLM administered lands in South Dakota.

| ***Habitat Type*** | ***Acres*** |
|---|---|
| Grasslands | 210,500 |
| Shrublands | 38,500 |
| Forest and Woodlands | 17,500 |

Source: South Dakota BLM Approved Resource Management Plan (BLM 2015a)

Species like mule deer, white-tailed deer, and pronghorn are the most common big game animals occupying much of the BLM planning area in South Dakota. The sagebrush areas (mainly in Butte and Harding counties), riparian habitats, upland woodlots, river breaks, and mixed grass rangelands found on BLM lands provide important big game habitats including winter range areas for pronghorn, mule deer and game birds. Other big game species in the planning area include elk, bighorn sheep, mountain lion, mountain goat, and an occasional moose (*Alces alces*).

Mule deer are widespread on BLM administered lands west of the Missouri River, and are typically associated with the more open landscapes and vegetative communities such as junipers, sagebrush, and other herbaceous cover. Mule deer also use the riparian corridors and woody draws. Mule deer tend to be present year round on BLM administered lands where it abuts cultivated fields (BLM 2015a). White-tailed deer, conversely, are typically associated with river bottoms, riparian corridors, woody draws, and hard-wood forest.

<u>BLM SD Field Office Goals, Objectives, and Management Decision</u>
The BLM has identified several goals general to all wildlife within the South Dakota Approved Resource Management Plan (SD RMP; BLM 2015a). These goals, while not specific to deer, are likely to benefit both mule deer and white-tailed deer. Identified goals of the SD RMP that are likely to benefit deer species include:

- Ensure that native wildlife species are provided habitat of sufficient quality and quantity to enhance biological diversity and sustain their economic, social and ecological values.
- Provide habitat and forage to support wildlife with consideration of South Dakota Wildlife Action Plan game management goals and the Northern Great Plains Joint Venture Program.
- Movement of big game species between habitats will be facilitated.

- Ensure that populations of native plants and animals are well distributed across the landscape.
- Provide suitable habitat condition to allow for movement between blocks of habitat and seasonal and specialized habitats on a local and landscape scale.

With these goals called out in the BLM's SD RMP (BLM 2015a), BLM initiated measures and restrictions to benefit wildlife populations such as the following:

- Any mechanical and vegetation treatments within big sagebrush habitat crucial to sagebrush obligate species will be evaluated at the project level by an interdisciplinary team to protect that resource.
- Surface disturbing and disruptive activities within big game winter range will be subject to a plan approved by BLM that provides adequate mitigation measures and conservation actions to protect habitat and limit disturbance in a manner that will support the long-term populations associated with the winter range.
- Big game winter range will be an avoidance area for commercial renewable energy development and other ROWs.
- Any conversion of vegetation type from pasture to native vegetation or from native vegetation to pasture will be allowed when needed to protect, maintain or improve wildlife habitat, sensitive soils, riparian vegetation and control weeds/invasive species. Vegetation type conversion proposals will be evaluated at the project level to protect wildlife habitat and watershed resources. No more than 1% of BLM SDFO administered lands would be converted from native species to introduced species.
- New fences will follow BLM specifications (BLM Handbook 1741-1 and Washington Office (WO)-IM-2010-022) to allow for wildlife passage and located or marked as feasible to minimize collisions and other wildlife issues, except for fences built specifically to keep wildlife out of an area.
- Existing fences will be reviewed to identify areas where fence modification or removal could be implemented to improve wildlife movement.
- BMPs for wildlife will be used to reduce impacts on wildlife.
- Coordinate with other federal, state and private land management agencies in developing a habitat management plan.
- Fuel treatments (prescribed burns, mechanical trimming, chemical control, etc.) will be designed to protect or improve wildlife habitat.
- Predator control will be permitted subject to the stipulations outlined in the annual Animal Damage Control MOU between BLM and USDA-APHIS.
- Identify distribution, key habitat areas, and special management needs for development of management plans and conservation measures with emphasis on riparian/wetland areas, cottonwood galleries, native grasslands, sagebrush steppe, woody draws and seasonal ranges supporting life cycle requirements for wildlife.

The SD BLM RMP provides protection to big game (including mule deer and white-tailed deer) winter range, by making approximately 121,406 acres of winter range an avoidance area for renewable energy development and implementing no surface occupancy for oil and gas development on 55,370 acres of BLM SDFO-administered surface lands that are within Greater Sage-Grouse Priority Habitat Management Areas (BLM 2015a and 2015b).

**USFS National Forests**

Custer Gallatin National Forest

Spanning more than 3.1 million acres and stretching across three states and seven ranger districts including Bozeman, Hebgen Lake in West Yellowstone, MT, Yellowstone in Livingston, MT, Gardiner, Beartooth in Red Lodge, MT, the Ashland in far southeastern MT and Sioux in Camp Crook, SD, the Custer Gallatin National Forest covers vast and ecologically diverse landscapes. Responsible for eight separate land units in southeast Montana and northwest South Dakota, the Sioux Ranger District rises with mesas of ponderosa pine and stretches out into the rolling grasslands and covers a total of 163,000 acres spread across a distance of 100 miles (Figure 60). The Custer and Gallatin National Forests were recently combined into one administrative unit. Citations within this section pertain to the former Custer National Forest Plan (USDA 1986a). The new administrative unit (Custer Gallatin National Forest) began revising and combining the old Forest Plans into one new Plan projected to be completed in late 2019. Changes in the revised Custer Gallatin National Forest Plan and implications for deer and deer habitats will be reflected in future revisions of this state-wide deer management plan. Also, "Management Indicator Species" (see BHNF description below) will no longer be a guiding principle according to the 2012 USFS Planning Rule.

The Sioux Ranger District is rich in archeological and paleontological resources and also includes two National Landmarks: Capitol Rock and The Castles. The Sioux Ranger District with its forest and rolling grasslands provides habitat for mule deer and white-tailed deer and various other game and non-game wildlife. Many recreationalists also enjoy hiking, horseback riding, cross country skiing, snowmobiling, mountain biking, fishing, camping and bird watching. Mule deer and white-tailed deer provide the largest share of hunting recreation on the Custer Gallatin National Forest. The Forest has sizeable populations of both species. For most of the Forest, the summer and winter ranges for these species are similar. The animals do not migrate to a lower elevation at the onset of winter. Rather, they use the same habitats that they use the rest of the year. For most of the prairie habitats and some of the timber habitats, notably the Long Pines area of the Sioux Ranger District, cover is considered to be the single largest limiting factor in winter (USDA 1986b).

The Custer National Forest Management Plan (Custer Forest Plan, USDA 1986a) provides long-term direction for managing the Custer National Forest. The Custer Forest Plan provides two levels of direction: general Forest-wide Direction and specific Management Area Direction. The Forest-wide Direction for wildlife in general states: *"The goal of wildlife and fisheries management is to manage and/or improve key wildlife and fisheries habitats, to enhance habitat quality and diversity, and to provide wildlife and fish-oriented recreation opportunities. Most of the critical habitat areas have been incorporated into management areas that maintain or improve these key habitats. Wildlife and fisheries management is considered in all management areas and the level of wildlife habitat management will increase over time."*

The Custer Forest Plan further states: *"The objective of wildlife management is to emphasize active management of wildlife habitat. Mitigation of adverse effects from other resources activities will continue. Threatened and Endangered plants and animals are given special consideration on an area by area and species by species basis. Special consideration is also given to certain high interest species, such as bighorn sheep and prairie chickens, by designating key habitat areas where other resource activities are modified."*

The Custer Forest Plan identifies management standards specific to Custer National Forest and in addition to national and regional USFS management standards. Custer Forest Plan wildlife management standards are generally designed to maintain at least viable populations of existing native and desirable non-native vertebrate species, to promote the conservation of federally listed threatened and endangered species and to coordinate and cooperate with appropriate state, federal and private agencies in the management of habitats for major interest species.

Custer Gallatin National Forest overall, including lands in South Dakota and Montana, includes 865,500 AUMs (animal unit month; USDA 1986a), with deferred grazing from April 15 to July 15 in some key areas. The Custer Forest plans states, *"livestock grazing will be modified as needed to meet wildlife habitat needs",* but further states that the allotment status would be retained. The forest plan explained that stocking and seasonal use may be adjusted to benefit wildlife and their habitat. Lands within the Custer Gallatin National Forest have been divided into 20 management areas, each with different management goals, resource potential and limitations.

The Sioux Ranger District has the unique opportunity to demonstrate the interrelationships and interdependence of three major resources--range, timber and wildlife. The management activities in any one resource will have an effect upon the others and must be carefully done. White-tailed deer, wild turkey and certain species of raptors are active inhabitants of the Sioux District and their habitat is critical to maintain. The opportunity for improving ownership patterns exists through a land exchange program with the State of South Dakota and various individual private landowners (USDA 1986a).

<u>Black Hills National Forest</u>

Black Hills National Forest (BHNF) encompasses approximately 7,700 square miles of western South Dakota and northeastern Wyoming (Figure 60; USDA 2005a). The BHNF is described as an island in the prairie. The "island" concept is important because species associated with ponderosa pine, white spruce, and hardwood communities could be susceptible to ecosystem change that could spread throughout the forest (USDA 2005a). The BHNF contains plant communities from the Rocky Mountains, northern coniferous forests, eastern hardwood forests, and the surrounding Great Plains. Because of this unique combination of vegetative communities, the BHNF functions as a place for intermingling of species.

An objective of the Black Hills National Forest Phase II 1997 Land and Resources Management Plan Final Environmental Impact Statement (BHNF Plan, USDA 2005b) is to maintain or restore white-tailed deer and mule deer habitat. Long-term fire suppression in the BHNF has resulted in adverse impacts on white-tailed deer habitat (USDA 2005b). Conversion of deciduous forests such as aspen and bur oak to ponderosa pine and invasion of ponderosa pine into meadow habitats has reduced available forage for white-tailed deer (Uresk and Severson 1998, Parrish et al. 1996). As a result, white-tailed deer were selected as a Management Indicator Species to evaluate the effects of implementation of the BHNF Plan and the ability of the BHNF to support species that rely on a variety of forest conditions, including the occurrence of understory forbs and shrubs.

The BHNF Plan provides direction to maintain range conditions and to increase grasslands and meadows which will improve forage quality and quantity. The BHNF Plan also includes an objective to make 233 million pounds of forage available for livestock and wildlife, of which wildlife will use up to 106 million pounds (USDA 2005b). Lastly, the BHNF Plan is designed to provide a diversity of forest conditions to provide forage in close proximity to cover. Structual stage objectives on 85% of the BHNF are designed to provide a diversity of forest conditions. The BHNF Plan also contains objectives to increase aspen and hardwoods which will benefit deer.

The BHNF Plan spatially divides the forest into management areas based on the different types of resource and use opportunities that are available to the public and where different management practices are to be carried out. Management area specific management strategies are applied in addition to the overall forest-wide strategy. Eight general categories (1-8), which are further subdivided into smaller areas, are used to further define management strategies within the forest. The eight categories are defined along a continuum that is based on the relative level of anticipated use by the public as well as the level of active management. These categories coincide with those used by the USFS throughout the Rocky Mountain Region as well as other regions. Of these general management categories within the BHNF, Category 5 areas include forest ecosystems where active management objectives are defined for wildlife and big game species. Specific Category 5 management areas defined in the BHNF Plan that identify strategies to benefit big game species include management areas 5.1A, 5.4, 5.4A, 5.43, and 5.6 (Figure 61). General information and management themes for these areas are summarized in Table 54.

Table 54. Summary of Black Hills National Forest Management Areas 5.1A, 5.4, 5.4A, 5.43, and 5.6.

| | **Black Hills National Forest Management Area** | | | | |
|---|---|---|---|---|---|
| | **5.1A** | **5.4** | **5.4A** | **5.43** | **5.6** |
| Acres | 89,706 | 396,516 | 12,236 | 10,162 | 22,176 |
| Percent of BHNF | 7.2 | 31.8 | 1.0 | 0.8 | 2.2 |
| Management Area Theme | These areas are managed to achieve and maintain the desired conditions for wildlife, livestock and vegetation. | These areas are managed to provide high-quality winter and transitional habitat for deer and elk, high-quality turkey habitat, habitat for other species, and a variety of multiple uses. | These areas are managed to provide habitat for game animals and birds. Some human activities are allowed, consistent with wildlife needs. | These areas are managed for wildlife and timber production, and include low open road densities and optimum forage/cover ratios. | These areas are managed for timber production, non-motorized recreational opportunities, and big game habitat value, with low open road densities and near-optimum arrangement of forage and cover areas. |

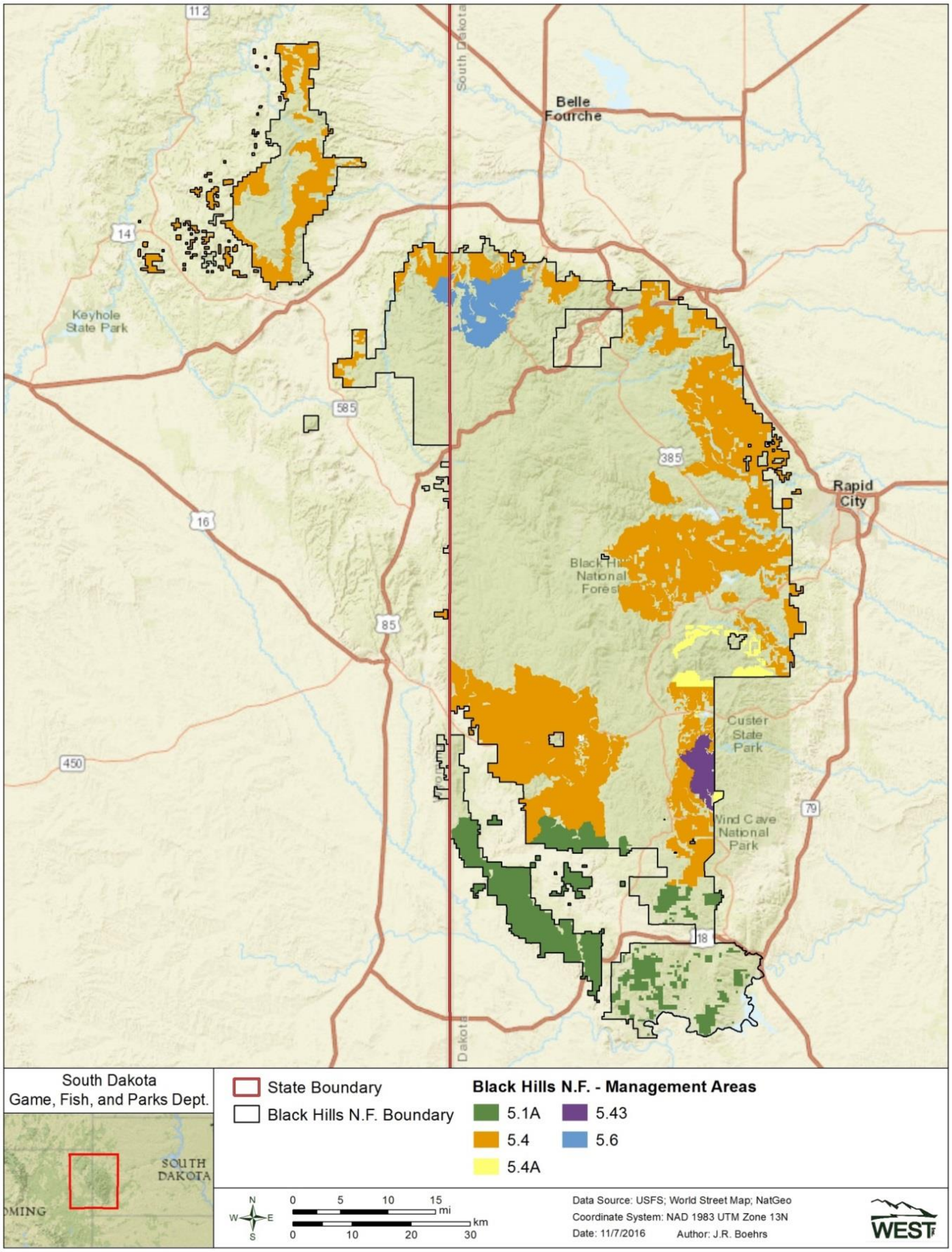



Figure 61. Black Hills National Forest management areas that specify strategies to benefit big game species, including mule deer and white-tailed deer.

Management Area 5.1A: Southern Hills Forest and Grasslands Areas

Management Area 5.1A, referred to as the Southern Hills Forest and Grasslands Areas, is dominated by open grasslands with areas of woody vegetation, in the southern portion of the BHNF. The Southern Hills Forest and Grasslands Areas comprise 89,706 acres or 7.2%of the BHNF (Figure 61). Wildlife habitat and forage production for both livestock and wildlife are emphasized in Management Area 5.1A. Livestock grazing can be a prominent feature seasonally as some vegetation management is carried out through livestock grazing. However, prescribed burning is the primary tool used to maintain desired conditions of habitat and vegetation. Vegetative diversity exists, including species associated with grasslands, sage brush, Rocky Mountain juniper, and ponderosa pine. The BHNF Plan states as a goal and objective for the Southern Hills Forest and Grasslands Areas is to *"provide thermal cover on at least 20% of the forested areas,"* where feasible. BHNF does not identify specific Management Area 5.1A standards or guidelines, but rather defers to forest wide standards and guidelines including those for wildlife.

Management Area 5.4: Big Game Winter Range Emphasis

Management Area 5.4, referred to as Big Game Winter Range Emphasis areas, are located in foothill or old wildfire sites where snow depths and forage conditions provide the habitat sought by mule deer, white-tailed deer, and elk during winter. Big Game Winter Range Emphasis areas are scattered across the north, east and south sides of the forest and encompass 396,516 acres or 31.8% of BHNF (Figure 61). These areas represent the traditional wintering sites and important transitional habitats where deer and elk often reside in the winter months. These low-elevation habitats play a critical role in the annual life cycle of many Black Hills elk and deer, and are becoming increasingly important, especially since residential and commercial development continues on private lands adjacent to National Forest System lands. The amount of use these areas receive from deer and elk depends on the severity of the winter.

BHNF manages Management Area 5.4 to provide big game winter range while maintaining healthy plant communities and recreational opportunities. All activities, including recreation, are managed so that deer and elk can effectively use the area during winter and other critical periods. However, high quality winter habitat is enhanced by reducing vehicle access to key areas with limited on road and off road vehicle traffic. Additionally, some roads may be permanently closed by barriers or seasonally closed by gates during the winter months, to minimize stress to wildlife, particularly deer and elk. However, some areas and roads may remain open to snowmobile traffic during winter months in accordance with Management Area 5.4 Transportation and Travel guidelines.
Timber harvesting and prescribed burns are the primary management tools used to stimulate browse production and to improve habitat. BHNF manages vegetation to provide healthy plant communities with a variety of species for food and cover, including thermal cover. Management emphasizes a vegetative mosaic, with natural and created openings, low- to high-density forest stands, and diverse sizes and ages of tree stands. Vegetative species composition in the Big Game Winter Range Emphasis areas includes aspen, bur oak and mountain mahogany, as well as ponderosa pine and white spruce.

The Forest Plan states that a goal and objective for the Big Game Winter Range Emphasis areas is to *"manage for an open-road density of 1 mile of road per square mile or less for general public travel from December 15 through May 15."* Furthermore, BHNF identifies that Management Area 5.4 has an objective to meet specific forest structural stage percentages (Table 55).

Table 55. Structural Stages Objective for Management Areas 5.4, 5.43, and 5.6.

| **Structural Stage Class** | **Objective Percentage** | **Structural Stage Class** | **Objective Percentage** |
|---|---|---|---|
| SS1 | 5% | SS4A | 25% |
| SS2 | 5% | SS4B | 25% |
| SS3A | 10% | SS4C | 5% |
| SS3B | 15% | SS5 | 5% |
| SS3C | 5% | | |

General Structural Stage class descriptions, as defined by the BHNF:

- SS1 (Grass/Forb): The grass/forb stage was historically a product of fires, windthrow or similar disturbances. Under forest management, this stage can be created through harvesting. This stage is dominated by grasses and forbs lasting until tree seedlings become established.
- SS2 (Shrub/Seedling): The shrub/seedling stage consists of shrubs such as chokecherry, rose and serviceberry along with tree seedlings. A stand remains in Stage 2 until the tree seedlings reach one inch diameter at breast height (DBH), which should take less than a decade.
- SS3 (Sapling/Pole): The sapling/pole stage consists of trees with stems one to nine inches DBH. This stage typically persists up to 30 years to age 70. Less than 40 percent canopy closure is 3A; 40 to less than 70 percent canopy closures is 3B; and greater than 70 percent canopy closure is 3C. Understory production is inversely related to overstory pine canopy cover.
- SS4 (Mature): The mature stage begins when trees reach the 9-inch DBH class. Trees remain in this stage until they are about 160 years old. As with Structural Stage 3, understory productivity depends upon the overstory canopy cover. Less than 40 percent canopy closure is 4A; 40 to less than 70 percent canopy closures is 4B; and greater than 70 percent canopy closure is 4C. The sizes of trees in this stage will vary depending upon growing-site potential and the density of the stand.
- SS5 (Late Succession): This structural stage is characterized by very large trees (16+ inches DBH). Trees are at least 160 years in age; ponderosa pine that reach this age are commonly referred to as "yellow barks." Late succession ponderosa pine may occur in dense stands, but may also grow in the open or in "park-like" stands.

BHNF also identifies specific Management Area 5.4, Big Game Winter Range Emphasis areas, guidelines. Guidelines for wildlife outlined for Management Area 5.4 include:

- Temporary openings in the grass/forb stage should be between 1 to 10 acres.
- Consider adjacent private land resources when designing management for isolated National Forest System tracts.

Openings in the canopy to allow for 1 to 10 acres of grass/forb growth will provide forage for mule deer and white-tailed deer. Clearings would also encourage edge shrub layer to develop allowing for winter browse for deer, elk and other wildlife. Additionally, forest wide standards and guidelines are implemented within Big Game Winter Range Emphasis areas.

Management Area 5.4A: Norbeck Wildlife Preserve

Management Area 5.4A, referred to as the Norbeck Wildlife Preserve, is located on the east-central portion of the forest and includes 12,236 acres or 1% of BHNF (Figure 61). The Norbeck Wildlife Preserve was established by Congress in 1920 for the "protection of game animals and birds and to be recognized as a breeding place therefor," (16 US Code 675). Although 16 US Code 675 does not prohibit other uses, the Congress left little doubt as to the primary purpose of the Norbeck Wildlife Preserve: the preserve is to be managed for the benefit of wildlife (USDA 2005a). In 2001, the first court (Sierra Club et al. vs. USFS. US 10th Circuit Court of Appeals, Case 99-1445) interpreted the 1920 legislation and reaffirmed that management actions in Norbeck must benefit game animals and birds over and above normal forest planning. This makes the Norbeck Wildlife Preserve the only management area on BHNF that must look at management actions and effects to "focus species" (Griebel et al. 2007) which includes white-tailed and mule deer.

To provide for a variety of wildlife species, Norbeck Wildlife Preserve contains a variety of vegetative communities including open areas, shrubs, tree stands of different ages, densities and species, and streamside areas. BHNF manages Norbeck Wildlife Preserve to create or maintain wildlife habitat diversity. Some stands may contain many dead trees, a result of insect infestation or disease. Where tree cutting has occurred, there may still be a canopy of older trees. BHNF can use prescribed burns to maintain forage for wildlife, to rejuvenate hardwood and shrub species, and to reduce fuel loads in an effort to minimize natural wildfires although prescribed fire has not recently been used with the Norbeck Wildlife Preserve.

In most areas, motorized travel is limited to highways, a few gravel roads, and access to private land and recreational sites. Most low-standard roads are permanently closed with barriers, gates or signs to provide wildlife seclusion. Closed roads are seeded with a native seed mix and may have grasses, shrubs or trees growing in them. Some non-motorized recreational opportunities, that have been determined not to be detrimental to wildlife, do continue to take place in the Norbeck Wildlife Preserve. Hiking, mountain biking and horseback riding are permitted within a system of trails. However, some trails may be closed seasonally to provide wildlife refuge from human disturbance during sensitive or environmental stressful times of the year (e.g., winter). Additional activities occurring in Norbeck Wildlife Preserve include fuelwood gather with permit, hunting, and trapping. The last livestock grazing allotment was phased out with the rare exception that only restricted grazing could be considered to improve wildlife habitat (USDA 2010c).

BHNF has identified specific management goals and objectives for the Norbeck Wildlife Preserve that either directly or indirectly benefit focus species (Griebel et al. 2007), including wildlife such as mule deer and white-tailed deer. Management within Norbeck is through a cooperative agreement between BHNF and SDGFP (USDA and SDGFP 2014) and recent long-term habitat management projects on 26,727 acres in the northern portion of Norbeck were conducted (USDA 2010d). Examples of habitat treatments which benefited white-tailed deer habitats included:

- Enhance shrub productivity
- Retain or restore acres of aspen and birch and other hardwoods
- Retain or restore acres of white spruce
- Retain low density of open motorized roads
- Work cooperatively with CSP on the shared boundary

Management Area 5.43: Big Game and Resources Production

Management Area 5.43, referred to as the Big Game and Resources Production areas, are located on the east-central portion of the forest south of Management Area 5.4 and includes 10,162 acres or less than 1% of BHNF (Figure 61). Management Area 5.43 contains important deer and elk habitat, including winter range. This area also provides opportunities for non-motorized recreation, while allowing timber harvesting and livestock grazing. Evidence of human activity is present from wood products production. Logging roads often provide access for hikers, mountain bikers, horseback riders and other non-motorized travelers and hunters. An extensive road system is present, but is usually closed to motorized vehicles, including snowmobiles. Most roads are covered with grasses or other vegetation (i.e., two-track roads), unless they have been recently used as logging haul roads. Timber harvesting and prescribed burns are primary management tools used to improve habitat for wildlife in the area. Vegetation is managed to provide healthy plant communities with a variety of species present for wildlife forage and cover. Activities allowed in Management Area 5.43 include hiking, mountain biking, horseback riding, hunting, cross-country skiing, and livestock grazing.

BHNF has established specific goals and objectives for Management Area 5.43 in addition to the forest wide goals and objectives. Management Area 5.43 specific goals likely to benefit mule deer and white-tailed deer include emphasizing wildlife habitats in forest communities, improving forage on range areas, managing for a road density of 1-mile of open roads per square mile of area, or less, between December 1 and May 15. Additionally, and similarly to Management Area 5.4 (Big Game Winter Range Emphasis area, see above), BHNF has a stated objective to manage forest in the Big Game and Resources Production areas for specific structural stages of ponderosa pine (Table 55). BHNF identified specific Management Area 5.43 guidelines, including temporary openings in the grass/forb stage between 1 to 10-acres and increasing forage through vegetation improvements on rangelands. Openings in the canopy to allow for 1 to 10-acres grass/forbs plot will provide forage for big game species including mule deer and white-tailed deer. Clearings also encourage edge shrub layers to develop allowing for winter browse for deer, elk and other wildlife. Furthermore, BHNF manage rangelands within Management Area 5.43 for increased wildlife foraging and livestock grazing including weed management, prescribed burns on grass covered range to encourage rejuvenation of native species, limiting the type of livestock that BHNF permit to use rangelands, and limiting both frequency and duration of livestock use. Additionally, forest-wide standards and guidelines are also implemented within Management Area 5.43.

Management Area 5.6: Forest Products, Recreation, and Big Game Emphasis

Management Area 5.6, referred to as the Forest Products, Recreation, and Big Game Emphasis area, is located on northern portions of BHNF, and includes 27,176 acres or approximately 2% of the forest area (Figure 61). Management Area 5.6 provides opportunities for a mixture of recreational opportunities, while allowing timber harvesting and livestock grazing. As the description of this management area suggest, Management Area 5.6 also contains important big game habitat, including winter range. Roads used for timber harvesting often provide access for hikers, mountain bikers, horseback riders, other non-motorized travels and hunters. In other portions of the Forest Product, Recreation and Big Game Emphasis areas access is available through trails.

Timber harvesting and prescribed burns are primary management tools used to improve habitat for wildlife in the area. Management Area 5.6 contains an extensive road system, however, except for major routes, motorized travel is restricted and most roads have unimproved surfaces. However, in accordance with Management Area 5.6 Transportation and Travel guidelines, over the snow travel is allowed unless restricted by a specific USFS documented decision. Non-motorized recreational opportunities are available including hiking, mountain biking, horseback riding, hunting and cross-country skiing. Additionally, BHNF permits livestock grazing through the summer and fall in parts of Management Area 5.6.

BHNF has established specific goals and objectives for Management Area 5.6 in addition to the forest wide goals and objectives. Management Area 5.6 specific goals likely to benefit mule deer and white-tailed deer include improving forage on range areas and an emphasis on non-motorized recreation. Additionally and similar to Management Area 5.4 and Management Area 5.43, BHNF has a stated objective to manage forest in the Forest Products, Recreation and Big Game Emphasis areas for a specific structural stages of ponderosa pine (Table 55).

BHNF identified specific Management Area 5.6 guidelines. Guidelines likely to benefit wildlife outlined for Management Area 5.6 include temporary openings in the grass/forb stage between 1 to 10-acres and increasing forage through vegetation improvements on rangelands. Openings in the canopy to allow for 1 to 10-acres grass/forbs plots will provide forage for big game species including mule deer and white-tailed deer. Clearings also encourage edge shrub layers to develop allowing for winter browse for deer, elk and other wildlife. Furthermore, BHNF manage rangelands within Management Area 5.6 for increase wildlife foraging and livestock grazing including implementing weed management, prescribed burns on grass covered range to encourage rejuvenation of native species, limiting the type of livestock that BHNF permit to use rangelands, and limiting both frequency and duration of livestock use. Additionally, forest wide standards and guidelines are also implemented within Management Area 5.6.

BHNF identified white-tailed deer as a Management Indicator Species within the BHNF Plan (USDA 2005b). As a Management Indicator Species, white-tailed deer populations on the BHNF are estimated annually and populations within the South Dakota portion of the BHNF appeared to have peaked in 2006 and gradually declined from 2006 to 2011. Since 2011, populations have been rebounding and approaching objective. The USFS suggests forest-wide available forage has increased, because fires, insects, and forest management practices have opened up pine stands since 2000 (USDA 2013). The USFS continues to recommend activities that promote understory shrub development to provide forage and cover for white-tailed deer and mule deer.

**USFS National Grasslands**

There are three National Grasslands located in South Dakota. Buffalo Gap National Grassland is located in the southwest, Fort Pierre National Grassland is in the center of the state, and Dakota Prairie National Grasslands (with Grand River National Grasslands the portion of Dakota Prairie that is located within South Dakota) in north-northwest portion of South Dakota (Figure 60). Specific deer management strategies are not identified at the regional level or within the individual grasslands. However, general grassland wide management goals and objectives for wildlife (which provide benefit to deer species) are found within the Land and Resources Management Plan for the Dakota Prairie Grasslands Northern Region (USDA 2001b) including management goals and objectives and direction for Grand River National Grasslands and the Revised Land Resource Management Plan for the Nebraska National Forest (USDA 2009a) which includes management goals and objectives for Fort Pierre National Grasslands and Buffalo Gap National Grasslands.

The grasslands collectively identified the following standards and guidelines for general wildlife management that would also specifically benefit mule deer and white-tailed deer on the grasslands (USDA 2001b and 2009a):

- Modify livestock grazing practices as needed to reduce adverse impacts of drought to food and cover for wildlife.
- Do not authorize construction of new woven wire fences and barbed-wire fences with 5 or more strands. This doesn't include fences designed to specifically exclude wildlife.
- Manage for native forb abundance and diversity to provide foraging habitat for big game, and other grassland wildlife.
- Design and implement livestock grazing strategies to provide well-developed emergent vegetation through the growing season on 30 to 50% of the wetlands (natural and constructed) distributed across watersheds and landscapes, contingent on local site potential.
- Design and implement livestock grazing strategies to provide for thick and brushy understories and multi-layer and multi-age structure in riparian habitats, wooded draws and woody thickets, contingent on local site potential.
- Design and build new structures, including fences, to reduce hazards to big game and to allow big game movement throughout the year. This does not apply to fences designed to specifically exclude wildlife.

In addition to the standards and guidelines that apply to the three grasslands within the state of South Dakota, Fort Pierre National Grasslands identified desired plant community succession stages in an attempt to mimic what the USFS called the, "evolutionary development of the northern Great Plains." As stated in USDA (2009), the desired succession structure includes:

- 20-40% late succession
- 30-50% late intermediate succession
- 10-30% early intermediate succession
- 1-20% early succession

Fort Pierre National Grasslands' goal in setting this objective is to establish a grassland ecosystem that features a mosaic of successional stages, both spatially and temporally, to benefit a broad range of viable wildlife populations (USDA 2009a). By creating a patchwork of vegetation structure, Fort Pierre National Grasslands would provide important habitat for grasslands Management Indicator Species, plains sharp-tailed grouse (*Tympanuchus phasianellus*), greater prairie chicken (*Tympanuchus cupido*), and black-tailed prairie dog (*Cynomys ludovicianus*) but also ample cover and foraging opportunities for mule deer and white-tailed deer. Fort Pierre National Grasslands specific standards and guidelines identify the use of current monitoring data and stocking rate guidelines to assist the USFS in achieving the desired vegetative structure (USDA 2009a). This would suggest an adaptive management strategy whereby the USFS would periodically review grassland conditions and adjust stocking rates accordingly but within the USFS approved suggestions for stocking rates (USDA 2009a). Suggested stocking rates including light, moderate, and heavy grazing intensity, were defined based on the herbaceous production of livestock palatable plant species and not a specified intensity or range (USDA 2009a). This method allows for precipitation and other weather conditions, but also soil conditions to be considered when evaluating grazing effects (USDA 2009a).

**US Fish and Wildlife Service**

The USFWS administers six National Wildlife Refuges (NWR) in South Dakota, encompassing approximately 48,570 acres of diverse habitats across the state. These include Lacreek NWR in the southwest, Lake Andes NWR and Karl Mundt NWR in the southeast, Waubay NWR and Sand Lake NWR in the northeast, and Bear Butte NWR in the northwest (Figure 60). In addition, the USFWS manages and administers four other categories of property within NWR associated management districts in the state of South Dakota: Waterfowl Production Areas (160,432 acres); Wetland Easements (591,308 acres); Grassland Easements (712 acres); and Farmers Home Administration Conservation Easements (40,875 acres, USFWS 2012). Comprehensive Conservation Plans are developed for each of the five management districts (Lake Andes NWR and Karl Mundt NWR are combined) and outline the strategies the USFWS follows in managing these resources. The Comprehensive Conservation Plans identify the role that each refuge will play in support of the mission of the Refuge System, and to provide long-term guidance to management programs and activities within management districts. South Dakota's NWR and management districts generally do not manage specifically for big game species, however, each of the above identified management districts identify the protection and enhancement of habitat for wildlife as one of their goals. Identified goals within South Dakota management districts that are likely to benefit mule deer and white-tailed deer include the following:

Bear Butte NWR, 374 acres (USFWS 2007)

- *Wildlife and Habitat Management:* Work with partners to maintain habitat for migratory birds and other wildlife.

Sand Lake NWR, 21,498 acres (USFWS 2005)

- *Biological Diversity Goal*: Promote the natural biological diversity of the area and, through management of refuge habitats, provide for the greatest number of native fauna and flora species within the capabilities of the Sand Lake National Wildlife Refuge.
- *Resident Wildlife Subgoal*: Contribute to habitat requirements for regional populations of resident wildlife including fish, reptiles, amphibians, mammals, and non-migratory birds.
- *Grassland Habitat Subgoal*: Restore, maintain, and provide quality habitat for the life requirements of a diversity of migratory birds and other wildlife species.
- *Wildlife Dependent Recreational Use:* Provide opportunities for quality, wildlife-dependent recreation for visitors to Sand Lake National Wildlife Refuge.

Lake Andes NWR and Karl Mundt NWR, 5,639 acres (USFWS 2012a)

- *Upland Habitat Goal:* Acquire, restore, manage, and maintain a diverse mix of native grassland habitats to support migratory birds and resident wildlife found in the northern mixed-grass prairie ecosystem.
- *Visitors Services Goal:* Provide opportunities for high quality and compatible hunting, fishing, environmental education, environmental interpretation, photography, and wildlife observation for persons of all abilities and cultural backgrounds by fostering an understanding and appreciation of the Lake Andes National Wildlife Refuge Complex and the missions of the Service and the Refuge System.

Lacreek NWR, 16,410 acres (USFWS 2006)

- *Goal 1. Wildlife and Habitat Management:* Conserve, restore, and enhance the native biological diversity of the Lake Creek Valley and Nebraska Sandhills for migratory birds and other wetland and grassland-dependent species.
- *Goal 3. Public Use:* Provide opportunities for quality wildlife-dependent recreation and promote awareness of Lacreek NWR's resources and the mission of the Refuge System.

Waubay NWR, 4,650 acres (USFWS 2002)

- *Habitat Goal*: To preserve, restore and enhance the ecological diversity of grasslands, wetlands, and native woodlands of the Prairie Pothole Region of the Great Plains on Waubay National Wildlife Refuge Complex.
- *Wildlife Goal*: To promote a natural diversity and abundance of native flora and fauna of the Prairie Pothole Region of the Great Plains on Waubay National Wildlife Refuge Complex.

- *Wildlife-Dependent Recreational Goal*: To foster an understanding and appreciation of the ecology and management of the fauna and flora and of the role of humans in the Prairie Pothole Region of the Great Plains by providing Complex visitors of all abilities with compatible wildlife-dependent recreational experiences.

<u>Waterfowl Production Areas</u>

Waterfowl Production Areas (WPAs) are either acquired as public land or protected by perpetual easements as part of the US Fish and Wildlife Service's National Wildlife Refuge System. Acquisition and management of these areas is funded by the sale of the Federal Migratory Bird Hunting and Conservation Stamp (a.k.a. "Duck Stamp"), of which 98% of the money goes directly to preserving these areas for hunting, wildlife viewing and native prairie protection. Areas that are owned by the US Fish and Wildlife Service provide public access to hunters (USFWS 2016). South Dakota has just over 161,000 acres of WPAs concentrated exclusively east of the Missouri River. The largest WPA in South Dakota is Perch Lake at 2,038 acres, but the majority of them are less than 500 acres in size (USFWS DOR 2016).

**National Park Service**

<u>Wind Cave National Park</u>

Wind Cave National Park (WICA), the eighth national park, was established by an Act of Congress on January 9, 1903 (32 Stat. 765). The park is located in western South Dakota, on the southern edge of the Black Hills (Figure 60; NPS 2015). The park boundary is approximately six miles north of Hot Springs, South Dakota, and is bounded by Custer State Park on the north, Black Hills National Forest on the west, and by private property on the south and east. The WICA Park encompasses 33,923 acres of prairie ecosystem, underlain by extensive karst deposits, with Wind Cave being one of the world's longest caves. The surface features of the park include expanses of mixed-grass prairie, ponderosa pine, and riparian ecosystems. The gently rolling landscape of the park is a transition zone between eastern and western biomes, and supports a great diversity of plant and animal species (NPS 2015). WICA has identified several general wildlife management strategies to ensure the park's wildlife, including mule deer and white-tailed deer, are protected. WICA Land Management Zoning Plan (NPS 2015) identifies policies and strategies for the benefit of the park's wildlife such as the following:

- Wind Cave National Park will work cooperatively with state and federal agencies to reestablish populations of native species to historic ranges within the boundaries of Wind Cave National Park and in certain cases within adjacent lands, and to take needed actions to protect and enhance the habitat of these native species. Wind Cave National Park will manage habitats for the recovery or reestablishment of native populations through collaborative planning with local, state, and federal agencies, user groups, and interested organizations.
- Wildlife management practices will promote attainment or maintenance of proper functioning condition riparian/wetland areas, appropriate stream channel morphology, desired soil permeability and infiltration, and appropriate soil conditions and kinds and

amounts of plants and animals to support the hydrologic cycle, nutrient cycle, and energy flow.
- Protocol shall be developed to prevent the outbreak and spread of infectious disease in Wind Cave National Park wildlife populations to address individual species accordingly.

<u>Badlands National Park</u>

Roughly half of the 244,000 acres that make up Badlands National Park consists of badlands with the remaining half consisting of a mixed-grass prairie ecosystem (Figure 60). The mixed-grass prairie supports a vast array of wildlife species. Badlands National Park has documented 9 reptiles, 6 amphibians, 206 bird species, 69 butterfly species and 39 mammals, including mule deer and white-tailed deer (NPS 2016). White-tailed deer generally are restricted to riparian habitats while mule deer are commonly seen in more open terrain and move in and out of the park.

The South Unit is open to big game hunting by members of the Oglala Sioux Tribe (OST) with a valid Tribal hunting license and restrictions as agreed upon by both Oglala Sioux Parks and Recreation Authority and Badlands National Park (NPS 2012). Big game includes mule deer and white-tailed deer. These hunts, which are regulated by the OST and the National Park Service (NPS), were evaluated in 2012 and are believed to have not adversely affected the populations of these animals. As such, hunting in the South Unit by Tribal members will continue (NPS 2012). In addition, both mule deer and white-tailed deer are hunted on lands adjacent to the park (NPS 2012).

Mule deer and white tailed deer are regularly observed within the park (NPS 2016). Badlands National Park does not identify deer specific management strategies in either the South Unit General Management Plan (SUGMP, NPS 2012) or the North Unit General Management Plan (NUGMP, NPS 2009). However, both plans, SUGMP and NUGMP, include general wildlife strategies to ensure the park's wildlife, including mule deer and white-tailed deer, are protected. Badlands National Park managers will employ policies and strategies for the benefit of the park's wildlife (NPS 2009 and 2012) such as the following:

- Seek to perpetuate the native animal life as part of the natural ecosystem. Emphasize minimizing human impacts on native animals and minimizing human influence on naturally occurring fluctuations of animal populations. Rely on ecological processes to control the populations of native species to the greatest extent practicable.
- Ensure the preservation of populations and habitats of migratory species inhabiting the park, such as birds and mountain lions. Whenever possible, cooperate with others to ensure the preservation of the populations and habitats of migratory species outside the park.

## PRIVATE LANDS

### Private Lands Habitat

A majority of land in South Dakota is privately owned (approximately 80% private land, 10% public land, and 10% tribal allotted or trust land), making farmers, ranchers, and other private landowners primary stewards of wildlife and wildlife habitat. SDGFP recognizes private landowners as essential partners in ensuring its agency responsibilities for managing South Dakota's fish and wildlife trust resources are met. Wildlife management not only involves biological and science-based habitat management practices, but also includes careful consideration of the wide array of social values held by both the general public and South Dakota landowners.

Sustaining adequate deer populations depends greatly on maintaining habitat of commensurate quantity and quality necessary to support desired population levels. SDGFP has focused much of its private lands habitat program efforts on both on-the-ground private lands habitat development and management, and addressing agricultural land use through affecting and influencing federal farm bill conservation programs and policy at both the national and local levels through its affiliation with and direct involvement in state, regional, and nation organizations and working groups (e.g., Association of Fish and Wildlife Agencies, Midwest Association of Fish and Wildlife Agencies, State Technical Committee, Prairie Pothole Joint Venture, Northern Great Plains Joint Venture, Conservations Reserve Program Working Group, etc.). A collaborative approach to working with farmers, ranchers, other private landowners, and various conservation partners has been and will continue to be critical to ensuring wildlife habitat remains on the landscape, conservation programs are successfully delivered, and wildlife is given due consideration in the agricultural policy arena.

<u>SDGFP Wildlife Partners Program</u>

SDGFP delivers a comprehensive private lands habitat and access program through its Wildlife Partners Program (WPP), with numerous habitat practices, technical resources, and financial incentives available to private landowners to address their wildlife habitat management and development needs and desires. WPP habitat practices and cost-share incentives are available for food habitat plots, woody habitat developments, wildlife habitat fencing, and nesting habitat establishment. These habitat incentives are designed to (1) meet the biological needs of a variety of resident and migratory wildlife species, (2) complement conservation program opportunities offered through the federal farm bill, and (3) meet the needs and desires of private landowners seeking to restore, protect, and enhance wildlife habitat on their lands.

<u>SDGFP Wetlands and Grasslands Program</u>

Delivered through its Wetland and Grassland Habitat Program, SDGFP private lands biologists have a long and highly successful history working across the state with private landowners – primarily those producers engaged in grass-based livestock operations - to develop wetland and grassland habitat. Technical and financial assistance is provided for a variety of wetland and grassland habitat restoration practices including wetland restoration, wetland enhancement, upland restoration, and upland enhancements such as cross fences, water development, riparian area pastures and wildlife friendly fencing.

<u>USDA Farm Bill Programs</u>

SDGFP private lands habitat programs are intended to complement US Department of Agriculture (USDA) conservation programs, such as the Conservation Reserve Program (CRP), Agricultural Conservation Easement Program (ACEP), Environmental Quality Incentives Program (EQIP), and the Conservation Stewardship Program (CSP). Because USDA conservation programs impact thousands of acres of private land across South Dakota, SDGFP private lands staffs are actively involved with the USDA Natural Resources Conservation Service (NRCS) state technical committee and its various program-specific subcommittees. Additionally, SDGFP staffs serve on the USDA Farm Service Agency (FSA) CRP sub-committee. This active engagement by SDGFP in the programmatic and policy arenas allows for significant input and advocacy for wildlife and wildlife habitat when developing and fine tuning program goals and objectives, and ranking program participation criteria at the state level. This involvement and participation is also valuable in creating a significant communication connection with USDA.

Other State, Federal, Local, and NGO Programs

Numerous other programs and financial incentives are available to farmers, ranchers, and landowners to conserve, maintain, and develop wildlife habitat on their lands. The most current information regarding all aspects of SDGFP private lands habitat programs, the various farm bill conservation programs, other state and federal agency programs, and programs offered through various non-governmental conservation organizations are available at: http://habitat.sd.gov/.

**Landowner Licenses and Preference System**

Since approximately 80% of South Dakota lands are under private ownership; farmers, ranchers and other private landowners are indeed the most important stewards of our wildlife resources and their habitats. The state legislature and SDGFP recognize these contributions provided by South Dakota's landowners for providing habitat, and the damage that can be caused by deer to crops and other property. As a result, qualifying landowners are offered privileged opportunities for deer hunting and include the following: 1) landowner free antlerless license; 2) landowner-own-land license; and 3) landowner preference.

Landowner Free Antlerless License

Signed into law during the 2010 state legislative session, this law grants the SDGFP Commission authority to issue free antlerless deer licenses as provided by SDCL § 41-6-19.8 (see below). Introduced as HB 1264, this bill was sponsored by several House of Representatives and Senators and ultimately signed by then Governor Rounds, at a time when high deer populations were present across much of South Dakota. Harvest statistics for these licenses can be found in Table 56.

> ***SDCL § 41-6-19.8. Resident antlerless deer licenses restricted to farm or ranch lands owned or leased by license holder.*** *In addition to any deer license authorized pursuant to § 41-6-19.3 or any other provision of law, in areas designated by the Department of Game, Fish and Parks, any farmer or rancher who is a resident of South Dakota and who owns and operates or leases and operates, for agricultural purposes, at least one hundred sixty acres of land may apply for and receive two antlerless deer licenses free of charge for use as provided in this section during the west river prairie deer season, east river deer season, or other deer season set by the commission pursuant to § 41-2-18. The five-dollar surcharge established pursuant to § 41-2-34.2 does not apply to the licenses provided for in this section. The licenses may only be used in areas designated by the department on lands owned or leased by the farmer or rancher within any unit for the specified hunting season. Not more than two*

*such licenses may be issued for use on any single farm or ranch. Upon receipt of an application prescribed by the Department of Game, Fish and Parks that meets the requirements of this section, the department shall issue two antlerless deer licenses that restrict the holder to the taking of the big game animals as designated on the license only from the farm or ranch lands owned or leased by the farmer or rancher. The license does not authorize the holder of the license to take any big game animal from land owned or leased by other persons.*

Table 56. Harvest statistics for landowner free antlerless deer licenses, 2011-2015.

| Year | Licenses Issued | WT Bucks | MD Bucks | WT Does | MD Does | Total Deer | Tag Success |
|---|---|---|---|---|---|---|---|
| 2011 | 2,005 | 91 | 9 | 709 | 104 | 913 | 46% |
| 2012 | 1,271 | 30 | 0 | 479 | 37 | 546 | 43% |
| 2013 | 1,390 | 35 | 3 | 359 | 32 | 430 | 31% |
| 2014 | Licenses Not Available | | | | | | |
| 2015 | Licenses Not Available | | | | | | |

The SDGFP Commission, as authorized by SDCL § 41-6-19.8, promulgated rules found within ARSD § 41:06:01:13, which provides the provisions when and where such licenses are made available (see below). Due to the high proportion of public land, the Black Hills unit is closed to these free antlerless deer licenses. As a result of declining deer populations since 2010, this administrative rule has been modified on two different occasions to align with current deer population management objectives. The original rule provided free antlerless deer licenses where at least one antlerless deer tag was available after the second lottery drawing from the previous year East River and West River deer seasons. In 2013, this rule was amended to also include language stating "no such free antlerless license would be valid in counties where antlerless archery and muzzleloader licenses were restricted". Lastly in 2016, this rule was again amended to offer only antlerless whitetail deer licenses in hunting units which offer a deer license with multiple tags for antlerless deer in the lottery drawing for the East River and West River deer seasons. Much of the state's mule deer population is below management objective; the issuance of these licenses as "antlerless whitetail" aligns with current management objectives for both mule and whitetail deer and the on-going effort to provide hunting opportunities in the most fair and equitable manner to all deer hunters.

***ARSD § 41:06:01:13. Designation of areas where free antlerless deer licenses can be used by farmers and ranchers.*** *Antlerless licenses authorized by SDCL § 41-6-19.8 may be issued to any qualifying farmer or rancher for use in the West River, East River, Youth, Archery, and Muzzleloading deer hunting units. Antlerless whitetail deer licenses will be available to qualifying applicants in hunting units which offer a deer license with multiple tags for antlerless deer in the lottery drawing for the East River and West River deer seasons. The* *requirements and equipment restrictions for each deer season apply to any free antlerless license issued.*

Landowner-own-land License

Resident landowner/operators, including any immediate family living at home, who have not already been issued a West River, East River, or Special Buck license that allows the harvest of a buck, may purchase a reduced-price license to hunt on their own land. Due to the high proportion of public land, landowners within the Black Hills unit are not eligible for these reduced-price licenses. These license types have been available to eligible resident landowner/operators since 1981 and are authorized by SDCL § 41-6-19.3 (see below). Harvest statistics for both East River and West River Landowner-own-land licenses can be found in Tables 57-58.

***SDCL § 41-6-19.3. Resident farmer or rancher limited deer or antelope permit--Eligibility.*** *If a resident farmer or rancher who owns or leases for agricultural purposes the minimum acreage of privately-owned farm or ranch land to qualify for landowner preference as prescribed by rules promulgated by the Game, Fish and Parks Commission and who actually resides on the land, or is an owner-operator of the land, has not received a big game license pursuant to § 41-6-19 that permits the harvest of a buck during the west river prairie deer season, east river deer season, or firearm antelope season set by the Game, Fish and Parks Commission pursuant to § 41-2-18, the farmer or rancher may obtain one any-deer license, one any-antelope license, one license that has one any-deer tag and one any-antlerless deer tag, or one any-antelope and one doe/kid antelope tag that is valid only on lands owned or leased by the farmer or rancher within any unit for the specified hunting season.*

*If a member of the immediate family of the farmer or rancher qualified to obtain a license under this section has not received a big game license pursuant to § 41-6-19 that permits the harvest of a buck during the west river prairie deer season, east river deer season, or firearm antelope season set by the Game, Fish and Parks Commission pursuant to § 41-2-18, the immediate family member may also obtain one any-deer license, one any-antelope license, one license that has one any-deer tag and one any-antlerless deer tag, or one any-antelope and one doe/kid antelope tag that is valid only on lands owned or leased by the resident farmer or rancher within any unit for the specified hunting season.*

*Upon receipt of the application prescribed by the department and applicable fee, the Department of Game, Fish and Parks shall issue a limited license that restricts the holder to the taking of the big game animals as designated on the license only from the privately-owned farm or ranch lands owned or leased by the resident farmer or rancher. The holder of the license may not take any big game animal from land owned or leased by other persons.*

Table 57. Harvest statistics for East River Landowner-own-land licenses, 2011-2015.

| Year | Licenses Sold | Tags Sold | WT Bucks | MD Bucks | WT Does | MD Does | Total Deer | Hunter Success | Tag Success |
|---|---|---|---|---|---|---|---|---|---|
| 2011 | 5,487 | 8,813 | 2,110 | 85 | 1,149 | 41 | 3,385 | NA | 38% |
| 2012 | 4,604 | 7,395 | 2,284 | 123 | 641 | 20 | 3,060 | NA | 44% |
| 2013 | 4,827 | 7,739 | 1,594 | 53 | 733 | 13 | 2,394 | NA | 31% |
| 2014 | 5,210 | 8,371 | 2,214 | 95 | 736 | 36 | 3,157 | 48% | 38% |
| 2015 | 5,816 | 9,380 | 2,687 | 102 | 908 | 43 | 3,741 | 51% | 40% |

Table 58. Harvest statistics for West River Landowner-own-land licenses, 2011-2015.

| Year | Licenses Sold | Tags Sold | WT Bucks | MD Bucks | WT Does | MD Does | Total Deer | Hunter Success | Tag Success |
|---|---|---|---|---|---|---|---|---|---|
| 2011 | 1,932 | 3,127 | 693 | 358 | 356 | 156 | 1,563 | NA | 50% |
| 2012 | 1,880 | 3,093 | 692 | 385 | 206 | 82 | 1,365 | NA | 44% |
| 2013 | 1,805 | 2,955 | 537 | 283 | 164 | 67 | 1,051 | NA | 36% |
| 2014 | 1,943 | 3,167 | 634 | 414 | 167 | 55 | 1,271 | 53% | 40% |
| 2015 | 2,248 | 3,540 | 958 | 504 | 134 | 59 | 1,654 | 59% | 45% |

Landowner Preference

Since 1975, up to 50% of all allocated licenses in each deer hunting unit during the first lottery drawing for the Black Hills, West River and East River deer seasons are made available to qualifying landowner or tenants as authorized by ARSD § 41:06:01:07, ARSD § 41:06:01:07.1, and ARSD § 41:06:01:07.2 (see below). From 2011-2015, the fewest amount of “any deer” licenses by deer season (for all license types allowing the harvest of a buck) issued to those meeting landowner preference was 1.4% for the Black Hills deer season in 2011, with the greatest percent of 31.6% for the East River deer season in 2015 (Table 59).

> ***ARSD § 41:06:01:07. Landowner preference limited by acreage.*** *In big game seasons where landowner preference is established, the related provisions in SDCL § 41-6-21 shall apply only to any landowner and tenant on private land tracts of 160 acres or more unless otherwise provided in the season rules. No such preference may be claimed by an applicant unless the private land is located within the hunting unit applied for.*
>
> ***ARSD § 41:06:01:07.01. Landowner preference application requirements and restrictions.*** *A landowner or tenant, but not both, may claim landowner preference for the same qualifying property. Employment on a farm or ranch alone does not qualify an individual for landowner preference.*

***ARSD § 41:06:01:07.02. Restrictions on landowner preference for legal entities.***
*Shareholders of a corporation, members of a limited liability company holding a membership interest in the company, partners in a partnership, and beneficiaries of a trust entitled to the current income and assets held in trust; all organized and in good standing under the laws of the State of South Dakota are eligible for landowner preference if:*
*(1) The entity holds title to 160 acres or more of private land located within the hunting unit applied for;*
*(2) The shareholder, member, partner, or trust beneficiary applying for landowner preference is a resident; and*
*(3) The shareholder, member, partner, or trust beneficiary is responsible for making the day-to-day management decisions for agricultural purposes on the farm or ranch.*

Table 59. Resident "any deer" licenses and landowner preference statistics by deer seasons, 2011-2015.

| **Year** | **2011** | | | **2012** | | | **2013** | | | **2014** | | | **2015** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dear Season | Black Hills | West River | East River | Black Hills | West River | East River | Black Hills | West River | East River | Black Hills | West River | East River | Black Hills | West River | East River |
| Number of Available Resident Buck Licenses | 3,900 | 16,080 | 23,620 | 3,200 | 16,120 | 22,040 | 3,200 | 16,155 | 20,515 | 3,200 | 16,075 | 20,575 | 3,700 | 15,725 | 19,475 |
| Number Issued to Landowner Preference | 137 | 1,478 | 6,844 | 142 | 1,531 | 6,675 | 145 | 1,465 | 6,416 | 145 | 1,429 | 5,982 | 149 | 1,454 | 6,160 |
| Percentage Issued to Landowner Preference | 1.4% | 9.2% | 29.0% | 4.3% | 9.4% | 30.3% | 4.3% | 9.1% | 31.3% | 4.5% | 8.9% | 29.1% | 4.0% | 9.2% | 31.6% |

In summary, there are two license types (landowner free antlerless license and landowner-own-land license) available to qualifying landowners/tenants with an unlimited number of licenses, though there are certain restrictions to the number of licenses per household. Landowner preference, available during the first lottery drawing for the Black Hills, West River and East River deer seasons, is also available to qualifying landowner/tenants and provides an advantage to these applicants against those with the general public. Table 60 illustrates the differences between these various options for landowner/tenants and the respective restrictions or conditions.

Table 60.  Deer license options available to qualifying landowners.

| License Comparison | Landowner Free Antlerless License | Landowner-own-land License | Landowner Preference |
|---|---|---|---|
| **Applicant Eligibility** | Available to qualifying resident landowners and immediate family members only. | Available to qualifying resident landowners and immediate family members only. | Available to qualifying resident landowners and immediate family members only. |
| **Landowner Eligibility Requirements** | Must own and operate, or lease and operate, for agricultural purposes a minimum of 160 acres of land. | Must own or lease for agricultural purposes a minimum of 160 acres privately-owned farm or ranch land and actually reside on the land or be an owner/operator of the land to qualify. | To be eligible for landowner preference, a landowner or tenant must operate at least 160 acres of private land within the unit applied for as a first choice. |
| **Open Area** | Available in open units to any qualifying landowner within the West River and East Deer season in hunting units which offer a deer license with multiple tags for antlerless deer in the lottery drawing. | Applicant's land or land leased or rented by the applicant as described on the application. The land must be within the area open for hunting as described on the application form. | License is valid anywhere on private and public land for the respective hunting unit. |
| **Number of Licenses** | Unlimited number of licenses; no more than two licenses may be issued for use on any single farm or ranch. | Unlimited number of licenses; may only hunt from the privately-owned farm or ranch lands owned or leased. | Half of resident licenses available for a hunting unit are set aside in the first drawing for those who qualify for landowner preference; may hunt anywhere in the hunting unit listed on the license. |
| **License Type** | Single tag license valid for antlerless whitetail deer. | Single tag license valid for an "any deer" or a double tag license valid for one "any deer" and one "any antlerless deer". *The applicant may not already have a license for the regular season that allows for the harvest of a buck.* | Valid for whatever license is obtained during the limited draw for the respective firearm deer hunting season. |
| **License Fee** | No fee | 50% of regular license fee | Regular license fee |

*Comparison table used to illustrate key differences and does not provide all differences in detail.

## Depredation Management

Deer management in South Dakota is a complex and adaptive process that must include careful consideration of the biological, social, economic, and political impacts. Wildlife managers must make careful decisions that recognize these considerations because wildlife is a public-trust resource yet utilizes private lands throughout the year. Approximately 80% of South Dakota is comprised of private land and sportsmen and women rely heavily on these private lands for hunting opportunities and access. Gigliotti (2009) found that 86% and 62% of deer hunters relied on private land for hunting access in eastern South Dakota and western South Dakota, respectively. In 2015, there were over 67,000 licensed hunters for all deer hunting seasons in South Dakota (Huxoll 2015). Deer abundance and harvest management strategies in South Dakota have fluctuated over the past ten years. When deer populations are high, decreased social tolerance is experienced by some landowners in many areas of South Dakota due to damage to livestock feed-supplies and/or growing crops. Conover (1998) and Horton and Craven (1997) also reported that over-abundant populations of deer in other areas of the United States has increased the number of human-wildlife conflicts as well as magnified their intensity.

Successful wildlife management programs must target private landowners and work cooperatively with farmers and ranchers to be effective (Bookhout 1996). SDGFP works diligently to maintain a balance between viable deer populations, social tolerances, and the desires of a variety of stakeholders. At times, this balance is difficult to achieve as landowners suffer damage to stored-feeds intended for livestock or damage to growing crops from deer, yet hunters desire higher deer populations for more hunting opportunities. Deer depredation has been a source of controversy between private landowners and wildlife agencies for many years (Tzilkowski et al. 2002 and Reiter et al. 1999). SDGFP understands that cooperative partnerships with private landowners are an essential component of deer management and that private lands serve an important role regarding all wildlife management. Without this cooperative partnership, it would not be possible to meet the agency's responsibility of successfully managing South Dakota's deer population. It is because of these important considerations that SDGFP operates such an active and comprehensive wildlife damage management program regarding deer depredation abatement. The public also supports management of wildlife that is causing damage to personal property when non-lethal techniques are employed (Reiter et al. 1999) as well as lethal techniques (Horton and Craven 1997).

As the deer population increased in South Dakota in the 1990s, SDGFP worked with the South Dakota Legislature to establish a funding mechanism to provide wildlife damage abatement services. In 1998, a five-dollar surcharge was established on most types of hunting licenses. Fifty-percent of these funds are allocated to SDGFP’s wildlife damage management program and the other 50% go to hunter access programs. The establishment of this funding was the financial foundation for which SDGFP’s deer depredation abatement program was initiated. From 2000 through 2016, SDGFP has spent over $7 million addressing deer depredation on private lands (Figure 62). Annual expenditures range from approximately $179,000 to $1.1 million and assist hundreds of landowners. Because these programs are funded entirely by sportsmen and women, SDGFP requires that all landowners that participate in deer depredation abatement programs sign an agreement that states, *"the Producer agrees to allow reasonable, free public hunting access to non-family members who obtain proper permission"* and *"the Producer agrees NOT to charge any person or entity a fee or payment for deer hunting access".* To achieve successful deer management it is imperative that sportsmen and women have access to private lands when revenues from hunting licenses are used to operate such programs and deer populations are largely managed through regulated hunting. Additionally, hunting has been shown to increase social/landowner tolerance of wildlife damage in some situations (Conover 2001).

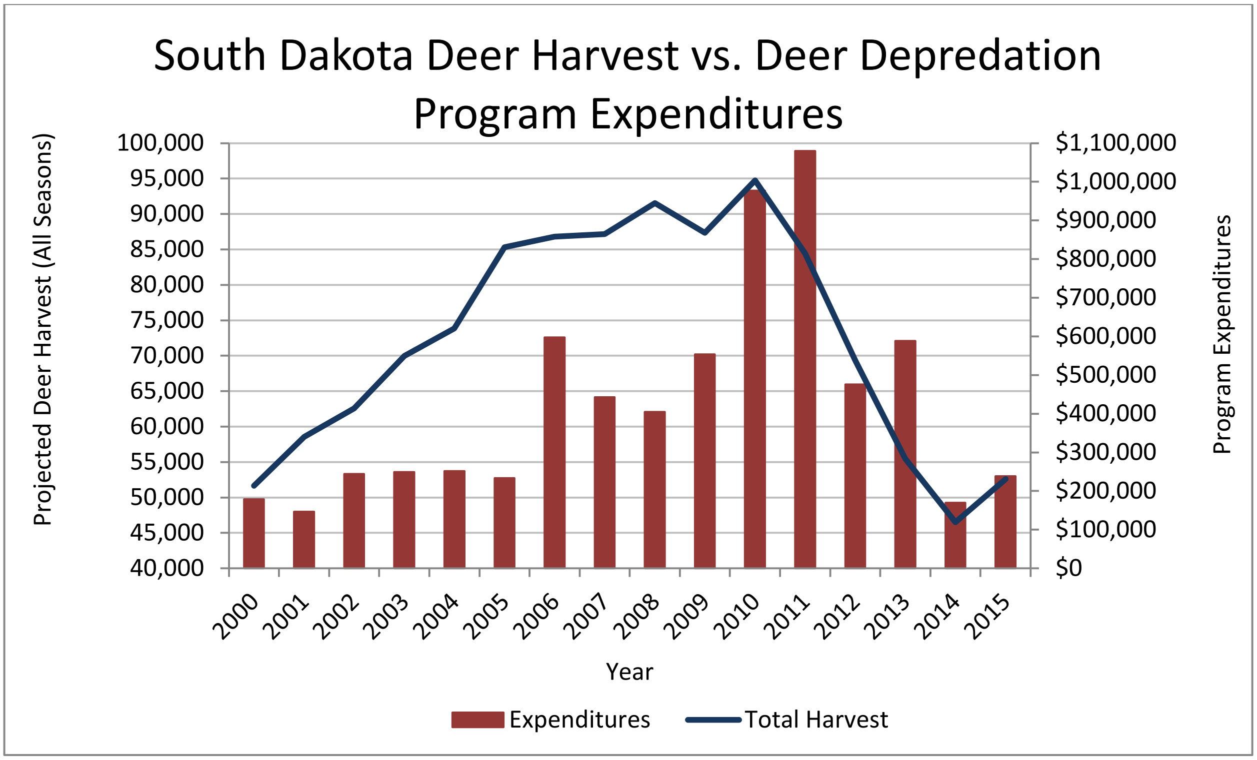



Figure 62. Annual expenditures of SDGFP's deer depredation abatement programs and services compared to South Dakota's projected deer harvest, fiscal years 2000-2015. The total expenditure amount for this 15-year timeframe was $6.8 million.

The demand for deer damage abatement services fluctuates annually due to population levels of deer, seasonal variations, weather events (e.g., deep snow or extreme cold) and changes to deer habitat (e.g., agricultural development, crop rotation, and human encroachment). However, the most significant factors that affect social tolerance and demand for deer damage abatement services are local deer population levels, severe weather, and landowners' financial dependency on affected crops or stored-feeds. Lacey et al. (1993) also found that tolerance for wildlife depredation quickly diminished as landowners' economic dependency on their land increased. When the estimated deer population likely peaked in South Dakota in the mid to late 2000s, SDGFP experienced record numbers of requests for assistance from landowners as well as a record level of expenditures to reduce deer damage on private property (Figure 62). Negative attitudes of landowners toward deer were found to be related to the density of deer in areas in northeastern South Dakota (Naugle et al. 1994). In a survey conducted by Longmire (2014), 47% of responding landowners that had white-tailed deer present on their property and 28% of responding landowners that had mule deer on their property, indicated that they had deer damage to their property within the last year. Similarly, Gigliotti (2007) found that 67% of landowners that responded to his survey indicated they had white-tailed deer damage within the past two years. More recently, a survey conducted by SDGFP found that approximately 60% of landowners that responded had deer damage to crops or personal property within the past five years (Longmire 2017a).

In South Dakota, conflicts with deer usually occur during the winter months (early-December through mid-March) when deer congregate into large herds and move to areas where there is abundant food and thermal protection. Many times, these protected areas are riparian areas, cattail marshes, or planted tree-belts near farmsteads. Sparrowe and Springer (1970) found that in some areas of South Dakota deer gathered into large herds although snow cover was minimal and food and cover were readily available. Typical herd sizes range from 30 to several hundred but during the severe winter of 2010-11, GFP staffs verified a herd of deer larger than 1,000 individuals on harvested cropland along the Bad River in western South Dakota. In some parts of South Dakota, deer can move large distances to find forage and cover resources and normally stay at these locations until they disperse in the spring. Stored-feed supplies intended for livestock can be accessed easily by deer as the feed is usually stored on the ground, not fenced, and utilized by farmers or ranchers on a daily basis. Deer cause problems by consuming the hay or other stored-feeds or climbing on top of these piles and urinating and defecating which makes the feed unpalatable to livestock. VerCauteren et al. (2003) documented damage or spoilage to stored-feeds from deer urine and fecal matter as well as punctures in plastic tarps meant to protect the stored-feed from moisture.

Conflicts with deer also occur during the summer months (July through September) when deer feed on growing crops such as corn, alfalfa, winter wheat, and soybeans. Deer damage to these crops has been documented across the US (Garrison and Lewis 1987, Austin and Urness 1993, Vecellio et al. 1994, and Tzilkowski et al. 2002). Damage usually occurs near the edges of agricultural fields near woody cover or other deer habitat. Wywialowski (1996) reported that deer and other wildlife species caused damage to corn and estimated loss value at more than $2.5 million in South Dakota in 1996. Gilsdorf et al. (2004) also found that deer damage to corn plants can be sufficient to prevent plants from producing ears in some cases. SDGFP staffs have also verified damaged areas being as large as several acres along the edges of some fields adjacent to good deer habitat. High densities of deer can also be attracted to irrigated agricultural fields that occur in semi-arid environments. SDGFP has utilized many traditional hazing techniques to reduce damage, but success has been limited. For the most part, these types of conflicts are difficult to effectively address and continue to challenge private landowners and SDGFP. Naugle et al. (1994) stated that a program which combined hazing, supplemental feeding, fencing, and chemical repellents could improve negative attitudes of farmers or landowners toward deer. Other types of conflicts with deer include damage to young tree plantings, commercial gardens or vineyards, and orchards. In all of these situations, deer are either browsing the young trees or causing damage by rubbing their antlers on trees which can kill the tree. Tree damage by deer has been well documented on many different tree species (Scott and Townsend 1985).

SDGFP's deer depredation abatement program and services is a multi-faceted program that is designed to prevent and/or reduce most types of damage caused by deer. First and foremost, SDGFP utilizes hunting as the primary management tool to address damage whenever possible. During ongoing hunting seasons, SDGFP will send hunters to certain areas that are experiencing damage. SDGFP created the Volunteer Hunter Program, which is a website where hunters can list their contact information and counties where they are willing to hunt and landowners can contact them directly (http://gfp.sd.gov/hunting/volunteer-hunter.aspx). This program is used each year by several landowners and creates positive outcomes for all parties involved. However, most depredation situations occur outside the timeframes of traditional hunting seasons which then SDGFP implements the other management techniques throughout their WDM program. SDGFP primarily focuses on non-lethal abatement techniques in most situations but may also utilize lethal techniques dependent upon certain circumstances. Non-lethal techniques include: permanent stackyards and fencing, protective panels, temporary fencing, short-stop baiting sites, and various hazing techniques (e.g., propane cannons, cracker-shells, and harassment).

Lethal control is conducted by SDGFP staffs in limited situations when other traditional damage abatement techniques have proven ineffective and severe damage is being experienced. SDGFP may utilize lethal control to address deer damage through South Dakota Codified Law:

> ***41-6-29 - Permit to kill animal or bird doing damage****--Animal or bird as property of state--Disposition--Violation a misdemeanor. If any game animals, game birds, black bears, mountain lions, or wolves are a threat to the public's health, safety, and welfare, or are doing damage to property, the secretary of game, fish and parks may by a written permit authorize a conservation officer, a municipality or county and their designees, a designee of the department, or the person whose property is being damaged to take or kill any such animals or birds by any methods that may otherwise be prohibited or under any restrictions as the secretary may prescribe in the permit. Any animals or birds so taken or killed are the property of the state and shall be disposed of as provided for in the permit.*

The most widely used program component to address damage to stored-feed supplies is cost-share assistance for the construction of permanent stackyards or SDGFP-provided protective panels. Both of these methods are long-term solutions and are designed to eliminate access to stored-feed supplies from deer. VerCauteren et al. (2006) stated that permanent fences made of woven wire are effective at eliminating deer access. Landowners that have deer damage to stored-feed supplies are eligible for up to $5,000 of cost-share assistance to construct a stackyard or $5,000 worth of portable protective panels. Landowners are limited to one contract for protective panels, but dependent upon individual needs and available funding, may be eligible for multiple contracts for permanent stackyards over several years. Following a year with severe winter weather, GFP spent over $260,000 in fiscal year 2011 in the construction of stackyards or purchase of protective panels.

Since 2000, SDGFP has cooperatively worked with over 1,300 landowners to implement protective stackyards or protective panels to alleviate deer damage to stored-feed supplies. This component of the program has provided permanent solutions to deer damage to hay and other stored-feed supplies for many years, and in some areas chronic problems have been completely resolved.

Cost-share assistance for temporary electric or permanent protective fencing is also utilized by SDGFP to address deer damage to shelterbelt plantings, vineyards, orchards, and agricultural fields. Temporary electric fencing relies on behavioral conditioning by administering an electrical shock (VerCauteren et al. 2006) and can be effective at restricting deer access. However, the large areas that need protection and the associated financial costs oftentimes make it difficult for producers to implement this management technique. SDGFP will provide up to $5,000 of cost-share assistance with the construction of temporary or protective fencing. Since 2000, SDGFP has cooperatively worked with 85 landowners to protect shelterbelt plantings, vineyards, and orchards across South Dakota. Cooperating landowners are limited to $5,000 but dependent upon individual needs and available funding some landowners may be eligible for multiple contracts over several years. Deer damage to agricultural fields is a very difficult problem to address and the sheer number of fields as well as the size of fields makes the implementation of temporary electric fence unfeasible in many areas. Additionally, the use of this technique to effectively eliminate deer damage has not been proven successful in some areas.

Another management technique utilized in the deer damage abatement program is different forms of hazing. Hazing can be an effective management tool but takes repeated and consistent efforts to be effective. SDGFP routinely works with landowners to employ different hazing practices to scare deer away from problem areas when possible. Safety concerns and the proximity to livestock and buildings are carefully evaluated when employing hazing efforts. These techniques include: pyrotechnics, propane cannons, hazing with ATVs, rubber bullets, and aircraft. Propane cannons can be effective for short periods of time, but deer can quickly become habituated to the noise (Gilsdorf et al. 2004). SDGFP also implements depredation pool hunts (ARSD § 41:06:46) in strategic locations where severe deer damage is occurring, where randomly selected registered hunters are enlisted to harvest deer, free of charge, to reduce impacts to private property. These types of hunts occur after the deer hunting season has ended and usually conclude by early-March. This management tool typically only removes a small number of deer at a specific location, but more importantly helps haze the remaining animals away from the immediate area because of the human disturbance and pressure. During the winter of 2015-2016, SDGFP implemented one depredation pool hunt and removed seven antlerless white-tailed deer. The hazing effect of the hunting pressure was enough to keep the deer away from the problem area in this situation. Previously, during severe winters with higher deer populations, SDGFP has approved up to 36 depredation pool hunts across the state to help address deer damage. SDGFP staffs may also kill a small number of deer to help haze deer away from the immediate area when authorized by the SDGFP Secretary. These types of removals usually result from deer damage to growing crops during the late summer and serve as an additional hazing tool. Any deer that are removed are salvaged and donated to charitable organizations.

In some areas, SDGFP will utilize supplemental baiting sites in conjunction with hazing efforts to move deer away from farmyards that have stored-feed when protective fencing isn't possible or all of the stored-feed cannot be protected with fencing or panels. In these cases, a baiting site is established away from the immediate area near other areas of protection. Alfalfa hay and corn are spread on the ground at these locations in an attempt to alter the deer's travel routes to the farmstead where they have found shelter. Careful consideration is given before implementing this management practice because if deer are severely stressed, certain foods can cause sickness or even death. When high quality feeds such as corn are made available to nutritionally stressed deer, rumen acidosis or rumenitis can occur (Wobeser and Runge 1975). It is important to understand that SDGFP is not feeding these deer to keep them from starving, rather as a management tool to keep them away from farmsteads and the related livestock stored-feeds.

While many of these management techniques and strategies have proven successful over the past 20 years, deer depredation and the associated conflicts will continue to challenge SDGFP. These matters not only involve the management of deer but also include socio-economic and political dynamics that must be considered as well. To help reduce or alleviate many of these conflicts, SDGFP must ensure that deer populations are managed proactively and that management goals are being met. Defined wildlife population objectives and management goals are critical to effectively manage wildlife populations. SDGFP also acknowledges that its wildlife damage management programs will not be able to completely resolve all issues regarding deer depredation in all situations. However, SDGFP has a proven history of working with private landowners and is committed to cooperatively working with private landowners into the future to implement reasonable solutions to address most concerns.

## TRIBAL LAND AND DEER MANAGEMENT

South Dakota contains nine Indian reservations, including the Cheyenne River, Crow Creek, Flandreau Santee, Lower Brule, Pine Ridge, Rosebud, Sisseton Wahpeton, Standing Rock, and Yankton (Figure 63). Each is managed by a respective Native American tribe under tribal sovereignty and their respective tribal councils. Most tribes have a wildlife department that conducts various deer population surveys and makes hunting recommendations to the tribal councils. South Dakota Indian reservations contain a diverse mixture of landscape features and associated habitats. As a result, deer and other wildlife species thrive on these tribal lands, benefiting both wildlife watchers and hunters.

With a combined land base of approximately 5,000,000 acres under tribal jurisdiction or approximately 10% of the total state land base, coordination between state and tribes on deer and other natural resources management is important. In developing recommendations for upcoming deer hunting seasons, regional SDGFP staffs discusses management options for firearm hunting units within tribal lands. Since hunter harvest is occurring from both state and tribal hunting seasons, these discussions are important to ensure that the appropriate level of harvest is occurring to meet identified population objectives. Cooperative deer research and surveys have been limited;

however, coordinated efforts occur with affected tribes to monitor hemorrhagic disease outbreaks and for collecting biological samples from hunters to test deer for chronic wasting disease from selected areas of the state.

SDGFP and some tribes are currently in the process of developing Memorandum of Understandings (MOU's). The purpose of these MOU's is to formalize cooperative efforts between tribes and SDGFP where mutual interest exists to conduct collaborative operations. Collaborative operations between the parties may include, but not be limited to the following: conducting and sharing wildlife surveys, developing big game and small game harvest season recommendations, communicating wildlife and fisheries resource management concerns, and conducting predator/nuisance animal control activities in an effort to safeguard domestic livestock operations.

Opportunities exist to increase collaboration between SDGFP and tribal agencies regarding deer management, in particular, for mule deer. State deer licenses are not valid on tribal-deeded land within a reservation and tribal licenses are not valid between tribes. Hunting rules and regulations vary by tribe and hunters are encouraged to contact or visit the website of their tribal interest (Table 61). In summary, tribal lands offer substantial deer habitat and additional opportunities for deer hunters.

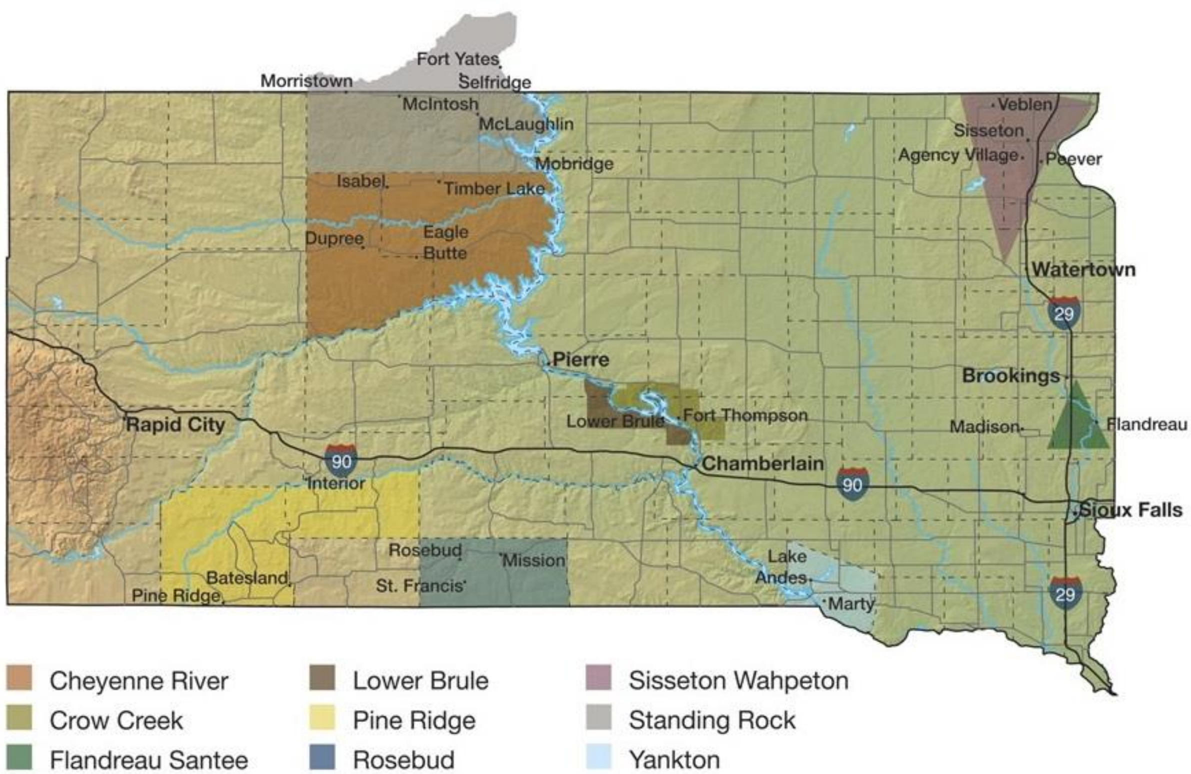



Figure 63. Tribal lands found in South Dakota. Source: South Dakota Department of Tribal Relations (SDDTR 2016).

Table 61. Names and contact information of South Dakota tribes and reservations.

| Tribe | Reservation | Headquarters | Land Area (acres) | Phone | Website |
|---|---|---|---|---|---|
| Cheyenne River Sioux Tribe | Cheyenne River Reservation | Eagle Butte, SD | Approx. 1,400,000 | 605-964-7812 | http://www.crstgfp.com |
| Crow Creek Sioux Tribe | Crow Creek Reservation | Ft. Thompson, SD | 125,591 | 605-245-2221 | http://www.crowcreekconnections.org |
| Flandreau Santee Sioux Tribe | Flandreau Reservation | Flandreau, SD | 2,356 | 605-997-3891 | http://www.santeesioux.com |
| Lower Brule Sioux Tribe | Lower Brule Reservation | Lower Brule, SD | 132,601 | 605-473-5561 | http://www.lbst.org |
| Oglala Sioux Tribe | Pine Ridge Reservation | Pine Ridge, SD | Approx. 1,700,000 | 605-867-1449 | http://www.oglalasiouxparksandrec.net |
| Rosebud Sioux Tribe | Rosebud Reservation | Rosebud, SD | 882,416 | 605-747-2381 | http://www.rosebudsiouxtribe-nsn.gov |
| Sisseton Wahpeton Oyate | Former Lake Traverse | Agency Village, SD | 106,153 | 605-698-3708 | http://www.swo-nsn.gov |
| Standing Rock Sioux Tribe | Standing Rock Reservation | Ft. Yates, ND | 562,366 in SD | 701-854-8500 | http://standingrock.org |
| Yankton Sioux Tribe | Yankton Reservation | Wagner, SD | Approx. 40,000 | 605-384-5687 | http://www.yanktonsiouxtribe.net |

## INTER-STATE COORDINATION

There are currently multiple gatherings and events with other surrounding state wildlife agencies to coordinate deer management efforts. SDGFP meets annually with the Wyoming Game and Fish Department to discuss deer and other species management in the shared Black Hills ecoregion and other units adjacent to Wyoming. In addition, SDGFP biologists annually meet and discuss deer management issues, strategies, and research with other state deer biologists at annual Midwest Deer and Wild Turkey study group meetings (http://mdwtsg.org/), annual Midwest Wildlife and Fish Health Committee meetings, White-tailed Deer Summit meetings, and biennial Western States Deer and Elk workshops. In addition, SDGFP is an active member of the Western Association of Fish and Wildlife Agencies' Mule Deer Working Group (http://www.wafwa.org/committees groups/mule_deer_working_group/).

## CITIZEN INVOLVEMENT AND OUTREACH

Effective decision-making by wildlife agencies necessitates the need to consider public perceptions and opinions, in addition to potential responses to management policies. Along with hunter harvest and biological data collected, public involvement is an important component in developing and implementing a deer management plan in South Dakota. Public participation helps ensure decisions are made in consideration of public needs and preferences. It can help resolve conflicts, build trust, and inform the public about deer management in South Dakota. Successful public participation is a continuous process, consisting of a series of activities and actions to inform the public and stakeholders, as well as obtain input regarding decisions which affect them. Public involvement strategies provide more value when they are open, relevant, timely, and appropriate to the intended goal of the process. It is important to provide a balanced approach with representation of all stakeholders. A combination of informal and formal techniques reaches a broader segment of the public; therefore, when possible, combining different techniques is preferred to using a single public involvement approach.

When it comes to public involvement, one-size does not fit all. Every situation is different and each approach to a specific situation will be unique. No single citizen or group of citizens is able to represent the views of all citizens. Multiple avenues for public involvement and outreach were used in the development of the Deer Management Plan. These approaches are designed to involve the public at various stages of plan development and to ensure opportunities for participation are accessible to all citizens.

**Previous Task Forces and Meetings**

There have been numerous task forces and meetings of various agendas regarding deer management and deer hunting opportunities in South Dakota. Meetings with the public occur on a regular basis and SDGFP staffs spend a considerable amount of time discussing input received from hunters, landowners, and the general public. For the purpose of deer management, a general summary is provided below on three significant efforts involving SDGFP and their constituents.

<u>Black Hills Deer Citizen Task Force</u>

During the late 1980s and early 1990s, deer hunters began to request change to the Black Hills deer hunting season primarily due to the perception of too few bucks, small antler size of bucks, and poor body condition of deer. In response, SDGFP and South Dakota State University cooperatively began research projects to study survival, mortality and habitat use of white-tailed and mule deer in the Black Hills. In addition, a public opinion survey of Black Hills deer was conducted by SDGFP and a citizen task force was assembled to discuss and develop recommendations for future deer management in the Black Hills.

The Black Hills Deer Citizen Task Force was comprised of nine individuals who held nine public meetings across the state. Of those attending the public meetings, it was reported that 68% supported some type of change to increase the quality of deer in the Black Hills. From this public input, 41 alternatives were considered and could be categorized into the following groups: 1) shorten the season length; 2) limit the number of buck licenses; 3) create hunting units for buck harvest; 4) modify the doe harvest; 5) raise license fees; 6) limit license sales; 7) increase law enforcement; 8) institute antler point restrictions; 9) increase predator control; and 10) cooperatively work with USFS to improve deer habitat (SDGFP 2008).

After considering all alternatives, the task force proposed a season with the following two license types:

- A 30-day season during the month of November with a limited number of buck-only licenses with a 2 points or more antler restriction on one side with an additional 8% of total resident licenses made available to nonresidents.
- A 10-day season with a limited number of “any deer” and “any whitetail” licenses valid in specific hunting units with an additional 8% of total resident licenses made available to nonresidents.

Though controversial, the task force alternatives were implemented by the SDGFP Commission for the 1996 deer hunting season. This change to the Black Hills deer hunting season was monitored closely by SDGFP with annual surveys sent to all hunters with a Black Hills deer license to monitor change in deer hunter opinions. From 1996-2006, minimal change occurred for the Black Hills deer hunting season. In 2007, the 2-point antler restriction was removed and a limited number of “any deer”, “any whitetail”, and “antlerless whitetail” licenses were issued; this same season structure continues to this day. Though the removal of the antler point restriction was controversial with hunters, educational outreach from SDGFP to Black Hills deer hunters indicated that that it was not the antler point restriction, but limiting the number of licenses that had the greatest influence on increasing buck numbers and buck age structure in the deer population.

<u>West River Deer Task Force</u>
In response to several issues related to big game management in western South Dakota, with deer management being the focal point of discussion, the West River Deer Task Force (WRDTF) was formed. The task force was comprised of nine members nominated by SDGFP staffs and Commissioners and appointed by the Department Secretary. Members included three West River landowners, three West River outfitter/commercial deer hunting interests, and three deer hunters from across the state.

A total of eight meetings were held by the WRDTF in 1996. The task force met to discuss the following topics: 1) hunters, who wanted improved access to private land; 2) landowners, who wanted better depredation control and more opportunity to be compensated for providing hunting or for providing food for wildlife; and 3) guides/outfitters, who wanted more opportunity to economically benefit from deer hunting.

The WRDTF had two assignments: 1) to clearly identify and prioritize the specific issues associated with the allocation of licenses, depredation by deer on private land, public access for deer hunting, and deer population management as they relate to the West River deer season) and 2) to recommend solutions to the above areas of concern, that if implemented, would maintain recreational and economic opportunities and be acceptable to the public and consistent with deer population management direction. A list of recommendations from the WRDTF, summarized responses from SDGFP staffs, and a summary of action taken by the SDGFP Commission can be found in Table 62.

Since the time period of the WRDTF during the mid-1990s, several of the same topics have come up for discussion at various levels at public meetings, SDGFP internal meetings, Regional Advisory Panel meetings, Commission meetings, and during state legislative sessions. Management of wildlife, their habitats, and hunting opportunities will continue to be an evolving and sometimes contentious process to meet current needs and demands.

Table 62. Summary of West River Deer Task Force recommendations, SDGFP staffs response, and SDGFP Commission action.

| WRDTF Recommendation | SDGFP Staffs Response | SDGFP Commission Action |
|---|---|---|
| **Outfitter-Sponsored Deer Licenses** | Developed a list of alternatives for SDGFP Commission consideration. | No action. |
| **License Types for Landowners** | Discussed some alternatives. Outreach to landowners on the explanation of existing options was the preferred option. | No action. |
| **Prevention of Depredation** | Developed new or improved existing programs for food plot program, stack yard program and winter feeding program. Also reviewed and revised existing policies and procedures. | No action. |
| **Landowner Preference Eligibility** | Agreed on the discussion of minimum acreage requirements, etc. | No action. |
| **Enhance Walk-In Areas West River** | Agreed with recommendation and to this day, efforts are made to increase and enhance the quality of walk-in areas open for public access. | No action. |
| **Landowner Liability** | Suggested that no action be taken on this issue. | Outside the jurisdiction of the SDGFP Commission as this is a civil matter. No action. |
| **Landowner Depredation Permits** | Agreed with some of the recommendation and developed rules and policy to implement depredation pool hunts and the allowance of kill permits where necessary and authorized by the Department Secretary. | No immediate action. |

| | | |
|---|---|---|
| **Revenue and Funding Recommendations** | Agreed with components of recommendation and already implement the intent of recommendation. | Annually approve budgets and spending authority. |
| **Deer Management by SDGFP** | Agreed that the current strategies of harvesting mature bucks are in alignment with also providing the maximum amount of recreational hunting opportunity. | Determined the present management system was meeting current demands. No action taken. |
| **Development of a "Master Hunter" Program** | Felt the current HuntSafe program was meeting this need, yet agreed to view alternative ways to increase relations between hunters and landowners and improve image of hunters. | Supported the intent of the recommendation and asked Department staffs to explore in more detail. |
| **Establishing a List of Landowners Wanting Hunter Assistance with Depredation Problems** | Agreed with overall intent of recommendation and ultimately created the Volunteer Antlerless Deer Hunter Program. | No action. |
| **All-Terrain Vehicles** | Agreed to continue dialogue with other public land managers. | Recommended that Department staffs continue to address with other public land managers. |
| **Sentencing of Big Game Violators** | Supported the recommendation. | Agreed with recommendation of more strict and comprehensive penalties. Two such laws were passed during the 1997 legislative session. |
| **South Dakota Residency Requirements** | Suggested that no action be taken on this issue. | Recommended no changes in current residency status categories. |
| **Provide License Check-off Directed to Depredation Prevention Fund** | Suggested that no action be taken on this issue. | Felt that this recommendation would generate minimal funds. No action taken. |

<u>West River Issues Working Group</u>

The West River Issues Working Group (WRIWG) was established in April 2004 for the purpose of identifying and finding solutions for issues related to public wildlife on private lands. Specific goals included the following: 1) improving relations among landowners, hunters, and SDGFP; 2) improving hunting access for South Dakota resident hunters; and 3) addressing problems of depredation by wildlife. Eight group members were initially identified, with four legislative members added to the group. The WRIWG met a total of eight times between May and November 2004. All meetings were open to the public and testimony was accommodated by the work group.

In total, 490 members of the public attended the meeting and 156 individuals provided public testimony for consideration of the working group.

Dozens of different topics were discussed by this working group, but ultimately this group agreed on 23 unanimous recommendations and 4 additional recommendations with split opinions. The recommendations were categorized under the following major themes: 1) improving communications; 2) Open Field Doctrine; 3) allocation of deer licenses; 4) improving hunter access; 5) land acquisitions; 6) Wildlife Division budget of SDGFP; 7) prairie dogs; 8) para-plane control and aerial hunting; and 9) mountain lions. Those recommendations related to deer management included allocation of deer licenses, improving hunter access, and land acquisitions.

In regards to allocation of deer licenses, there were recommendations for a landowner-sponsored license drawing, deer-on-your-own-land license that could be transferred to another eligible hunter, and landowner choice depredation antlerless big game tag. There were mixed opinions on these recommendations and no immediate formal action was taken by SDGFP. Depredation pool hunts and free antlerless deer licenses for landowners in open areas are now implemented by SDGFP by modifications to Department policy and state legislation.

Providing hunter access has always been a priority of SDGFP and the Walk-In Area Program has been a successful tool in helping to meet the needs of public access to hunters. Continual dialogue amongst SDGFP staffs and landowners, SDGFP Access Committee annual meetings, and other hunter input assists SDGFP in making continual improvements to the Walk-In Area Program. Coordination with other public land managers to improve public access to land-locked public parcels and the recent Controlled Hunter Access Program has enhanced public access opportunities across the state.

Land purchases through acquisitions of state-owned Game Production Areas is recognized by SDGFP as an important conservation tool in protecting and managing wildlife habitats and in providing public access; however, land purchases by a state agency can at times be controversial. The SDGFP Commission, based on Department recommendations, has the decision making authority to approve land purchases. Public access for deer hunters and other outdoor recreationists and the protection and management of unique habitats will continue to be a priority into the future.

**Public Opinion Surveys**

In addition to hunter harvest surveys, SDGFP conducts opinion surveys to identify and understand the interest and needs of the public. Scientific standards are used to ensure reliability, validity, representativeness, and generalizability of results when designing and administering public opinion surveys. Successful surveys are conducted in a way which reduces error to the extent practical. The four primary types of error in survey research are sample error, coverage error, measurement error, and non-response error. To this end SDGFP surveys are administered to random samples of the target population using a modified Dillman Tailored Design Method (Dillman et al. 2014) and, when possible, a mixed mode approach using both internet and mail surveys. A target overall response rate of 50% is used. When response rates below 50% are obtained consideration should be given to administering a non-response survey to determine the presence and effect of non-response error. Appropriate sample sizes should be determined using a ±5% sampling error at a 95% confidence interval.

**2016-2017 Deer Stakeholder Group**

A stakeholder for this purpose is defined as a person, group, or organization with an interest in the management of deer. Because deer are important to many South Dakota residents and non-residents, SDGFP felt it was important to have a diverse representation of stakeholders to provide input for future management of deer in South Dakota. The formation and input from this stakeholder group, however, did not inhibit SDGFP from obtaining and incorporating additional input and opinions on deer management in South Dakota.

The South Dakota Deer Stakeholder Group included representation from the following: general public, deer hunters, private landowners, agricultural interests, commercial hunting interests, and conservation organizations. Those who served on the South Dakota Deer Stakeholder Group during this planning process can be found on page ii, and the Deer Stakeholder Group Charter is located in Appendix C. This charter was shared with all stakeholders and described the purpose, objectives, authority, roles and responsibilities of this group.

The South Dakota Deer Stakeholder Group held four meetings in 2016 (February 5, June 27, August 26, and December 8) and one meeting in 2017 (February 24) in Pierre. Information and supportive data were provided by SDGFP staffs to ensure all members were knowledgeable about the topics and issues discussed and deliberated by the group. Key topics and issues discussed by the stakeholder group included the following: status of white-tailed deer and mule deer populations, SDGFP deer depredation program, current challenges and opportunities, population objectives, loss of habitat, habitat and access programs, outreach and education, urban deer management, antlerless deer harvest strategies, unit boundaries, fair and equitable distribution of hunting opportunities, and review of the draft deer management plan.

Individual views and opinions varied amongst the broad representation of this stakeholder group. While many topics were discussed at length, a great deal of time was devoted to how SDGFP determines population objectives, landowner tolerance, fair and equitable distribution of hunter opportunity, hunter desires, and depredation tools. Careful consideration of these opinions was included in identifying the management objectives and strategies necessary to successfully manage deer within the varying social carrying capacities.

**Public Meetings/Open Houses**

The term *public meeting* is used as an umbrella term for all types of meetings including but not limited to public hearings, open houses, or workshops. South Dakota Game, Fish and Parks uses a variety of public meeting formats designed to be accessible by all members of the public and to provide meaningful opportunities for public involvement. Involvement opportunities include open houses, Regional Advisory Panels meetings, and the SDGFP Commission meetings.

In an effort to ensure accessibility to all interested individuals, multiple regional open houses are held each year in different locations and at various times to provide for maximum participation. These open houses are advertised to the public through a variety of outlets, and are designed to both inform the public about specific topics (e.g., unit-specific deer population objectives, season dates, unit boundaries, deer depredation) and to gather input and feedback from the public. These open houses are also used to inform and collect input from targeted stakeholders and groups regarding deer populations and season recommendations. Upcoming meetings are advertised in local newspapers and can be found on the SDGFP website at http://gfp.sd.gov/agency/meetings/default.aspx.

The SDGFP Division of Wildlife also has four Regional Advisory Panels, which meet to share information and receive feedback from wildlife stakeholders. Panels typically consist of about 8 members. Members of the panels are appointed, with selection designed to be representative of the stakeholders in their respective regions. Upcoming meetings and past meeting notes can be found on the SDGFP website at http://gfp.sd.gov/agency/advisory-councils/regional-panels.aspx.

As part of the rule setting process, the SDGFP Commission formally holds a public hearing at each meeting where it takes public testimony regarding pending matters under the board's purview, including but not limited to, deer management. In addition to the public hearing process, the Commission also reviews department management plan drafts, related public comments, and formally adopts final management plans for implementation. All meeting agendas, minutes, etc. can be found at http://gfp.sd.gov/agency/commission/default.aspx.

Each given situation is different and each approach to a specific challenge will be unique, therefore public involvement strategies will use a variety of techniques to encourage all citizens to actively participate.

**Communications and Public Relations**

Information on the development of the South Dakota Deer Management Plan has been available online at http://gfp.sd.gov/hunting/big-game/deer/deer-management-plan.aspx since the beginning of the planning process; outlining the plan's contents, timeline and how staffs, customers and stakeholders can get involved.

Individuals and stakeholder groups were invited to participate in deer stakeholder group meetings. Information presented at these meetings and minutes of discussions are available for review at the previously mentioned link above.

The plan and any updates were provided to the public through Facebook, Twitter and targeted email messaging (specifically to resident and nonresident deer/big game hunters). Scheduled

Facebook and Twitter posts were made after the release date of the plan as reminders to let followers know this information is available. However, if users made comments via social networking, they were directed to provide those comments in writing to wildinfo@state.sd.us or mail them to 523 E. Capitol Ave., Pierre, S.D. 57501 and include a full name and city of residence in order for them to be a part of the official public record. Once the plan was available for public review and comment, in March 2017, a PDF version was posted online. All email comments from the public pertaining to the draft plan were sent to DeerPlan@state.sd.us and were available in public folder for all staff to review.

Media outlets were informed of the plan through the standard press release distribution process. Press releases were sent via email to a group of over 5,000 recipients (media and customers alike) who have opted in to receive all GFP News (or press releases). In addition, availability of the draft plan and deadline for public comments was shared via email to all deer hunting applicants from 2015 and 2016 and a postcard was mailed to all landowners who subscribe to the SDGFP Landowner's Matter Newsletter. Press release information was also shared internally with over 600 GFP employees and posted to all GFP digital platforms mentioned above as well as online at: http://gfp.sd.gov/news/default.aspx and http://news.sd.gov/.

**Non-Governmental Organizations / Sportsmen's Clubs**

State wildlife management agencies are mandated by their respective states for implementing laws, rules, and other regulations for the benefit of wildlife and their habitats while providing hunting opportunities to these public resources. Non-governmental organizations (NGO's) provide a non-governmental voice and serve a critical role for wildlife conservation Many NGO's partner with SDGFP on important issues pertaining to wildlife, including deer management, through support and funding contributions of various habitat, public access, hunter education, and research. Without the assistance of NGO's, SDGFP would at times be limited in various aspects of completing outreach efforts and putting projects on the ground for the benefit of the public and various wildlife resources. Though not an exclusive list, several NGO's that have missions related to deer management in South Dakota are found in Table 63.

Table 63. Partial list of non-governmental organizations/sportsmen's clubs active in South Dakota.

| Organization | Mission | Other Information | Website |
|---|---|---|---|
| South Dakota Wildlife Federation | SDWF is an affiliate of the National Wildlife Federation, the largest conservation organization in the world. The close working relationship between the state and national organizations ensures effective, coordinated conservation action at all levels of government. | Currently have 15 affiliate clubs, commonly referred to as sportsmen's clubs, across South Dakota.<br><br>Actively follow legislation and other wildlife-related policy through the South Dakota Camo Coalition. | www.sdwf.org |
| South Dakota's Bowhunter's, Inc. | An organization founded by bowhunters to advance and promote bowhunting in the state of South Dakota. | | www.sdbi.net |
| Quality Deer Management Association | To ensure the future of white-tailed deer, wildlife habitat and our hunting heritage. | Sioux Falls | www.qdma.com |
| Whitetails Unlimited | To raise funds in support of (1) educational programs, (2) wildlife habitat enhancement and acquisition, and (3) preservation of the hunting tradition and shooting sports for future generations. | Brookings | www.whitetailsunlimited.com |
| Mule Deer Foundation | To ensure the conservation of mule deer, black-tailed deer and their habitat. | | https://muledeer.org |
| National Deer Alliance | To ensure the future of North America's wild deer, wildlife habitat and our hunting heritage. | Serves as an association to bring several NGO's focused on deer management together to facilitate data and information sharing to professionals, landowners, and deer hunters. | http://nationaldeeralliance.com |

## HABITAT BEST MANAGEMENT PRACTICES FOR DEER

This section is intended to provide general guidance to assist public and private land managers in enhancing mule deer and white-tailed deer abundance and habitat in South Dakota through best habitat management practices (BMPs). When determining what types of BMPs to implement to benefit deer, it is important to consider the life history needs (e.g., water, food, cover) of the species and their most limited habitat resources. Because of the wide variety of habitats found throughout the state, some of the practices are likely to provide more benefit and be applicable to specific areas of the South Dakota.

### Woody Cover Development

Thermal and security cover are limited resources for deer populations throughout the prairie landscapes of South Dakota. Both deer species seek topographic relief and wooded stands, shelterbelts or draws for thermal, escape and bedding cover. The MDWG identified woody cover as the limiting factor for mule deer in the Great Plains (Fox et al. 2009). With the limited woody vegetation communities in both the West River and East River region, a management priority should be providing and/or protecting thermal and security cover for both deer species. Creating corridors and patches of native shrubs/trees such as eastern red cedar, chokecherry, American plum and Rocky Mountain Juniper have been shown to be vital to deer as cover and travel corridors (Fox et al. 2009, NRCS 2014).

In agricultural dominated landscapes, ensuring adequate security and thermal cover is vitally important when managing land to benefit deer within the tallgrass and mixed grass prairies (Halls 1984). White-tailed deer prefer habitat that provides a mosaic of patches including early successional shrub and tree cover, wooded lots, edge communities, and grasslands (Pierce and Flinn 2013). White-tailed deer will utilize standing crops for cover throughout the summer months; however once harvested, escape cover becomes extremely limited. Riparian areas with dense vegetation including shrubs/trees, shelterbelts and woodlots are important for thermal and security cover and for providing travel corridors. Protecting riparian areas can help to increase cover for deer as can planting 8-16 row shelterbelts and tree plots. High quality edge habitat, the transition zone between vegetation communities, can be created by planting shrubs and small trees in a wide strip at the edge of open meadows (Pitts and McGuire 2000). Simply allowing fence rows to grow or planting hedge rows can also provide important cover for white-tailed deer. Planting conifers or shrubs in a minimum of four rows deep can provide thermal and escape cover and if the corridor can connect bedding areas and foraging areas the benefit of the planting increases by providing travel corridors by reducing stress and exposure (Fox et al. 2009, Yarrow, 2009).

In the Black Hills ecoregion of South Dakota mature ponderosa pine stands dominate, as >70% of the Forest is categorized as structural stage 4 (USDA 2013). These areas provide ideal thermal cover for deer and increased survivorship in the winter has been associated with these areas of greater tree density and cover (Klaver et al. 2008). Security cover is also an important component of deer habitat in high disturbance areas and during seasonal disturbances (e.g., hunting). Security cover can be provided by standing trees and understory vegetation and is especially important along roads. In most areas within the Black Hills, however, security and thermal cover are abundant and habitat management should focus on tree thinning or removal to increase understory shrub and forb production. Forest management should consider the importance of cover and should be designed to maintain or protect areas of dense forest cover where thermal cover is a limiting factor, and in order to minimize deer disturbance priority should be given to vegetation treatments that remove security cover in areas away from roads and trails.

A summary of the best tree, shrub, and rangeland shrub species to plant for deer thermal and security cover development in South Dakota can be found in Tables 64 and 65.

Table 64. Tree and shrub species planting recommendations for deer BMPs in South Dakota (Source: Larson and Johnson 1999, Johnson and Larson 2007, Fox et al. 2009, MDWG 2015a, and USDA 2017).

| Best tree and shrub species for deer in South Dakota | | | |
|---|---|---|---|
| **Shrubs/Trees** | **Bare root stock available** | **Adaptations** | **Mature Height** |
| Boxelder | Yes | Prefers river bottoms and disturbed sites on heavy, wet soils, often seasonally flooded (up to 30 days). It is one of the most common bottomland trees throughout its range. Demonstrates fast growth on clay or heavy fill. Is tolerant to stressful sites and requires little special care. | <60 ft |
| Bur Oak | Yes | Calcareous soils, rich bottomlands, intolerant to flooding, very drought resistant. | 70-80 ft |
| Chokecherry | Yes | Grows abundantly in many habitat types and plant associations. Prefers direct sunlight and is not an understory species. Chokecherry occurs naturally in a wide range of soil types and textures. Soil textures range from silt to sandy loam. | <20 ft |
| Eastern Redcedar | Yes | Widely adapted to most soils and moisture conditions. Drought tolerant and provides excellent thermal cover. | 20-40 ft |
| Green Ash | Yes | Widely adapted to soils, moisture | <50 ft |

| | | | |
|---|---|---|---|
| | | conditions and pH found east of the Rocky Mountains. The species will tolerate seasonal flooding, but is intolerant of shading from surrounding trees. Green ash is a fairly early successional tree on most sites. | |
| Honey Locust | Yes | Honey-locust occurs on well-drained sites, upland woodlands and borders, rocky hillsides, fence rows, river floodplains, hammocks, and rich, moist bottomlands. | <60 ft |
| Plains Cottonwood | Yes | Best growth on moist, well-drained, fine sandy loams or silt loams. Coarse sands and heavy clay soils are not satisfactory. Cottonwood is resistant to flood damage and usually tolerates a soil pH range of 4.5 to 8.0. | 50-100 ft |
| Quaking Aspen | Yes | The most widely distributed tree species in North America. Grows well in acidic, loamy, moist, sandy, well-drained and clay soils. It prefers abundant moisture and full sun. | 40-50 ft |
| Redosier Dogwood | Yes | Grows in soils that are saturated for at least a portion of the growing season. Common on the edges of lakes, ponds, within wetlands, and along streams. | 5-20 ft |
| Rocky Mountain Juniper | Yes | Widely tolerant of droughty and moist, well-drained sites. Drought tolerant and provides excellent thermal cover. | 20-40 ft |
| Serviceberry | Yes | Moist soils but highly adaptable and occurs in wooded draws, woodland interfaces, and riparian zones. | 10-20 ft |
| Silver Buffaloberry | Yes | Grows on most well-drained soils. It is tolerant of non-saline to slightly saline, calcareous soils. It prefers full sunlight, often on northwest to east facing slopes. The shrubs are excellent bank stabilizers, once established. | 3-20 ft |
| Skunkbush Sumac | Yes | Habitat includes rocky hillsides, canyon bottoms, rocky riparian areas, and well-drained shorelines. | 3-10 ft |
| Smooth Sumac | Yes | Extremely drought resistant and tolerant of slightly acid soil conditions and textures ranging from course to fine. Sumacs are | 10-15 ft |

| | | | |
|---|---|---|---|
| | | not highly shade tolerate and are considered early successional species. | |
| Wild Plum | Yes | Forms thickets in grasslands, woodlands, and along roadsides and riverbanks, especially on lighter textured soils. Drought resistant, shade tolerant, prefers well drained soil. | 3-24 ft |
| Willow | Yes | Shade intolerant, prefers moist site conditions along stream banks, wet meadows, ditches, and shores. | 5-20 ft |

Table 65. Planting recommendations for rangeland shrub species for deer BMPs in South Dakota (Source: Larson and Johnson 1999, Johnson and Larson 2007, Fox et al. 2009, MDEQ 2013, MDWG 2015a, and USDA 2017).

| **Best rangeland shrub species for deer in western South Dakota** | | | | | |
|---|---|---|---|---|---|
| **Native Shrub** | **Seeding Rate** | **Planting Depth** | **Bareroot Stock available** | **Adaptations** | **Forage Value** |
| Antelope Bitterbrush | Drill: 1- 2 lbs per acre | 1 inch | Yes | Antelope bitterbrush is adapted to a wide range of soils with 8 to 34 inches of annual precipitation. The shrub has good tolerance to drought and cold. | Excellent |
| Silver sagebrush | Broadcast: 2 lbs per acre | ¼ inch | Yes | Drought and alkali tolerant. Typically found in dry prairie grasslands on well-drained, deep loam to sandy soils. | Excellent |
| Winterfat | Broadcast: 7 lbs per acre | ¼ inch | Yes | Grows well on a wide range of soil textures, prefers more basic or limy soils. Tolerates moderate to highly saline conditions, but is not tolerant of acidic soils. Does not tolerate flooding or extended wet conditions. | Excellent |

**Food Resource Enhancement**

A land manager can enhance food resources for deer by planting desirable perennial forage species or by managing areas to increase available perennial forages for deer (Tables 64, 65, 66, and 67).

Land managers should tailor forage plantings to season of use and forage needs of deer (Figure 64), as well as ecoregion. For example, in the Black Hills creating small openings in wooded areas to allow native forbs (e.g., wild spirea, western rose, clover) and shrubs (e.g., Oregon grape, western snowberry, mountain mahogany, oak, bearberry) to grow can provide deer additional forage (Yarrow 2009). In prairie habitats, creating small openings (typically < 5 acres) in eastern cedar and Rocky Mountain juniper dominated wooded areas can have similar effects on forb and shrub growth.

Using prescribed burns, herbicide treatments or mechanically altering an area (trimming, mowing, plowing or disking) can allow a land manager the opportunity to reseed a plot of land with a seed mix that can provide deer higher nutrition and more palatable forage. Seedings and plantings should be carefully planned to assure they will be effective. Factors to consider include: site objectives, cost, timing, surrounding forage availability, site preparation, precipitation, seeding or planting method, history of noxious weeds, and post-treatment monitoring and management. Species selected for planting should be adapted to the specific geographic area and readily established. Success rate for shrub establishment is higher when bare rootstock is used (MDWG 2015a). Once planted or seeded, it is critical newly established plots are excluded from livestock grazing for best results. In some situations native grasses, forbs and shrubs will respond to available sunlight from the opened canopy and no reseeding is necessary.

Quality forage can be a limiting factor to deer in the Northern Great Plains, especially during years of extreme winter severity. Planting annual food plots provides additional winter food resources that can be beneficial to deer especially if food plots are adjacent to quality escape and thermal cover (e.g., wetlands, shelterbelts, tall warm season grasses). Winter food plots, both annual and perennial, must be located near cover in order to be effective. Establish winter food plots in close proximity to and preferably on the southeast side of existing winter cover. Food plot use by deer is increased when located near winter cover and when the surrounding landscape contains woody habitat. Food plots should be of adequate size (minimum 2-10 acres) to provide food throughout the winter. Valuable crops planted as winter food plots include unharvested corn, soybeans, winter rye, winter wheat, forage oats, clover, alfalfa, Austrian winter peas, purple top turnip, and/or Winfred and Hunter forage brassicas (Pierce et al. 2015). With the exception of corn, alfalfa and soybeans, the best time to plant winter food plots is late summer and early fall (e.g., August 1-15). Rotating different annual plants from year to year can be beneficial in meeting the differing nutritional requirement of deer throughout the year or planting of multiple species at one time can also be beneficial. Furthermore, multiple winter food plots can be created across an area, providing multiple forage opportunities while minimizing movement and exposure risk (Fox et al. 2009, Yarrow 2009, Hamrick and Strickland 2011, and Pierce et al 2015,).

The following guidelines should increase the success of forb plantings that are used to improve and supplement food resources for deer in South Dakota (MDEQ 2013, MDWG 2015a):

*Site Preparation*

- Eliminate existing vegetation prior to seeding with tillage, herbicide, or a combination of techniques.
- Fallow the area to be seeded for at least one growing season. Delay seeding until after a flush of fall germinating weeds.
- Create a firm, weed-free seed bed.
- Some herbicides can have residual carryover and can negatively affect seedling establishment. Know the cropping history and past herbicide use of the site to be planted.

*Seeding*

- Seed forbs during late fall (November or December).
- One of two seeding methods is recommended:
- Drill seed into a firm weed-free seedbed. The best drill seedings have been accomplished by setting the drill to place the seed no deeper than ¼ inch. Drag chains or press wheels help to cover the seed with a thin soil layer and improve seed to soil contact.
- Broadcast seed into a weed-free seedbed. The best broadcast seedings have been accomplished by pulling the tubes on the drill and running the packer wheels with enough down pressure to create good furrows and seed to soil contact.
- Rice hulls may be used to assist seed flow.

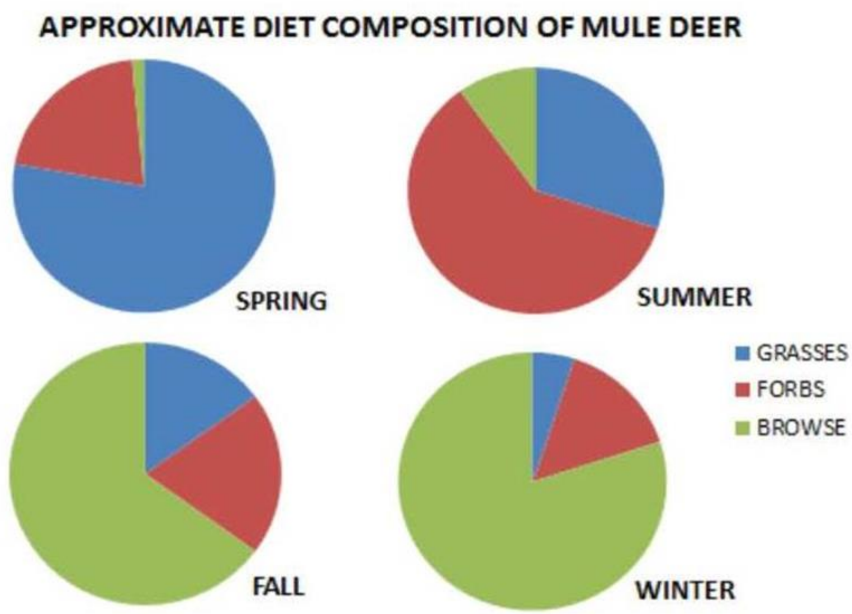



Figure 64. Dietary composition of mule deer (MDWG 2015a).

Table 66. Planting recommendations for forb species for deer BMPs in South Dakota (Larson and Johnson 1999, Johnson and Larson 2007, Fox et al. 2009, USDA 2011, MDEQ 2013, MDWG 2015a, and USDA 2017).

| Best forb species for deer in South Dakota | | | | | |
|---|---|---|---|---|---|
| **Common Name** | **N = native I =introduced** | **Seeding Depth (in)** | **Seeds/lb** | **Seeding Rate (lbs/ac)** | **Adaptations** |
| Alfalfa | I | 1/8-1/2 | 200,000 | 10 | Grows best on deep, well-drained, friable soils. Seedbed must be smooth, firm, free of weeds and contain adequate moisture for germination and emergence. |
| American Vetch | N | 1-2 | 33,000 | 33 | Climbing vine excellent for sunny and partially shady locations. Can be part of a wildlife seed mixture where native grasses and wildflowers are seeded together. |
| Arrowleaf Balsamroot | N | 0- 1/4 | 100,000 | 9 | Adapted to fine to medium textured soils and because of the deep taproot, it tolerates fire, grazing, trampling and drought and prefers well-drained silty to loamy soils with a pH range of 6.5 to 8.0. |
| Leadplant | N | 1/4-1/2 | 195,000 | 5-10 | Can occur in soils that are somewhat acidic to alkaline and can tolerate some salinity. It is resistant to occurrences of fire and can tolerate a moderate amount of grazing. Leadplant is a good indicator of well managed lands that have moderate to low levels of livestock grazing. |
| Scarlet Globemallow | N | 1/4-1/2 | 500,000 | 2 | Adapted to a wide range of soil types from sandy to clay loams to gravelly to alkaline and moderately saline soils. Extremely drought tolerant and does not tolerate shady conditions. |
| White and Purple Prairie Clover | N | 1/4-1/2 | 132,000 | 7 | Adapted to slopes along hillsides, prairies, and plains. It occurs mostly on sandy, sandy loam, and other moderately drained soils. |

Table 67. Planting recommendations for grass species for deer BMPs in South Dakota (Larson and Johnson 1999, Johnson and Larson 2007, Fox et al. 2009, and USDA 2017).

| **Best warm-season grass species for deer in South Dakota** | | | | |
|---|---|---|---|---|
| **Common Name** | **N = native I =introduced** | **Seeding Depth (in)** | **Seeding Rate (lbs/ac)** | **Adaptations** |
| Big Bluestem | N | 1/4-1/2 | 7-12 | Adapted to a range of soil limitations such as shallow depth, low pH, and low fertility. Big bluestem should be seeded as early in the spring as possible. Conventional tillage should be used where practical. |
| Indiangrass | N | 1/2-3/4 | 6-8 | Grows best in deep, well-drained floodplain soils. However, it is highly tolerant of poorly to excessively well-drained soils, acid to alkaline conditions, and textures ranging from sand to clay. The optimum time to plant is from early May to late June. |
| Little Bluestem | N | 1/4-1/2 | 4-5 | Adapted to a range of soil limitations such as shallow depth, low pH, and low fertility. Seed into a firm seedbed in early spring for best results. Has moderate drought tolerance. |
| Switchgrass | N | 1/4 | 10 | On suitable soils, switchgrass is climatically adapted throughout most of the United States. Prefers sandy to clay loam soils and does poorly on heavy soils. |

### Grassland Establishment

Undisturbed warm season grasses provide excellent cover for deer, including winter cover, fawning cover, and bedding cover (Fox et al. 2009). The most beneficial warm-season grasses for deer are big bluestem, Indian-grass, and switchgrass. Cool season grasses also provide important seasonal forage, and may also contribute to important fawning and bedding habitats. All grasslands should be interseeded with forbs (Table 66) to provide maximum benefit to deer and other wildlife. Providing blocks of undisturbed grasslands with a minimum size of 40 acres is ideal. Once established, grassland habitats can be managed by haying, grazing, or prescribed fire. If necessary, use 2-3 years of farming for seedbed preparation for grassland restoration efforts of non-native cool season grasslands (e.g., smooth brome, Kentucky bluegrass).

**Grazing Management**

Livestock grazing has great potential to influence deer throughout South Dakota. Cattle grazing can change the availability and quality of forage and cover for mule deer and white-tailed deer (Fox et al. 2009). Deer tend to avoid areas heavily grazed by cattle (Loft et al. 1991) and in general, Fox et al. (2009) suggested that higher mule deer densities typically occur where cattle grazing was light or absent. Furthermore, Gallizioli (1976) correlated areas with little cattle grazing pressure with greater vegetative productivity and better mule deer habitat than areas more intensely used by cattle. Jenks et al (1996) identified that cattle generally feed on grass (when available), and can assist deer by feeding on grasses that over shadow the forbs and other broadleaf plants deer browse on. However, some forbs and browse are highly palatable to cattle and during periods of drought or high intensity stocking rates, cattle may also feed on forbs and woody browse, directly competing with deer (Fox et al. 2009). Impacts to deer are minor when cattle stocking rates are controlled such that cattle feed primarily on grasses and not on forbs and woody browse (Fox et al. 2009, Jenks et al. 1996). If stocking rates are maintained at a level where cattle compete with deer for forbs and more palatable woody browse, deer nutrition levels may drop or deer may even leave or avoid areas used by cattle (Austin and Urness 1986, Fox et al. 2009). Also, the timing and climatic conditions of the specific area grazed plays a significant role in vegetative regeneration and therefore the possible effects livestock grazing has on deer forage (Olson et al. 1985, ASI 2006, Fox et al. 2009, Johnson 2014, Chowanski and Gates 2015). Grazing in spring and early summer may be more beneficial to deer as grazing during these time periods can be beneficial to forb and shrub enhancement.

Rotational grazing practices or deferred rest-rotation grazing systems can also be beneficial to deer and increase forage production if stocking rates are conservative. In addition, deferred rest-rotation grazing systems, particularly in June and July may provide increased residual hiding and bedding cover for fawns (Rice and Carter 1982).

Chowanski and Gates (2015) are currently investigating possible grazing impacts on ponderosa pine (*Pinus ponderosa*) stands in the Black Hills; in preliminary findings, they have suggested that species richness and diversity decline as grazing intensity increases. However, they also suggest that the timing of grazing and precipitation may influence vegetative richness, diversity and productivity (Chowanski and Gates 2015). The suggestion from Chowanski and Gates (2015) that timing and climatic conditions play a significant role in determining the influence of grazing on plant communities has been supported in other studies (Olson et al. 1985, ASI 2006, Fox et al. 2009, Johnson 2014). In general, it has been suggested that lower to moderate grazing intensity has a greater benefit to plant diversity, productivity and richness, than high intensity grazing of resources (Olson et al. 1985, Heitschmidt 1987, ASI 2006, Fox et al. 2009, Cox 2014).

Several studies have also identified the benefits of limiting or excluding livestock access to riparian corridors (Belsky et al. 1999, Fox et al. 2009). Limiting grazing within riparian areas allows plant communities to develop into later successional stages providing browse, escape cover, thermal cover, bedding areas and travel corridors for both mule deer and white-tailed deer (Halls 1984, Bookhout 1996, Bolen and Robinson 1999, Fox et al. 2009) as well as other wildlife species. Utilizing fencing to exclude livestock from these important resources provides important escape cover for deer, quality forage and also improves water quality (Belsky et al. 1999, Pierce et al. 2015).

In summary, stocking rates that result in low to moderate intensity grazing have a greater benefit to plant diversity, productivity, and richness (Olson et al. 1985, Heitschmidt 1987, ASI 2006, Fox et al. 2009, Cox 2014). Livestock grazing impacts to deer are minor when stocking rates are conservatively controlled (Godwin and Thorpe 1994) ensuring livestock do not consume large amounts of forbs and browse as a result of high intensity stocking rates. Furthermore, riparian livestock exclusion is extremely beneficial to deer and provides a greater diversity of forbs and shrubs for feeding, and increased thermal and security cover (Fox et al. 2009).

**Prescribed Burn Treatments**

Prescribed burns are effective in reducing ground litter and returning nutrients to the soil (Goodrich et al. 2008, Fox et al. 2009) along with manipulating vegetative communities. The combination of exposing the ground to sunlight previously blocked by ground litter or taller vegetation, and infusing the surface soils with nutrients can stimulate dormant seeds to sprout and encourage sprouting from existing root systems beneath the surface (Goodrich et al. 2008, Fox et al. 2009, Thompson et al. 2013). Tender young sprouts, twigs, buds, and shoots provide important browse for mule deer and white-tailed deer (Halls 1984, Fox et al. 2009). Prescribed burns can increase forb production and a variety of forbs have been identified as very important forage species for deer (Schenck et al. 1972, Schneeweis et al. 1972). The use of prescribed burns can influence forest composition by burning back pine species and allowing aspens, oaks, mountain mahogany, grass, forb and other shrub species to revegetate an area providing forage and cover for deer and other wildlife species (Fox et al. 2009, Thompson et al. 2013). The timing of burns can affect vegetative condition differently and should be planned carefully to meet specific goals. The use of prescribed burns in early to mid-winter can maximize forb production, improve germination and suppress succession of woody browse at a stage that benefits deer. Late winter/early spring prescribed burns can improve the quality of warm season grasses and increase species composition. Late spring and early summer prescribe burns promote perennial grasses and can inflict the greatest level of mortality of woody brush if that is a desired result (NRCS 2008, Fox et al. 2009, Thompson et al. 2013, NRCS 2016).

Whether a land manager needs to seed an area modified by fire will depend on different factors. Desired natural seed may be readily available, either as dormant seed in the soil or available as unaffected plants in the immediate area, such that a sufficient seed base is present, therefore reseeding may not be necessary (Thompson et al. 2013). However, if the goal is to modify the existing vegetation community beyond what exists in the seed bank, then reseeding may be necessary. Replanting is generally recommended during the fall when seeds are naturally dispersed (Thompson et al. 2013); however some measures may need to be enacted during seed dormancy to reduce competition with weeds and minimize erosion (Fox et al 2009, Thompson et al. 2013). Prescribed burns can be a useful management tool for controlling the spread of eastern red cedar in areas where deer forage is determined to be a limiting factor, however, land managers should be careful to minimize impacts to thermal and security cover that is important for deer. Burning existing cover, woody or brushy draws or stands, may negatively impact deer by eliminating the only available cover in an area. Table 68 provides a summary of benefits that fire can provide to deer habitats.

Table 68. Some of the major benefits of fire on important habitat requirements for deer (Severson and Medina 1983, Richardson et al. 2001, Heffelfinger et al. 2006).

| | |
|---|---|
| Food | Creates a mosaic of different successional stages<br>Increases palatability of forage and nutrient value of plant species<br>Encourages early spring green-up and stimulates seed germination<br>Removes dense, decadent, over-mature growth<br>Stimulates crown or root sprouting |
| Cover | Produces temporary opening and creates edge<br>Modifies utilization patterns and provides control of young invading woody habitat<br>Improves fawning cover through promotion of seed germination and growth of perennial bunchgrasses<br>Creates or maintains appropriate cover levels |
| Water | Improves water yield<br>Improves water infiltration, retention and deep percolation<br>Spring recharging |

**Mechanical Treatments**

In the Black Hills, forest management practices such as logging and timber thinning can enhance deer habitat in pine forests. In prairie habitats, creating small openings (typically < 5 acres) in eastern cedar and Rocky Mountain juniper dominated wooded areas can enhance deer forage production. Vegetation treatments which provide suitable deer browsing and foraging habitats include maintenance and enhancement of meadows and forest openings. Pine encroachment into meadows is a constant event which requires mechanical or prescribed fire treatments. Furthermore, silviculture and vegetation treatments that move a large percentage of even-aged forest to a more diverse pine ecosystem are opportunities to enhance and create habitats for a variety of wildlife, including deer. Recently a significant emphasis has been placed on cutting and thinning pine trees on both public and private lands to reduce the wildfire threats and address mountain pine beetle (MPB, *Dendroctonus ponderosae)* infestations, resulting in what will likely be a general, long-term improvement to deer habitat.

**Summary of Habitat BMPs for Deer**

Both mule deer and white-tailed deer populations can benefit from improved habitat management and habitat development. BMPs established for deer can provide increased forage resources, thermal cover, hiding cover, fawning cover, and bedding cover. Improved habitat conditions resulting from implemented BMPs may increase deer survival, reproduction, and overall recruitment of deer populations in many areas of the state. Better habitat can equate to higher deer densities and subsequently more deer harvest and viewing opportunities for the public. Habitat management for deer relies on BMPs that focus on woody habitat development, food resource enhancement, grassland establishment, grazing management, prescribed burn treatments, and mechanical treatments. See Table 69 for a summary of South Dakota habitat BMPs for deer.

Table 69. Summary of habitat Best Management Practices for deer by each ecoregion (Black Hills, West River, and East River) of South Dakota.

| **Best Management Practices For Deer in South Dakota** | | | | |
|---|---|---|---|---|
| **Management Practice** | **Recommendation** | **Black Hills** | **West River** | **East River** |
| **Woody Habitat Development** | Plant shrub/tree seedlings in early spring (late March through April) directly into soil where vegetation has been killed during the previous growing season with 1-2 applications of herbicides or by mechanical site preparation. | | X | X |
| | Suppress weed growth around trees/shrubs with use of weed barrier fabric or herbicides. | | X | X |
| | Install protective tubes or other barriers to reduce damage from rodents, rabbits and deer. | | X | X |
| | Exclude livestock from newly established trees/shrubs. | | X | X |
| | Establish and maintain 8-16 row shelterbelts composed of trees and shrubs that are beneficial to deer. | | X | X |
| **Food Resource Enhancement** | Provide food plots of un-harvested corn, soybeans, winter rye, winter wheat, forage oats, clover, alfalfa, Austrian winter peas and forage brassicas. | | X | X |
| | Food plots should be >2 acres in size to provide food throughout the winter. | | X | X |
| | Establish food plots in close proximity to and preferably on the southeast side of 8-16 row shelterbelts or other winter cover such as large wetlands dominated by cattails. | | X | X |
| | Plant forb plots such as alfalfa and American vetch during late fall (November/December). | X | X | X |
| | Plant rangeland shrub plots (e.g., antelope bitterbrush, silver sagebrush, mountain mahogany and winterfat) in early spring | X | X | |

| | | | | |
|---|---|---|---|---|
| | (late March through April). | | | |
| | Patch clear cut (typically < 20 acres) in ponderosa pine dominated forests. | X | | |
| | Patch clear cut (typically < 5 acres) in eastern red cedar and Rocky Mountain juniper dominated landscapes. | | X | X |
| **Grassland Establishment** | Provide tracts of warm-season grasses (e.g., switchgrass, Indiangrass, big bluestem) >40 acres in size. | | X | X |
| | Control noxious weeds by spot treating infested areas in lieu of blanket spraying when possible to minimize loss of beneficial forbs. | | X | X |
| | Manage existing upland habitat by haying, grazing, prescribed fire, disking, inter-seeding of forbs and chemical application to encourage early successional habitat and discourage invasion of exotic grasses. | | X | X |
| | As necessary, use 2-3 years of farming as seedbed preparation for grassland restoration efforts of non-native grasslands. | | X | X |
| **Grazing Management** | Grazing intensity <40% total utilization. | X | X | X |
| | Conduct spring and early summer grazing to promote forbs and shrubs. | X | X | X |
| | Establish rest-rotation grazing systems. | X | X | X |
| | Riparian fencing to control timing of grazing or eliminate grazing in critical deer habitat areas. | X | X | X |
| | Conservatively control stocking rates to alleviate grazing on forbs and shrubs. | X | X | X |
| | Conduct early spring grazing to promote warm season grasses. | X | X | X |
| **Prescribed Burn Treatment** | Develop a burn plan which includes:<br>• Site description (topography, vegetation, and structures).<br>• Management objectives.<br>• Preparations (site, personnel and equipment).<br>• Desired prescription (weather conditions and timing).<br>• Execution (ignition, suppression measures, and smoke management).<br>• Notification procedures (regulatory agencies, local fire departments, law enforcement and adjoining landowners). | X | X | X |
| | Implement proper post-burn management activities (e.g., seeding, planting, fencing). | X | X | X |
| | Defer grazing typically two growing seasons post-burn. | X | X | X |

| | | | | |
|---|---|---|---|---|
| **Mechanical Treatments** | Commercial logging:<br>• Create a mosaic of uneven-aged stands which results in varying pine successional stages. | X | | |
| | Non-commercial timber thinning/patch clear cuts:<br>• Create small openings in pine forest (typically < 20 acres) and cedar/juniper forests (typically < 5 acres) to generate forage and edge contrast.<br>• Practice variable density thinning which provides stand diversity. Allow for heavier timber on north and east-facing slopes while lowering timber basal areas on south and west-facing slopes.<br>• Retain heavier pine densities next to roads and trails to create screening cover.<br>• Remove pine from hardwoods, meadows and riparian areas. Where needed, consider fencing, hinging of trees, or leaving slash to reduce impacts of browsing. | X | | |

## CHALLENGES AND OPPORTUNITIES

### Habitat Loss, Conversion, and Fragmentation

<u>Invasive species on USFS Lands</u>

The Black Hills and pine highlands in northwestern South Dakota were historically fire-maintained ecosystems which naturally kept an overabundance of conifers (pine and juniper spp.) out of meadows. Fires also reduced understory conifer reproduction, resulting in some open areas in otherwise dense forests. Vegetation treatments which provide suitable deer browsing and foraging habitats include maintenance and enhancement of meadows and forest openings. Pine encroachment into meadows is a constant event and without wildfire, mechanical treatments or prescribed fire are warranted.

The Black Hills National Forest Plan (USDA 2006) considers the soils that formed under grass or meadows to determine the extent of pine encroachment treatments. The Custer Gallatin National Forest Plan has several directives for conifer encroachment control methods depending upon potential conifer productivity of a site and type of rangeland, but the Forest Plan also recognizes that cover is the single largest limiting factor for deer in winter (USDA 1986b). A recent drop in market value of commercial pine saw timber, mountain pine beetle mortality, and reduction in commercial timber sales have reduced funds for non-commercial habitat improvements. While commercial removal continues, limited funding is available for non-commercial vegetation manipulation through mechanical and/or prescribed fire. The amount and spatial distribution of dense non-commercial pine is widespread across all USFS pine forests. This type of pine cover limits the distribution of early successional vegetation and woody understory. Vegetative treatments to open the forest floor to sunlight would encourage understory vegetation and provide forage and browse for white-tailed and mule deer.

Juniper and cedars, as well as other woody species, may invade some areas on USFS grasslands due to lack of fire. Conifer invasion can present interesting challenges. Trade-offs of conifer invasion along short and mixed-grass prairie habitats include an increase in abundance and wider distribution of thermal and screening cover for deer. However, conifers in dense patches can significantly reduce understory forage and browse. When deemed by USFS that there is need to suppress these conifer species, management alternatives for deer habitat include site-specific analysis of conifer abundance and distribution. Some areas of dense conifers should be retained in known deer ranges for thermal and security cover. Another management strategy includes enhancement and retention of native deciduous woody draws with a minor component of native conifers in some areas. There is currently no wide-spread USFS attempt to treat areas with fire or mechanical removal.

All USFS offices in South Dakota have invasive and noxious weed programs and collaborate with various private and public stakeholders to assess and control weeds. Control measures include chemical, prescribed fire, biological (insects), livestock grazing and hand weeding. Invasive weed control and reporting protocol varies by USFS office and is constantly changing as inventory methods improve and funding allows. Because of this variation, recent mapping and treating efforts is found on most USFS websites. For example, Black Hills National Forest reports that over 180,000 non-contiguous acres are weed infested (USDA 2015a). Some infested areas include persistent species that occur in large fire areas.

The imbalance of a preponderance of non-native grasses is profoundly evident in the northern Black Hills and on some USFS grasslands across the Northern Great Plains. Historical methods of soil stabilization and establishing hay meadows included seed mixes with smooth brome, timothy and crested wheatgrass. These non-natives grasses, including Kentucky bluegrass, are well established and have resulted in mono-cultures (few forbs and shrubs) which are not as biologically rich as native vegetation communities. Vegetation management such as prescribed fire, chemical application, and directed livestock grazing can be implemented in certain situations to keep non-native grasses from proliferating. USFS no longer seeds non-native, persistent grasses. Some seed mixes used after wildfires may have a non-native annual grass to stabilize soils but these species will not persist.

<u>Wild and Prescribed Fire</u>

Changes in deer habitats due to fire can be variable. When large acreages of pine stands are completely consumed or removed by severe fires (stand-replacement fires), big game winter cover (thermal, screening and security) in the form of vegetation is reduced or lost for decades. Severe fires can scorch soils, destroy available seeds and cause longer recovery for understory vegetation. With the loss of tree cover, the positive trade-off for big game is a flush of forage and browse.

All land management agencies in South Dakota generally suppress wildfire either directly or indirectly because of risk to infrastructure, other resource values, and adjacent lands. The Black Hills National Forest, Custer Gallatin National Forest, Fort Pierre National Grassland, Grand River National Grassland, and Buffalo Gap National Grassland have prescribed fire programs. Implementation of prescribed fire is sporadic due to funding, weather and vegetation conditions.

***Black Hills National Forest***

Over a century of fire suppression in the Black Hills has contributed to degradation of elk and deer habitats in the Black Hills (Thilenius 1972). Loss of fire as an integral ecosystem regulator is highly responsible for altered plant communities, especially an increase in distribution and density of ponderosa pine, significant decrease in lush understories and loss of meadows, shrubs and hardwoods; all components that provide for healthy, diverse ecosystems for wildlife including both deer species. Similar fire suppression practices in other western states have resulted in radical changes in pushing fire-prone ecosystems towards dense conifer cover (Slovkin et al. 2002).

Sieg (1997) recommends that implementation of prescribed fire to support wildlife habitat needs should take into consideration the timing of ignitions and known vegetation responses. Attempts to mimic historic fires (summer and fall) and realities of proximity to human habitation are rarely compatible. Spring and early summer fires could have a local, short-term detrimental impact to parturition and fawn rearing habitats. Wildfires are not common in the early growing season (except in extremely dry situations) but prescribed fires are common springtime management practices due to lower risks of escape.

Prescribed fires on USFS lands may not occur every year depending upon vegetation and weather conditions, funding and fire index, to name a few considerations. Acreage burned varies depending upon goals and objectives to meet Plan directives, to reduce fuel loads, proximity to human habitation and anticipated understory vegetation responses. Prescribed fire should not be planned during peak white-tailed deer or mule deer parturition dates which typically occur from late May to late June across South Dakota. Short-term negative impacts, such as loss of fawn cover may be considered minor compared to the long-term benefits of reduced fuel loads, rejuvenated vegetation and setting back invasive and undesirable vegetation.

Understory diversity and biomass are inversely related to pine canopy cover (Uresk and Severson 1989). This pre-fire vegetation relationship can, in part, influence the severity and intensity of fires. Fire impacts to soils can influence vegetation recovery. South-central Black Hills historically was subjected to an average fire interval of 16 years, up through early 1900s when European settlement began (Brown and Sieg 1996). The southern Black Hills had more frequent fires with a 10-12 year return interval (Brown and Sieg 1999). Within the South Dakota portion of Black Hills National Forest, approximately 131,000 non-contiguous acres have burned via wildfire since 1996 (USDA 2014a).

In the past 15 years, several wildfires within the Black Hills have demonstrated quite severe and intense fire behavior due to high fuel loads, dense pine canopy closure and loss of natural fire breaks such as forest openings, wet meadows and expansive hardwood (primary species include quaking aspen, birch and bur oak) stands. In 2000, the Jasper fire in the southern and central Black Hills burned a total of 83,510 acres (USDA 2001a). The Jasper fire impacted 39,959 acres of a geographic area that is managed by Black Hills National Forest for big game winter range. The remaining 38,546 acres burned an adjacent geographic area where big game occurs, but it is not specifically managed by the USFS for big game. Jasper fire was approximately 25% larger than any other recorded fire in the Black Hills and the effective burn area was expanded south in 2001 when an additional 11,896 acres burned in the Rogers Shack fire (USDA 2002). Within 2 years, 12.3% of big game winter range was converted to early successional vegetation due to near 100% pine mortality across large expanses. Small pockets of mature pine survived.

Fifteen years post-fire, the bulk of the burned areas remain in early successional vegetation (grasses, forbs and hardwood shrubs with some small diameter sapling pine regeneration or plantings by Black Hills National Forest). This change to a preponderance of early successional vegetation favors summer and winter foraging habitat for deer unevenly distributed across burned areas. The big trade-offs, in terms of deer habitat effectiveness, were that mature pine with interlocking crowns (snow interception) and denser winter cover were extremely reduced. Also, the heavily roaded Jasper fire area lost most screening cover in the form of trees along roads. Instead of a 100-foot or less sight distance, views were opened for miles (USDA 2004) which can make deer more vulnerable to human disturbances. Despite the loss of tree cover, topography will continue to be used by deer as cover.

***Custer Gallatin National Forest - Wild and Prescribed Fire***

The most recent fire on the Custer Gallatin National Forest in northwest South Dakota was the 2015 human-caused Moonshine Fire during an extremely dry April. Approximately 3,570 acres burned in the northern Slim Buttes. Burn severity was low to moderate across the entire fire and the effects to herbaceous and deciduous vegetation was minimal because most of the plant species were still in winter dormancy. Timely precipitation after the fire allowed for a quick green-up of grass and forb understory vegetation.

As stated above, existing forest conditions indicate a buildup of pine biomass and fuels. The East Short Pines have been rated as high hazard for wildfire activity. The Sioux Ranger District interprets the buildup of conifer species (pine and juniper) as an ecological imbalance. Custer Gallatin National Forest considers the outcome a loss of ecosystem resilience and diversity of flora and fauna (USDA 2014b). Most native woody draw vegetation responds well to fire because bur oak, green ash, chokecherry and aspen sprout following fire. Fire frequency return intervals in concert with precipitation help regulate vegetation successional stages. Short fire-return intervals favor grasses and forbs over woody species (Wright and Bailey 1982, Sieg 1997).

***Western South Dakota, Woody Draws and Grasslands***

Lightning-caused fires on the Northern Great Plains were historically common, along with other influences such as wild herbivores, and were necessary for natural vegetative processes. Fires generally occur April through September. July and August have the most lightning ignitions (Higgins

1984). Fire frequency, or return intervals, is between two and 30 years depending upon topography and geographic area (Wright and Bailey 1982).

From 1940-1981, there were 254 lightning-caused fires, averaging a fire frequency of six fires a year or one for every fire season month (April-September) in both Montana and South Dakota (Higgins 1984). Another interpretation of data from 1951-1991 indicated a fire frequency of 10 fires per year and most were lightning caused. Approximately 10% were >20 acres in size (USDA 1992). From 1985-2010, 246 fires < 300 acres were suppressed (USDA 2014b).

In July 2016, a lightning-cause fire burned portions of the Buffalo Gap National Grassland, Bureau of Land Management and mostly private rangeland near Edgemont, South Dakota. Approximately 14,133 acres burned but it is too soon to know specific vegetation responses. If sufficient late summer rains occurred, there may be fall greening of some forb and grass species for deer forage. Assuming normal snow and precipitation in the next year, the post-fire flush of vegetation, especially woody shrubs, will provide deer with ample foraging and browsing opportunities.

Insects on USFS Lands

The mountain pine beetle (MPB; *Dendroctonus ponderosae*) is an endemic insect and is important in naturally setting back pine structural stages because it creates holes or pockets of a few dead trees to several acres. In turn, dead trees provide habitat for cavity-dependent birds and mammals for approximately 5-10 years post-mortality. The majority of MPB-killed pine will snap below 25' and fall to the ground (Schmid et al. 2009), similar to the pattern after a wildfire. Beetle outbreaks have killed millions of trees in the Black Hills since the early 1900s (Blackman 1931, Thompson 1975). During the most recent epidemic beginning in the mid-1990s, considerable tree mortality has occurred. From 1996-2013 an estimated 414,000 acres, roughly a third of the Black Hills, incurred substantial tree mortality (Howell et al. 2014, Figure 65).

Openings in the forest canopy are created when dead pine needles are dropped and pine snags eventually fall. Sunlight is allowed to reach the forest floor and early successional plants capture the site until pine once again recolonizes the area. Responses to loss of pine by shade-intolerant quaking aspen (*Populus tremuloides*) and deciduous shrubs have been noted in some areas (Cogan et al. 2002). If aspen clones successfully reach the status of functional, multi-layered stands, habitat will exist for wildlife species such as ruffed grouse (*Bonasa umbellus*), songbirds, small mammals, mule deer, white-tailed deer, and elk. This constant but fluctuating rhythm of MPB outbreaks across the forest, along with other natural disturbances, perpetuates diverse habitats.

Black Hills National Forest has an active MPB response program (USDA 2012). The MPB Response Project was a site-specific project designed to address MPB and hazardous fuels across 250,000 acres more efficiently by reducing the need to conduct National Environmental Policy Act (NEPA) analysis on individual treatment areas. Pine thinning will reduce stand densities on 122,000 acres with goals to make stands more resilient to MPB attacks. Unfortunately, up to 50 miles of new USFS system roads will be open for use and authorized mostly within the Spearfish Canyon area, further fragmenting the forest and creating more motorized disturbances. Mitigation treatments may result in early successional habitat types which can improve forage production for deer.

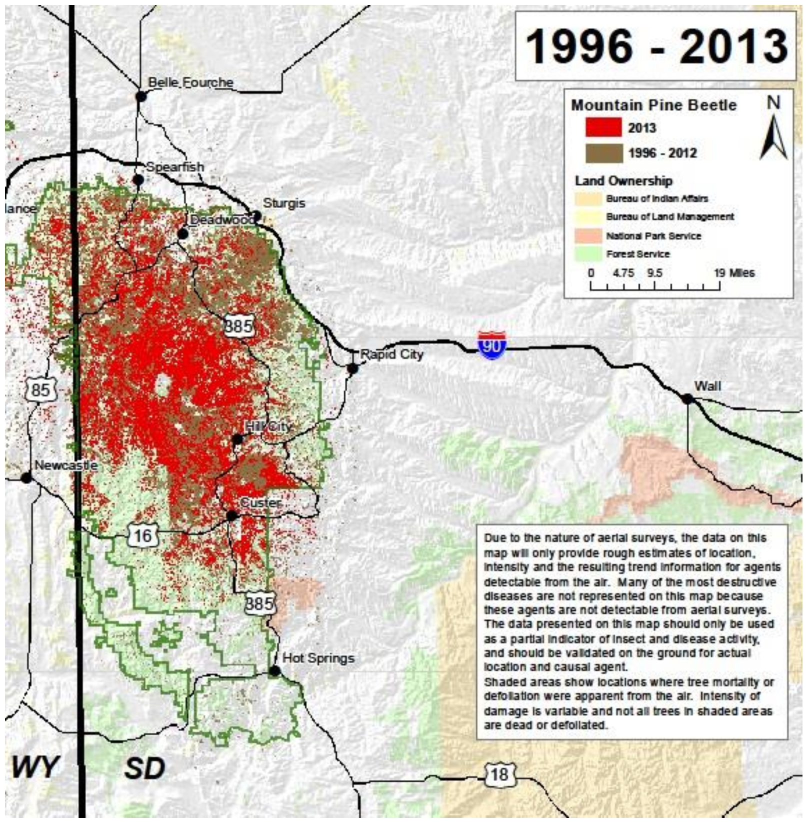



Figure 65. Mountain pine beetle activity on the Black Hills National Forest, 1996-2013. (http://www.fs.usda.gov/detail/r2/forest-grasslandhealth/?cid=stelprdb5447305).

As of early 2017, the MPB epidemic has ended (K. Allen and J. Ball, personal communication) but efforts to continue pine thinning and prescribed fire are necessary to avoid another buildup of biomass which contributes to forest-wide conditions for another MPB outbreak. Because MPB is endemic, small pockets and some areas of pine will periodically experience MPB mortality.

Mountain pine beetle are also a native insect to the pine highlands of the Custer Gallatin National Forest but their populations have not recently become exponential as they have in the Black Hills. Expansive MPB beetle outbreaks on the Custer Gallatin National Forest have been mostly confined to the southern portions of the Long Pines in Montana (USDA 1986b) adjacent to South Dakota. Large outbreaks within South Dakota have not occurred in recent times. Pine stands on all land ownerships have become dense, thick and could be prime habitat for MPB. Despite logistical challenges, Custer Gallatin National Forest continues to plan pine treatments to reduce tree densities, enhance stand structures and release meadows and hardwoods from pine encroachment in the East Short Pines (USDA 2016).

Another insect that has the potential to impact deer habitats at the landscape level is the emerald green-ash borer (*Agrilus planipennis*), which could put green ash tree communities in danger of complete mortality. As of 2015, this invasive insect has not yet been detected in South Dakota (J. Ball, personal communication). Green ash communities have habitat value for game and non-game animals and birds (Lesica and Marlow 2013).

<u>Herbivory</u>

Hardwood habitat types are some of the most diverse communities in terms of vegetation, invertebrates and associated fauna. The same reasons that allowed conifer invasion into uncommon open habitats have contributed to severe loss of hardwood habitat types in western South Dakota. Added impacts to hardwood woodlands occurred in the 1940s from exceeding over utilization of woody browse communities (Berner 1949) and historic unregulated livestock grazing on public lands. Hardwood stands that have remained on the landscape the past 130 years now receive disproportionate browse pressure, use, and trampling from wild and domestic ungulates.

These small pockets of remnant hardwoods attract browsing pressure due to the more desirable vegetation available. As grasses and forbs cure throughout the fall, livestock and elk diets include a greater percentage of woody browse. Deer are year-round browsers. Therefore, late fall through early spring is a critical time to intensively manage large animals and their access to woody draws. Winter browsing by livestock and elk can create competition for deer and put additional pressure on woody species.

Bur oak (*Quercus macrocarpa*) is uncommon in the Black Hills (Sieg and Wright 1996). It is generally found in lower elevational foothills and drainage bottoms which may or may not be associated with a stream (Marriott and Faber-Langendoen 2000). It is difficult to germinate and is slow-growing into its tree form. Conifer removal is beneficial in bur oak stands because increased sunlight will increase growth rates of bur oak. Bur oak sprouts from burned mature trees and variably responds from prescribed fire (Sieg and Wright 1996). Mature trees which produce mast should be retained and made a retention priority in all management treatments because the mast is consumed by many wildlife species, including deer. Black Hills National Forest has an objective to manage 30-50% of each bur oak stand for 100-year old and older trees.

Custer Gallatin National Forest experienced a similar decline in hardwoods as in the Black Hills. The forest plan has management direction for woody draws such as conifer removal (USDA 1986a). Acreage and location of these woodland types had not been identified in 1986 but were to be mapped and evaluated during range allotment management plans or other project evaluations.

Green ash (*Fraxinus pennsylvanica*) woodlands were noted to be in significant decline back in 1978 (Boldt et al. 1978). Green ash is particularly important in grassland woody draws and riparian areas (Uresk and Boldt 1986, Lesica and Marlow 2013, Uresk et. al In Press). Successful hardwood stimulation and retention on the National Grasslands is possible; however, hardwood regeneration is very slow in the drier National Grasslands compared to higher elevations and requires a commitment toward long-term monitoring and protection. Fire, livestock grazing and deer browsing can stimulate certain woody shrubs and trees, but only with intense management to keep animals from over-utilizing browse. As grasses and flowering plants dry and cure in late fall and winter, livestock and deer heavily browse woody vegetation. Repeated nipping of terminal branches can set back woody species and inhibit growth up and out of the reach of most browsers. "Knowledge of seasonal shrub use by livestock through dietary analyses will enable managers to adjust stocking rates of livestock at critical time periods to maintain or increase shrub stands in woodlands on the northern Great Plains" (Uresk and Boldt 1986).

<u>Habitat Change, Agricultural Conversion, and Human Impacts</u>

Basic habitat components for any wildlife species include food, water, and cover. Further, the physical association of how these habitat components are interspersed across the landscape is an even more important aspect of wildlife habitat. South Dakota's diverse agricultural landscape – from intensive row crop production in the east to vast open rangelands in the west – generally provides the core habitat components necessary to produce and sustain a healthy deer population. And while agricultural land use certainly affects the annual quantity and quality of deer habitat available, the influence of non-habitat impacts (e.g., disease, predation, hunter harvest) on annual deer reproduction and survival cannot be dismissed.

Land use changes across South Dakota's diverse landscape have no doubt affected habitat conditions for deer as well as numerous other wildlife species. According to a recent study (Reitsma et al. 2015) over 1.8 million acres of grassland in South Dakota were lost primarily to cropland conversion between 2006 and 2012. Unfortunately grassland loss continues to occur at very concerning rates to both wildlife managers and producers involved in grass-based agriculture. Equally unfortunate is the apparent lack of available long term data regarding the status and trends of other habitat types important to deer, particularly native woodlands and shrub lands across South Dakota.

Wildlife habitat across South Dakota has been and will continue to be profoundly impacted by federal agricultural programs and policies. No other collective body of legislative rubric impacts wildlife habitat quantity and quality across South Dakota or the nation quite as significantly as the conservation and commodity titles of the federal farm bill. The mass of federal law, rule, and regulation known as the farm bill provides a host of conservation programs and billions in funding to address both environmental issues and agricultural commodity production on private lands. Arguably the most successful and impactful conservation program ever created by the farm bill is Conservation Reserve Program (CRP). Originally enacted to address excess commodity production, CRP objectives have shifted to address soil erosion concerns, water quality issues, and of course wildlife habitat. Like many wildlife species across South Dakota, deer populations responded significantly to the presence of large undisturbed habitat blocks created across much of the landscape.

CRP enrollments grew rapidly in the late 1980s and remained relatively stable until the mid-2000s when CRP contracts providing large acreages of habitat began to expire and be reverted back to crop production. Current and future expiring CRP acreages are a significant concern to wildlife managers, as indications point to many of these acres likely being reverted back to crop production, despite many producers and landowners acknowledging the value of CRP to wildlife.

The diversity and expanse of deer habitat types across South Dakota presents myriad challenges to wildlife managers, both in attempting to implement habitat conservation and development programs aimed specifically to benefit deer, but also in efforts to adequately inventory habitats and monitor habitat condition and change. Contributing to these challenges is the fact most land in South Dakota is privately owned (80%), so implementing meaningful wildlife habitat monitoring efforts, habitat conservation programs, and habitat cost-share initiatives is ultimately at the discretion of the private landowners and how they value wildlife and wildlife habitats on their lands. If deer habitats across South Dakota are to be conserved, developed, and managed on private lands, it's imperative SDGFP cooperate with private landowners to identify their wants, needs, and desires to making deer and deer habitats a component of their agricultural operations. And despite all well-intentioned efforts to develop and improve habitat to sustain deer populations at the individual farm- or ranch-level, truly only landscape scale habitat improvements, and any long-term and comprehensive cumulative result of individual farm- or ranch-level conservation efforts, will ultimately result in long-term sustainability of deer populations across South Dakota. Furthermore, past wildlife habitat conservation, development, and management efforts directed at private lands - while traditionally conducted to benefit game species such as pheasants - have no doubt benefited numerous non-game species.

As a whole, South Dakotans desire to see all wildlife populations managed at sustainable levels. With game species such as deer, a sustainable level is one that supports both recreational harvest opportunities while also maintaining the population within a range of acceptable social tolerances. Finding this proper balance of a sustainable deer population can be made extremely difficult given the human impact on habitat availability and condition. Direct human impacts to deer habitat in South Dakota include but are by no means limited to agricultural conversion and development; urban encroachment and development; and transportation infrastructure development. Further, specific habitat types and plant communities important to deer throughout the year can be impacted by human-led management practices including fire suppression, livestock grazing, woody cover removal, and activities that encourage non-native and invasive plant species.

It's important to consider, however, not all human-led management practices resulting in habitat change are necessarily detrimental. In particular, traditional agricultural practices (e.g., row cropping, alfalfa production) can provide important seasonal habitats for deer in some situations as well as improve overall habitat conditions for deer. Furthermore, many wildlife habitat management practices applied by agricultural producers and public land managers require specific manipulation of existing conditions. Careful attention must then be paid to determining what spatial and temporal scale these manipulations must take place at to sufficiently achieve management objectives, while also giving full consideration to the impacts of those practices on other trust fish and wildlife species.

It's without debate the well-being of deer populations in South Dakota, both now and in the future, depends on the quantity and quality of available habitats. Thus habitat needs for deer must be given due consideration and be incorporated into land management plans on both public and private lands.

**Depredation**

SDGFP understands that cooperative partnerships with private landowners are an essential component to deer management and that private lands serve an important role regarding deer management in South Dakota. With about 80% of the state being held in private ownership, SDGFP relies heavily on private land for wildlife production and hunting access. Longmire (2017a) reported that 60% of responding landowners who were surveyed indicated that they experienced deer damage within the past five years. Effectively addressing deer depredation is a tremendous challenge for SDGFP and fluctuates annually because of weather events (e.g., severe winters and deep snow), deer population levels, and changes that occur to deer habitat (e.g., habitat loss, human encroachment, and agricultural development). Deer can impact private lands in many ways, and because of these impacts, SDGFP cooperatively works with many private landowners each year to resolve wildlife damage concerns. Private landowners with high intensities of wildlife damage experience a lack of tolerance for the species responsible for the damage (Conover 1998). Wildlife damage management operates at the cross-roads of science and politics as well as economics and social tolerances. SDGFP understands the important role that private landowners play regarding deer management in South Dakota and values these partnerships. These partnerships are the reason that SDGFP operates such a comprehensive deer damage abatement program which addresses impacts to private property in most situations.

Gigliotti (2006) stated that 64% of landowners that received SDGFP's deer depredation abatement program services were satisfied with the assistance. While 64% of landowners being satisfied with the SDGFP services is acceptable, SDGFP would like to see a higher level of satisfaction. To successfully manage for higher population levels of deer, SDGFP will need to continue to offer its deer depredation abatement programs to address private landowners' concerns regarding all types of deer depredation. While higher deer populations across South Dakota will certainly offer more recreational opportunity for hunters, there will be increased costs to address conflicts due to deer depredation to private lands. Because social tolerance is an important element in deer management and because deer hunting is held in such high regard with South Dakota sportsmen and women, SDGFP believes that offering assistance with deer depredation programs is a valuable use of funding. These monies allow SDGFP the ability to cooperatively work with landowners that experience deer depredation and address social tolerance concerns in many cases.

Primary management techniques includes cost share assistance with stackyards and protective fencing but also include direct assistance with hazing deer away from problem areas and other damage concerns. Longmire (2017a) reported that the highest area of concern from landowners regarding deer damage was damage to growing crops. Deer damage to growing crops is a substantial concern from landowners and SDGFP needs to evaluate its current programs to determine if program adjustments are possible to better meet the demand from producers regarding this topic. While this issue is challenging to address because of the vast areas of South Dakota that are involved in agriculture and the abundant deer populations, perhaps there are adjustments or new program components that can be integrated into SDGFP's deer damage abatement program that can better assist landowners with deer damage to growing crops. Since 2000, SDGFP has spent over $7 million dollars cooperatively working with landowners to address deer damage, primarily to protect stored-feed supplies intended for livestock from deer (Fisk 2016). If SDGFP was to launch a new program component that addressed damage to growing crops, tens-of-millions of dollars would be needed on an annual basis due to the number of agricultural producers and the amount of acres planted in South Dakota. In 1996, Wywialowski (1996) found that deer and other wildlife species caused damage to corn and estimated that value at more than $2.5 million in South Dakota. The landscape and deer populations have greatly changed in the past 20 years and attempting to address deer damage on growing crops is a daunting challenge.

Another concern from South Dakota's landowners has been deer damage to growing trees in shelterbelts. Many times, people plant trees to protect buildings or livestock from wind or they plant trees specifically for wildlife. SDGFP's habitat programs even provides funding to landowners to establish trees as a form of wildlife habitat, yet has no programs to protect those trees from deer browsing or damage from bucks rubbing trees. SDGFP will need to continually research new and innovative solutions that could possibly reduce deer depredation to private lands and the many complex issues that accompany these challenges.

Due to the complexity of many depredation situations, SDGFP continues to research and evaluate new and innovative ideas and solutions to address these conflicts. Most recently, SDGFP has worked with South Dakota State University to determine if white-tailed deer preferentially feed on different corn hybrids during the growing season. The determination of how deer selectively feed on growing corn could assist SDGFP with implementing food plots that are more desirable to deer on nearby GPA's to help alleviate deer damage to private cornfields in some areas where historical concentrations occur (Delger 2009). Schmitz (2000) evaluated the potential development of lure forages for use in an attempt to decrease winter deer depredation in South Dakota. Local deer densities and access to other habitat and food sources make the utilization of these techniques difficult to successfully implement in many areas. As human-wildlife conflicts continue into the future, SDGFP will continue to evaluate innovative strategies to potentially reduce these conflicts.

SDGFP is continually challenged to find the balancing-point between recreational opportunity and impacts to private lands from deer. Although SDGFP's deer depredation abatement program and services is a multi-faceted program that is designed to prevent and/or reduce most types of damage caused by deer, several types of deer damage (e.g., damage to growing crops and damage to large-scale tree plantings) are very challenging to develop effective abatement techniques for. While many of the more traditional forms of damage can be effectively dealt with, these other types of damage are a social consideration that must be realized. While many of SDGFP's damage abatement techniques have proven successful over the last 20 years, deer depredation and the associated conflicts will continue to challenge SDGFP. These matters are complex and not only involve the management of deer but include socio-economic and political dynamics as well. SDGFP acknowledges that its programs will not be able to completely resolve all issues regarding deer depredation; however, SDGFP has a proven history of working with private landowners and is committed to cooperatively working with private landowners to implement reasonable solutions to address most concerns.

**Social Tolerance**

Research into the acceptance of wildlife indicates both objective and subjective factors shape beliefs about wildlife populations (Decker and Purdy 1988, Zinn et al. 2000). In addition to objectively measured population levels, risks, and benefits, factors such as value orientations, and perceptions of population levels, risks, and benefits have been found to be important in determining stakeholder acceptance capacity for wildlife (Zinn et al. 2000). Understanding attitudes is important since they can influence and predict behavior, and the more specific the attitude is toward a certain behavior (i.e., same target, context, action, and time) the stronger the relation between attitude and behavior (Ajzen and Fishbein 1980, Fishbein and Manfredo 2002, Vaske 2008).

In 2012, a statewide survey of South Dakota residents' wildlife and environmental attitudes reported most residents (77%) believed it was very important that South Dakota conserves as much fish and wildlife as possible where appropriate. In addition, most residents (77%) believed healthy wildlife populations are very important to the economy and well-being of South Dakota residents (Gigliotti 2012). As part of developing this deer management plan, and as a first step in identifying the interests and needs of South Dakota landowners and hunters, SDGFP conducted comprehensive opinion surveys in the winter of 2016 (Longmire 2017a). Forty percent of South Dakota landowners rated the number of white-tailed deer on their property over the past 5 years (2010 to 2015) as being just about right. Just over one-third (35%) rated the number seen as too many and 23% thought the number of white-tailed deer on their property was too few (Longmire 2017a). Slightly more than one-third of West River and Black Hills landowners (36%) rated the number of mule deer seen on their property from 2010 to 2015 as just about right. Thirty-seven percent rated the number seen on their property as too few and 13% said there were too many mule deer on their property. Only 14% of West River and Black Hills landowners indicated there were no mule deer on their property compared with 75% of East River landowners (Longmire 2017a).

South Dakota landowners agreed with statements regarding perceived benefits of deer in South Dakota. Nearly three-quarters of landowners (72%) agreed that having a healthy, self-sustaining population of deer in South Dakota is important to them. Black Hills landowners were more likely than East River or West River landowners to strongly agree with this statement (42% compared to 31%). Fifty percent of landowners agreed that the presence of deer near their home increased their quality of life. The majority of landowners agreed deer benefit local economies through hunting and wildlife viewing opportunities. West River landowners (63%) and Black Hills landowners (65%) were more likely to agree with this than East River landowners (54%). South Dakota landowners also expressed concern about the potential risks of deer in South Dakota. The majority of landowners (74%) indicated they worried about deer-vehicle collisions. Fifty-four percent of landowners agreed that deer threaten people's livelihoods by damaging private feed supplies and agricultural crops. Additionally, 44 percent indicated they worried about diseases in deer that may be transmitted to livestock (Longmire 2017a).

The length and date of deer seasons may impact landowners' tolerance for deer hunting. In 2016, South Dakota landowners were also asked their opinions regarding length and dates of South Dakota deer seasons (Table 70; Longmire 2017a). The majority of landowners (53%) thought the East River deer season length was just about right, and 24% indicated they had no opinion. West River and Black Hills landowners were much more likely than East River landowners to have no opinion about the East River deer season length. Forty-one percent of landowners thought the length of the West River deer season was just about right, and 41% indicated they had no opinion about it. East River landowners were more likely than West River or Black Hills landowners to have no opinion about the length of the West River deer season. Forty-four percent of landowners believed the Archery Deer season length was just about right, while just over one-third (35%) indicated they had no opinion about it. Just over one-third (34%) of landowners thought the Black Hills deer season length was just about right, while the majority of landowners (58%) indicated they had no opinion. East River and West River landowners were much more likely than Black Hills landowners to indicate they had no opinion about the Black Hills deer season length. Over one-third (36%) of landowners thought the length of the Muzzleloader Deer season was just about right and nearly one-half (49%) indicated they had no opinion. The majority of landowners indicated the dates for the East River (60%) and West River (50%) deer seasons were just about right. Over one-quarter (28%) of landowners had no opinion about the East River season dates, and 45% of landowners had no opinion about the West River deer season dates. The majority of landowners (61%) indicated they had no opinion about the Black Hills deer season dates, while 37 percent felt they were just about right. Similar to the trends seen in season lengths, landowners who live outside the region where the deer season is located are more likely than those who live within the applicable region to indicate no opinion in the season dates. Nearly half (47%) of landowners felt the dates for Archery Deer season were just about right 43% indicated they had no opinion. Finally, the majority (55%) of landowners had no opinion regarding the season dates for Muzzleloader Deer season, and 36% felt the dates were just about right.

Deer are a highly valued wildlife species in North America from both wildlife viewing and hunting perspectives. Understanding how stakeholder groups perceive wildlife and deer specifically in South Dakota is an important step in developing and implementing a deer management plan responsive to public values.

Table 70. Landowner opinions on deer seasons length and dates, 2015.

| Deer Season | Season Lengths | | | | Season Dates | | | |
|---|---|---|---|---|---|---|---|---|
| | Too Short | Just About Right | Too Long | No Opinion | Too Early | Just About Right | Too Late | No Opinion |
| East River | 11.8% | 53.3% | 11.1% | 23.8% | 1.9% | 59.6% | 10.5% | 27.9% |
| West River | 15.4% | 40.6% | 2.7% | 41.3% | 2.1% | 50.1% | 2.7% | 45.1% |
| Archery | 5.0% | 44.4% | 15.2% | 35.4% | 6.5% | 46.7% | 3.3% | 43.4% |
| Muzzleloader | 5.1% | 35.5% | 10.8% | 48.6% | 1.1% | 36.2% | 7.5% | 55.1% |
| Black Hills | 4.3% | 34.4% | 2.9% | 58.4% | 0.6% | 37.2% | 1.0% | 61.1% |

**Deer Management Assistance to Private Landowners**

SDGFP currently offers assistance to private landowners to improve habitat through the private lands program, and examples of assistance include conservation and management of wetlands, grasslands, woody habitats, and food plots. In addition, SDGFP works with NGOs to provide assistance to landowners for signup under federal programs such as CRP and WRP (see *Private Lands Habitat* section). SDGFP also provides assistance to landowners to manage deer populations through hunting and depredation. In many areas of the state, qualifying landowners are allowed up to two free antlerless deer permits, and all landowners are entitled to reduced price deer licenses valid on their own land. When deer depredation occurs, qualifying landowners may receive services such as stackyard and other fencing, food plots, depredation hunts, or kill permits (see *Depredation Management* section).

Most state wildlife management agencies provide deer management assistance directly to private landowners and other entities. Assistance can be in the form of habitat management or herd management, and the levels can vary substantially. Several states provide this assistance packaged in one all-encompassing program called a Deer Management Assistance Program (DMAP).

While most states' DMAPs focus on providing site-specific management for landowners in the form of antlerless deer permits, either due to damages from high deer densities to agricultural or forest properties, some state programs go beyond this concept. The Wisconsin Department of Natural Resources (WDNR) has a recent and well-developed Deer Management Assistance Program as an example to review (http://dnr.wi.gov/topic/wildlifehabitat/dmap.html). The goals of the WDNR DMAP are to 1) promote sound land stewardship practices, 2) provide outreach and educational information to landowners about wildlife habitat management practices, 3) provide a means for site-specific deer management, and 4) improve relations. The DMAP has 3 enrollment levels. Level 1 has no minimum acreage requirements and no annual fee. Level 2 is for landowners with 160-640 acres and has a $75/3 year fee. Level 3 is for landowners with >640 acres and has a $150/3 year fee. Benefits vary by program level, but some include assistance from local biologists, DMAP reports/workshops, recommendations on forming cooperatives, on-site visits, property management plans, harvest reports, reduced price antlerless licenses, habitat assessments, deer population monitoring, and assistance with grant opportunities.

The WDNR DMAP program was developed in accordance with key recommendations of an external review of WDNR deer management (Deer Trustee's Report; http://dnr.wi.gov/topic/wildlifehabitat/trustee.html) to improve communications and thereby increase trust and credibility with landowners and deer hunters. SDGFP underwent a similar external review of its big game program in 2013, however, no such recommendations came from this review. Nonetheless, it's important to consider whether or not this type of program could improve deer management in South Dakota and if it is a high enough priority to warrant funding.

**Hunter Access**

One challenge is to provide enough public hunting access to fill the need to retain existing deer hunters and recruit new deer hunters. Fortunately, the SDGFP has the ability to purchase land as Game Production Areas as well as lease private land through the Walk-In Area and Controlled Hunting Access Program for public hunting access. The downside of providing more public hunting opportunity is that hunters become less willing to develop landowner relationships in order to secure hunting access to private lands. Providing public hunting access opportunities near population centers continues to be a challenge as an increasing amount of the hunting population lives in town. The most populated areas of the state are the same areas that have the least amount of public hunting opportunity. It is a challenge to both purchase and lease land for hunting access in these parts of the state due to high land values, concern about safety, and smaller land ownership tract sizes.

The commercialization of hunting creates competition with SDGFP to lease private land for hunting access. Every year existing SDGFP hunting access program cooperators consider leasing their land to a private individual or commercial hunting outfit for more money than what the SDGFP pays. In some areas of the state, SDGFP has lost many Walk-In cooperators to commercial or private leases.

Providing public access to existing landlocked public lands (those public lands without public access) has long been an opportunity and a challenge. In 2016, there were 200,550 acres of publicly inaccessible land owned by SDSPL and another 98,460 acres of publicly inaccessible land owned by the BLM (Figure 66). These lands are only publicly accessible by traveling down unmarked section lines, which depending on the terrain and distance from a public road can be challenging to do without trespassing on private land. The WIA program provides access to 74,681 acres of publicly owned lands that would otherwise be inaccessible, but there has not been a dedicated effort to work with adjacent landowners to secure public access to existing land locked public lands (Table 71).

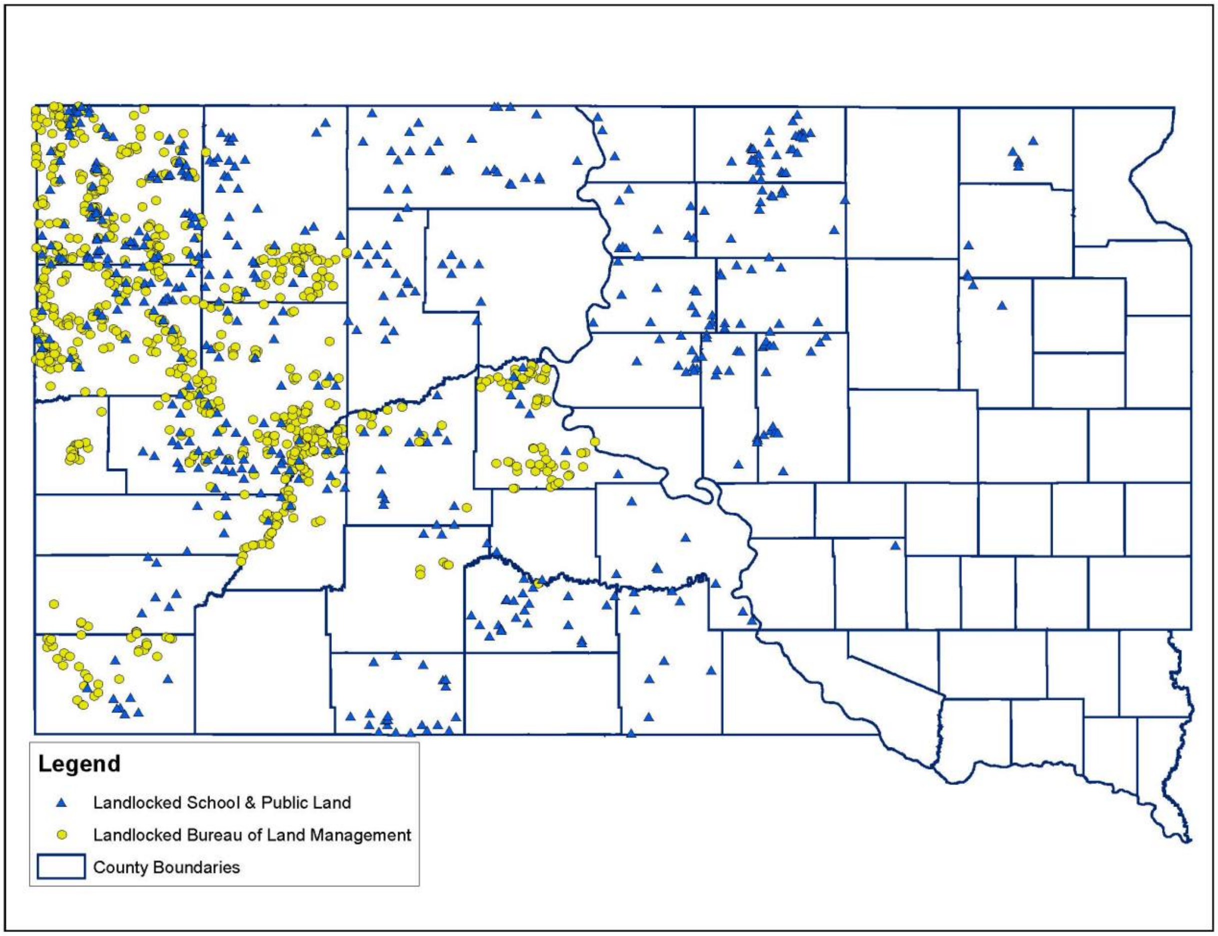



Figure 66. Inaccessible parcels of public land in South Dakota owned by the Bureau of Land Management (BLM) and the State of South Dakota's Office of School and Public Land (SDSPL).

SDGFP's ability to enhance hunter access through land acquisition is a valuable tool that is challenging to use. The political support for SDGFP to purchase more land as Game Production Areas varies based on many factors. The location of a property, the size of the property, who is selling the property, who the neighbors are of the property, and the wishes of the Governor all play a role in if there is political support for a land acquisition by SDGFP. For example, in 2010, the Governor placed a 2.5 year moratorium on SDGFP from buying land. During this moratorium land acquisition was only utilized on a small scale to round out some existing pieces of public land with money raised in memory of Tony Dean.

Table 71. Landlocked public land acres in South Dakota, 2016.

| | |
|---|---|
| **Acres of public Land that Walk-In Areas provide access to** | |
| SPL | 36,728 |
| BLM | 37,953 |
| **Acres of Landlocked Public Land (No Road, WIA, or Other Accessible Public Land Adjacent)** | |
| SPL | 200,550 |
| BLM | 98,460 |
| **Acres of Landlocked Public Land ≤ 0.25 Miles from a Road** | |
| SPL | 28,232 |
| BLM | 8,546 |
| **Acres of Landlocked Public Landlocked ≤ 0.50 Miles from a Road** | |
| SPL | 56,709 |
| BLM | 19,150 |
| **Acres of Landlocked Public Land ≤ 1.0 Miles from a Road** | |
| SPL | 107,994 |
| BLM | 35,275 |
| **Acres of Landlocked Public Land > 1mile from a Road** | |
| SPL | 92,556 |
| BLM | 63,185 |

**Commercial Deer Hunting**

Commercial deer hunting occurs throughout the state, but is most prevalent in western South Dakota (West River). This is primarily due to nonresidents receiving an 8% allocation of deer licenses for each the West River and Black Hills firearm seasons. There are also 500 resident and 500 nonresident Special Buck licenses available during the West River deer season that are valid only on private property. Nonresidents do not receive an allocation in the East River rifle hunting season. In addition, western South Dakota better lends itself to commercial deer hunting because there are much larger tracts of land to hunt and also because mule deer are present, therefore providing more and additional species opportunities than the eastern side of the state.

The amount of commercial deer hunting activity seems to be on the increase. There may be many factors driving increased popularity including: the real or perceived notion that access to hunting land has decreased over time, expectations and promotion provided by the greater hunting industry (i.e., hunting product companies and hunting television shows), the supposition that hunters today seem to have less time to scout and develop relationships with landowners, more hunters willing to pay for access, fewer farmers and ranchers due to larger business operations, and the realization by landowners that it can provide an additional source of income. Increases in commercial hunting opportunities may be due to an expanding disconnect between hunters and landowners. Additionally, along with increased interest in archery hunting in general, archery licenses are unlimited for residents and nonresidents alike, and the use of outfitters for archery hunting has been receiving more interest by those willing to pay for access to hunt deer throughout South Dakota in recent years. This has also allowed for commercial interests to become more established in eastern South Dakota, as the archery season is the only guaranteed season to ensure nonresidents licenses in this part of the state.

Guiding and outfitting deer hunters is big business throughout North America, and many landowners and business-minded individuals have explored this opportunity here in South Dakota as well, primarily as a means to supplement farm and ranch income. According to a recent survey of landowners in South Dakota, it was reported that just under 4% receive payment for private hunting access (Longmire 2017a). However, it was reported that over 10% of West River landowners receive payment for deer hunting access while less than 2% of eastern South Dakota landowners do (Longmire 2017a). A quick internet search will show that rates charged by outfitters for deer hunting access in South Dakota can range from roughly $2,000 for an archery white-tailed deer hunt to over $6,000 for a rifle mule deer hunt. Pay-hunters do have higher expectations of success than the average hunter, and are often times seeking additional amenities as part of their hunt package including lodging and food service.

Commercialized hunting typically puts greater emphasis on the presence and harvest of mature bucks with substantially less harvest occurring on populations of younger bucks and does. With less harvest on this segment of the deer population, those landowners associated with commercial hunting operations often times see deer overpopulate their private properties and even adjacent non-commercial properties, leading to damage to growing crops and stored feed and hay supplies. Often times these landowners request assistance from GFP to deal with these problems; however, because commercial operations receive financial compensation for wildlife on their property, it has been the policy of SDGFP to not provide depredation services to those landowners. Specifically, depredation program guidelines state that "*Wildlife Damage Management contracts with… commercial and fee hunting areas…are not allowed under current policy.*" Additionally, where the Department does provide depredation services, landowners agree to provide free, reasonable access to non-family members who obtain proper permission.

Currently, the commercial deer outfitting industry in South Dakota is not specifically regulated by SDGFP and licenses for guides and outfitters are not required. Of those states surrounding South Dakota, a guide or outfitter license is required for persons who outfit and/or guide for deer hunting in North Dakota, Nebraska, Wyoming, and Montana, while this is not currently a requirement in Minnesota or Iowa.

There are a range of factors that state wildlife agencies must consider in deciding whether or not to license or more closely regulate commercial guides and outfitters. While there are currently no license requirements for guides and outfitters, SDGFP continues to review the necessity for additional statutes and regulations, taking into account that enactment of enabling legislation would be required for the Department to create a guide and outfitter license. With the passage of such legislation, it is likely there would be a need for additional administrative rules that would establish licensing criteria, application procedures, compliance requirements, penalties for non-compliance, a procedure for license suspension or revocation, possible bonding and liability requirements, and consideration by SDGFP as to the workloads involved for staffs administration and oversight of such a program. The implementation of a guide and outfitter license would undoubtedly require support from those in the guiding and outfitting industry as well as landowners and sportsmen.

At present, South Dakota state law listed below prohibits outfitters to guide hunters on state-owned or managed lands where hunting is allowed. A hunting guide, under this statute, is defined as a person who holds himself or herself out to the public as a hunting guide (for compensation or remuneration) and directs or provides services to any person for the purpose of hunting any wild animals.

> ***SDCL § 41-4-13. Hunting guide activities barred from certain state-owned or state-managed areas--Violations.*** *No person, acting as a hunting guide as defined in § 41-4-12, may guide any hunting activity on state-owned or managed game production areas, state parks, recreation areas, and lakeside use areas, federal land leased or under agreement to the state which is posted as a game production area and managed for wildlife purposes, or private land leased or under agreement to the department for the purpose of providing public access, or on highways or other public rights-of-way within this state that otherwise meet the requirements of § 41-9-1.3, except that a hunting guide or employees of a hunting guide may guide a hunting activity on the road right-of-way immediately adjacent to property owned or leased by the hunting guide. A violation of this section is a Class 1 misdemeanor.*

Other lands in South Dakota where public hunting is allowed include South Dakota School and Public lands (SPL), and lands administered by the USFS, the US Army Corps of Engineers, the BLM, and the US Bureau of Reclamation. According to the terms and conditions on SPL grazing leases, it states that the Lessee shall not receive any monetary or other payments for or from anyone to hunt on these lands. However, it is legal for outfitters to guide on certain federal lands within South Dakota provided the proper permits are obtained from those respective land management agencies. On USFS lands (National Forests and National Grasslands) commercial outfitting services need to obtain the appropriate permit. Outfitters must pay the required fees (ranges from $150-$600 based on number of service days per year), submit operating plans and provide proof of insurance, among other requirements. They also receive an annual performance evaluation and rating by those regulating agencies. In 2016, 13 outfitting businesses were permitted to guide deer hunters in the Black Hills National Forest and one outfitting business was permitted to guide deer hunters on the Custer Gallatin National Forest in Harding County. Additionally, on BLM administered lands all commercial guides and outfitters must maintain a current Special Recreation Permit with the BLM to conduct business on public lands, and knowingly operating on these lands without a Special Recreation Permit is a Class A misdemeanor.

The popularity of West River Special Buck licenses has increased since inception (Figure 67), as has the demand of those who manage commercial deer hunting operations on private lands in the state. Although the number of applicants is greater than the allocation, unsuccessful Special Buck applicants are able to apply for regular West River and East River firearm seasons. In addition, those unsuccessful applicants have the ability to purchase a preference point for a both the Special Buck and regular firearm seasons.

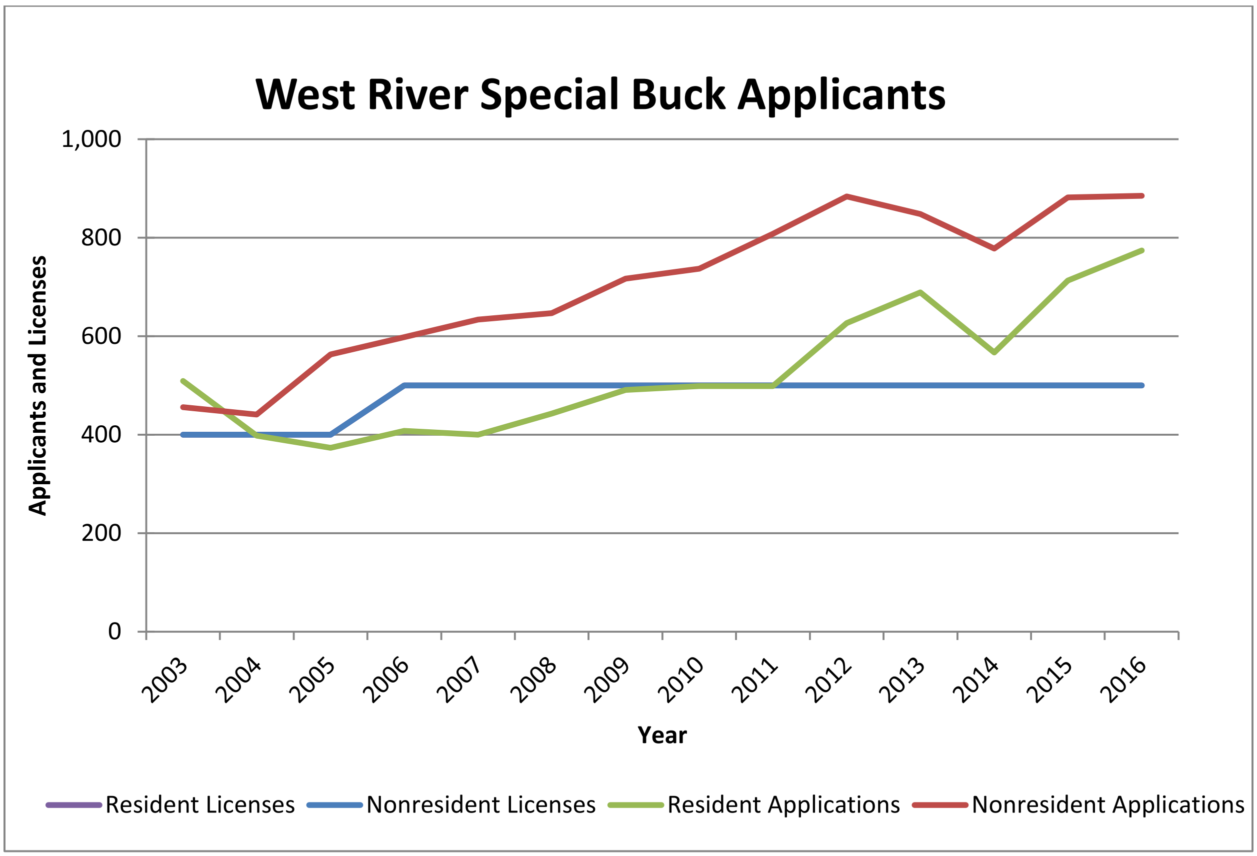



Figure 67. The number of West River Special Buck applicants and licenses available, 2003-2016. The current number of resident and non-resident licenses available are identical, totaling 1,000 Special Buck licenses during this season.

SDGFP is responsible for the management of wildlife resources that are held in public trust for all citizens, thus there are continual challenges to managing publicly owned wildlife and privately-owned lands. If there is a substantial increase in the commercialization of hunting opportunities in South Dakota, the net result could be a significant reduction in hunting opportunities for those unable or unwilling to pay for access on private land. A reduction in the availability of access to private land also increases hunter densities on the limited public lands that are available to hunters.

When deer hunting is commercialized, hunting is no longer simply a recreational activity, it becomes a business transaction and guides and outfitters may take on additional liability while hosting paid hunters. The current state laws pertaining to hunting and landowner liability are outlined in SDCL § 20-9-12 through 20-9-18 (see § 20-9-12 and § 20-9-13 below) and provide that once a landowner elects to charge an access fee to private lands for the purposes of hunting, he/she could be potentially liable for acts of gross negligence or willful or wanton misconduct or liable in situations where a hunter may suffer an injury where the landowner charges for hunting access.

> ***SDCL § 20-9-12. Definition of terms.*** *Terms used in §§ 20-9-12 to 20-9-18, inclusive, mean: (1) "Charge," the admission price or fee asked in return for invitation or permission to enter or go upon the land. Any nonmonetary gift to an owner that is less than one hundred dollars in value may not be construed to be a charge;*
>
> ***SDCL § 20-9-13. Landowner not obligated to keep land safe for outdoor recreation or agritourism or to give warning--Exception.*** *Except as provided in § 20-9-16, an owner of land owes no duty of care to keep the land safe for entry or use by others for outdoor recreational purposes or agritourism activities, or to give any warning of a dangerous condition, use, structure, or activity on the owner's land to persons entering for outdoor recreational purposes.*

While commercial deer hunting can be controversial and caters often to those with an above average financial status, it does fulfill a niche and promotes deer hunting in the state. However, wildlife in North America is considered public property and is held in trust to be managed by the States. This is the basis for management practices by SDGFP and hunting opportunities must be provided that are consistent with this approach.

## Hunting Regulations

<u>License Allocation</u>

South Dakota offers eight different deer seasons: Black Hills, West River, East River, Custer State Park, National Wildlife Refuge, Archery, Muzzleloader, Mentor/Youth. Within some of these eight deer seasons, there are also licenses for Special Buck, Landowner Free Antlerless Deer, and Landowner-own-land Deer. Unit-specific and limited license allocations are implemented for some seasons, while other seasons offer an unlimited number of licenses. The complexity of these various seasons and the unregulated deer harvest that can occur from some seasons can create challenges for wildlife managers in developing hunting regulations and harvest strategies to provide the maximum opportunity for hunters in accordance with established deer population objectives.

As with most other game seasons, hunting regulations and license allocations are recommended by SDGFP staffs and finalized by the SDGFP Commission well before the fall hunting seasons. One key component of the biological data used in making harvest recommendations is 5-month recruitment, or those young born in the spring that will be available during the fall for hunters and ultimately survive one year contributing to the reproductive potential. This can create challenges for wildlife managers, such as uncontrollable events including severe winter, drought or disease outbreaks that could affect survival and cause additive mortality. Therefore, the collection of long-term annual survival, mortality, fawn: doe ratios, buck:doe ratios, and other biological data are critical for population modeling, which allows the Department to make science-based decisions in developing harvest recommendations and hunter opportunities. Since 2013, SDGFP has made substantial investments in the collection of biological data and development of population models to improve upon the knowledge of population growth related to survival, reproduction, hunter harvest, and other factors. Undoubtedly, these survey and research efforts, along with improved quantification of landowner and hunter public opinion, will benefit deer management and hunter opportunities into the future.

Deer Drawing System

The limited license drawing system uses a weighted lottery, which ensures those applicants with the most accrued preference points have an advantage over those with fewer preference points and that applicants with preference points will be drawn before those without preference points. For example, applicants with two preference points will basically have their name put into the draw system two times, applicants with 3 preference points will be put in 3 times, and so on. This drawing system does not guarantee a license to those with the highest preference point total, however, two or more years of preference points are required to be successful in drawing a licenses in high demand units. Preference points may be purchased ($5 resident; $10 nonresident) when an applicant is unsuccessful in drawing their first draw, first choice licenses in a season. Since demand for license types for certain hunting units within a season vary widely, it is difficult to inform deer hunting applicants on their "chance" of drawing a particular license for a season.

The draw process for limited deer licenses involves several stages (Figures 68 and 69). The deer license drawing process for Custer State Park is different than all others, due to the extremely high demand by hunters for a very limited number of deer licenses. For the Black Hills, West River, and East River deer seasons, the initial draw begins with 50% of licenses within each unit available to qualified landowner applicants in the Landowner Preference Pool. The 1st pass of the draw process begins with the Landowner Preference Pool with those landowners with 2+ years of preference. Any licenses remaining from the 50% allocation of licenses is then made available to those landowners with 1+ years of preference, followed by landowners with no preference. These landowner preference licenses are valid for all open areas within a respective hunting unit for successful landowners receiving this license. The Landowner-own-land deer license and free antlerless deer licenses, however, are restricted to land owned or operated by the qualified applicant. There is no landowner preference available in the drawing process for those units managed as Limited Access Units (LAUs), Custer State Park, and National Wildlife Refuge deer seasons, as these seasons or units are entirely public land. Landowners who do not receive a license during the normal firearm draw are eligible to receive a reduced-price deer license which is restricted to land owned or operated by the qualified applicant.

Any remaining licenses from the Landowner Preference draw are returned to the General Preference Pool. These remaining licenses are allotted to non-landowner applicants with 2+ years of preference first, then any remaining licenses from the 2+ Preference Pool are randomly issued to license applicants in the 1+ Preference Pool. The next pass of the draw process includes all unsuccessful landowners and non-landowners without preference from licenses remaining from previous draws. If licenses still remain after the initial draw process, all unsuccessful 1st choice applicants are then drawn for a 2nd choice. Finally, all unsuccessful applications from the first drawing sequence described above are then eligible to apply for any licenses available for the 2nd draw process (Figure 68).

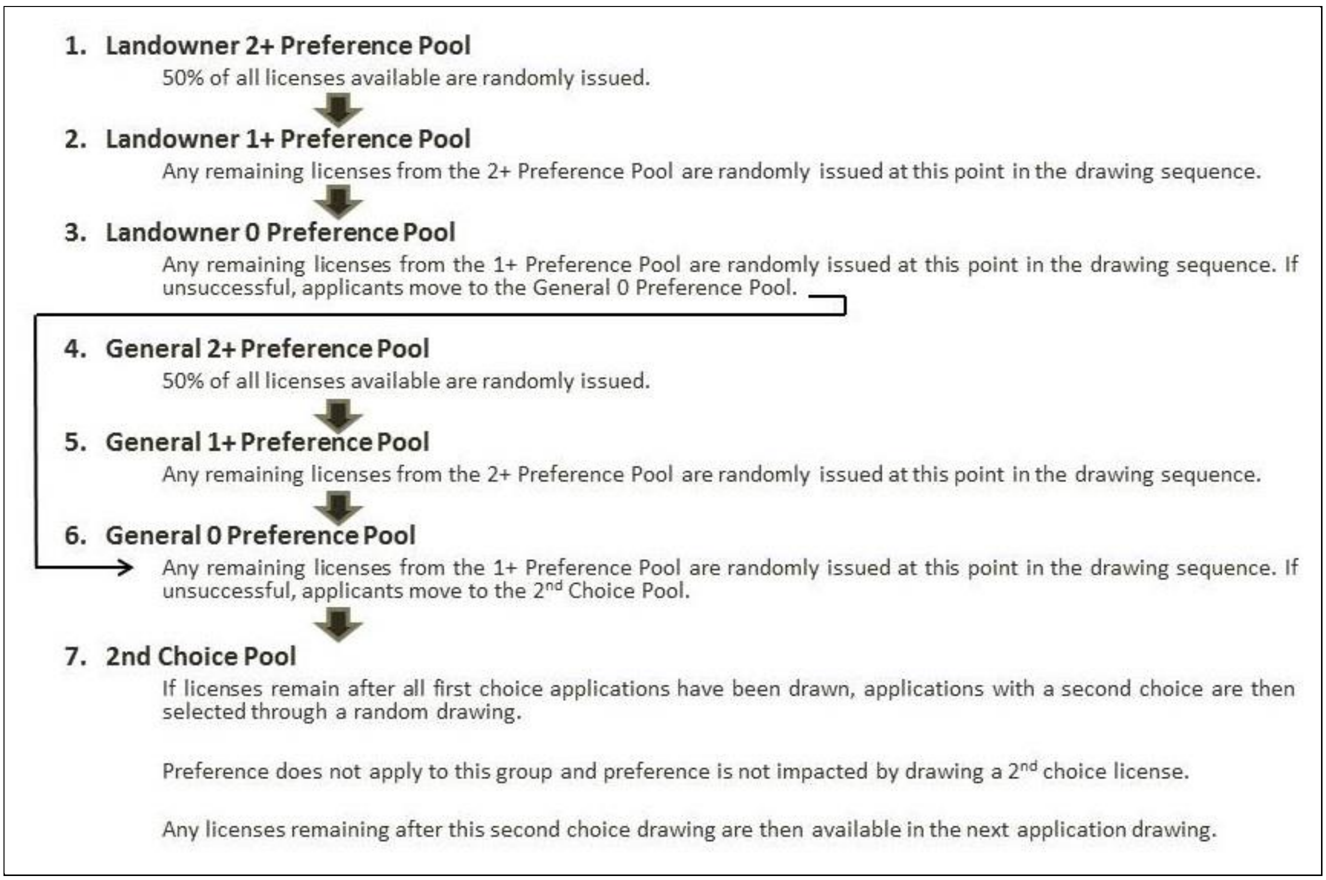



Figure 68. Deer license drawing process (excluding Custer State Park).

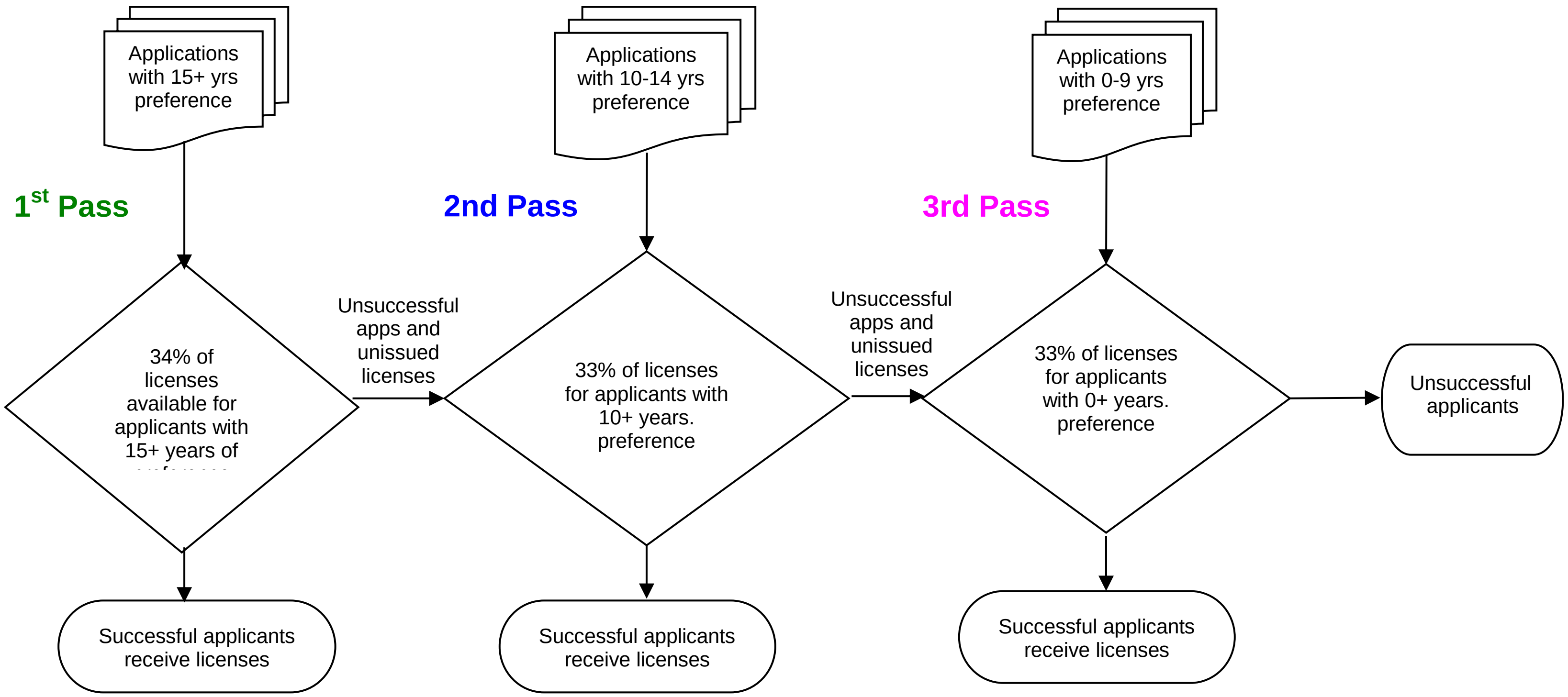



Figure 69. Deer license drawing process for Custer State Park.

Hunter demand for buck licenses exceeds supply in several deer hunting units, in particular Custer State Park, Limited Access Units, Refuge deer seasons, and for many East River deer hunting units. For many deer hunters, they are only interested in deer hunting their local hunting unit, within a certain distance from their home, or in a specific area where they have access to private land. Other deer hunters are more willing to travel across the state, in particular to West River deer hunting units, where demand is not as high for buck licenses as seen in most East River deer hunting units. The willingness for some deer hunters to travel or participate in archery or Muzzleloader Deer hunting seasons, allows for additional opportunities to become successful in obtaining a buck license. Tables 72 and 73 illustrate the number of buck licenses obtained by unique deer hunters from 2011-2015. During this time period for all deer hunting seasons combined, more than half of all deer applicants obtained at least one buck license and less than 10% of all deer hunters held two buck licenses for a respective hunting year.

Table 72. Number of buck licenses by resident deer hunters, 2011-2015[1].

| | 2011 | | 2012 | | 2013 | | 2014 | | 2015 | |
|---|---|---|---|---|---|---|---|---|---|---|
| **# Buck Licenses** | **Unique Hunters** | | **Unique Hunters** | | **Unique Hunters** | | **Unique Hunters** | | **Unique Hunters** | |
| 0 | 13,968 | 25.87% | 18,116 | 33.20% | 17,271 | 32.04% | 17,892 | 33.39% | 22,283 | 40.93% |
| 1 | 34,536 | 63.96% | 32,240 | 59.08% | 32,434 | 60.17% | 31,574 | 58.92% | 28,070 | 51.56% |
| 2 | 4,948 | 9.16% | 3,908 | 7.16% | 3,858 | 7.16% | 3,728 | 6.96% | 3,802 | 6.98% |
| 3 | 473 | 0.88% | 256 | 0.47% | 285 | 0.53% | 330 | 0.62% | 256 | 0.47% |
| 4 | 52 | 0.10% | 37 | 0.07% | 43 | 0.08% | 49 | 0.09% | 20 | 0.04% |
| 5 | 12 | 0.02% | 11 | 0.02% | 5 | 0.01% | 15 | 0.03% | 6 | 0.01% |
| 6 | 6 | 0.01% | 4 | 0.01% | 5 | 0.01% | 2 | 0.00% | 1 | 0.00% |
| 7 | 2 | 0.00% | 0 | 0.00% | 1 | 0.00% | 2 | 0.00% | 1 | 0.00% |
| 8 | 0 | 0.00% | 1 | 0.00% | 1 | 0.00% | 0 | 0.00% | 0 | 0.00% |
| 9 | 0 | 0.00% | 0 | 0.00% | 0 | 0.00% | 0 | 0.00% | 0 | 0.00% |
| 10 | 0 | 0.00% | 0 | 0.00% | 0 | 0.00% | 0 | 0.00% | 0 | 0.00% |
| 11 | 0 | 0.00% | 0 | 0.00% | 0 | 0.00% | 0 | 0.00% | 0 | 0.00% |
| 12 | 0 | 0.00% | 0 | 0.00% | 0 | 0.00% | 0 | 0.00% | 0 | 0.00% |
| 13 | 1 | 0.00% | 0 | 0.00% | 0 | 0.00% | 0 | 0.00% | 0 | 0.00% |

[1]Includes Black Hills, West River, and East River deer seasons (does not include Special Buck licenses).

Table 73. Number of buck licenses by nonresident deer hunters, 2011-2015[1].

| | 2011 | | 2012 | | 2013 | | 2014 | | 2015 | |
|---|---|---|---|---|---|---|---|---|---|---|
| # Buck Licenses | Unique Hunters | | Unique Hunters | | Unique Hunters | | Unique Hunters | | Unique Hunters | |
| 0 | 2,454 | 45.22% | 2,854 | 54.92% | 2,404 | 51.58% | 1,883 | 48.90% | 2,351 | 57.47% |
| 1 | 2,814 | 51.85% | 2,242 | 43.14% | 2,169 | 46.54% | 1,914 | 49.70% | 1,685 | 41.19% |
| 2 | 149 | 2.75% | 96 | 1.85% | 76 | 1.63% | 51 | 1.32% | 51 | 1.25% |
| 3 | 6 | 0.11% | 3 | 0.06% | 9 | 0.19% | 2 | 0.05% | 1 | 0.02% |
| 4 | 2 | 0.04% | 1 | 0.02% | 1 | 0.02% | 0 | 0.00% | 2 | 0.05% |
| 5 | 1 | 0.02% | 1 | 0.02% | 2 | 0.04% | 0 | 0.00% | 1 | 0.02% |
| 6 | 1 | 0.02% | 0 | 0.00% | 0 | 0.00% | 1 | 0.03% | 0 | 0.00% |

[1]Includes Black Hills, West River, and East River deer seasons (does not include Special Buck licenses).

During the past five years, there have been numerous discussions and ideas generated on how to distribute and provide buck licenses in the most fair and equitable manner. While no drawing system will ever be perfect for every individual circumstance, a change was made during the 2015 deer hunting limited-license drawing system which allocated all limited draw licenses after the landowner preference pass to non-landowner applicants and any unsuccessful landowners from the original landowner draw with 2+ years of preference. This modification to the drawing process was implemented to increase the odds of those applicants with several years of preference points for their preferred season and hunting unit.

Those deer hunters who are only interested in firearm deer hunting often question the unlimited number of buck licenses available to both resident and nonresident archery hunters. Justification for this difference has been firearm harvest accounts for the majority of deer harvest within individual hunting units. Archery hunting has increased significantly over the past 10 years and in some deer hunting units now accounts for greater than 50% of both buck and antlerless deer harvest, in particular in areas close to high population areas. As a result, wildlife managers are now challenged to distribute deer hunting opportunities and harvest levels in a manner to meet the demands of deer hunters and to achieve desired management objectives.

Sharing information and educating the general public and those interested in hunting deer is an important aspect of deer management. Currently, draw statistics can be found on the SDGFP website at https://apps.sd.gov/gf79license/DrawResultStat.aspx. Developing the proper outreach mechanism that fully explains the supply and demand for deer hunting in South Dakota could help improve understanding of the realistic chances of drawing a buck license for an applicant's preferred season and unit (Table 74).

Table 74. Number of applicants by year of preference category for the 2015 license drawing[1].

| Years of Preference Category | Black Hills Deer | West River Deer | West River Special Buck | East River Deer | East River Special Buck | Muzzleloader Deer[2] | National Wildlife Refuge Deer | Custer State Park Deer |
|---|---|---|---|---|---|---|---|---|
| 0 | 5,309 | 14,887 | 1,124 | 25,136 | 770 | 2,339 | 321 | 338 |
| 1 | 3,957 | 4,898 | 343 | 8,092 | 118 | 1,671 | 288 | 225 |
| 2 | 1,993 | 1,610 | 80 | 1,818 | 25 | 1,085 | 187 | 208 |
| 3 | 861 | 654 | 43 | 634 | 25 | 765 | 119 | 173 |
| 4 | 447 | 270 | 3 | 195 | 12 | 488 | 85 | 162 |
| 5 | 230 | 76 | 0 | 94 | 0 | 284 | 69 | 164 |
| 6 | 183 | 32 | 2 | 41 | 0 | 147 | 33 | 116 |
| 7 | 114 | 13 | 0 | 20 | 0 | 60 | 18 | 81 |
| 8 | 112 | 6 | 0 | 12 | 0 | 35 | 10 | 82 |
| 9 | 35 | 2 | 0 | 6 | 1 | 14 | 3 | 71 |
| 10+ | 2 | 2 | 0 | 4 | 0 | 5 | 1 | 247 |
| **Totals** | **13,267** | **22,450** | **1,595** | **36,052** | **951** | **6,893** | **1,134** | **1,867** |

[1] Archery Deer, antlerless Muzzleloader Deer, Youth Deer, Mentor Deer, Landowner-own-land deer, and Free Antlerless Landowner Deer licenses are unlimited.
[2] "any deer" muzzleloader licenses.

Landowner Preference

As described in the *Private Lands* section of this plan, up to 50% of all deer licenses made available in each management unit for the Black Hills, West River (except those public lands managed as a Limited Access Unit), and East River deer hunting seasons are available to those who qualify for landowner preference. While the public, including deer hunters, understands the important role of farmers and ranchers for providing wildlife habitat and hunting opportunities, some deer hunters question the 50% allocation of these licenses to qualifying landowners when they can already purchase a Landowner-own-land buck license valid on the property they own or lease and may be eligible for up to two free antlerless white-tailed licenses.

Hunter demand is high for licenses that provide the opportunity to harvest a buck, especially for mule deer. For example, there are two license types in the Black Hills rifle season that allow for the harvest of a buck deer; an "any deer" license and an "any whitetail" license. In 2015, 50% (100 out of 200) of the "any deer" licenses for the Black Hills deer season were issued to those applicants qualified for landowner preference, compared to 23.3% (93 out of 400) in 2010. In 2015, 1.4% (49 out of 3,500) of the "any whitetail" licenses for the Black Hills deer season were issued to those applicants who qualified for landowner preference, same comparison of 1.4% (54 out of 4,000) in 2010.

The number of available resident buck licenses and the allocation of buck licenses to applicants qualified for landowner preference by the three major firearm seasons from 2011-2015 is illustrated in Figures 70-72. In general, the percentage of licenses allocated to landowner preference is minimal for the Black Hills and West River deer hunting seasons. The allocation of landowner preference licenses, however, is a more significant percentage of the available buck licenses for the East River deer hunting season, in particular during years of lower deer license numbers.

A more detailed analysis of buck license types issued to those qualifying for landowner preference can be found in Table 75. It should be noted that in some deer hunting units, more than one type of license that allows for the harvest of a buck can be available. The percent of buck licenses issued to landowner preference is categorized into the following: 0-9%, 10-19%, 20-29%, 30-39%, 40-49%, and equal to or greater than 50%. Smaller farm sizes and higher human population sizes per county or deer hunting unit creates a stronger demand for obtaining these regular draw firearm licenses for the East River deer hunting season.

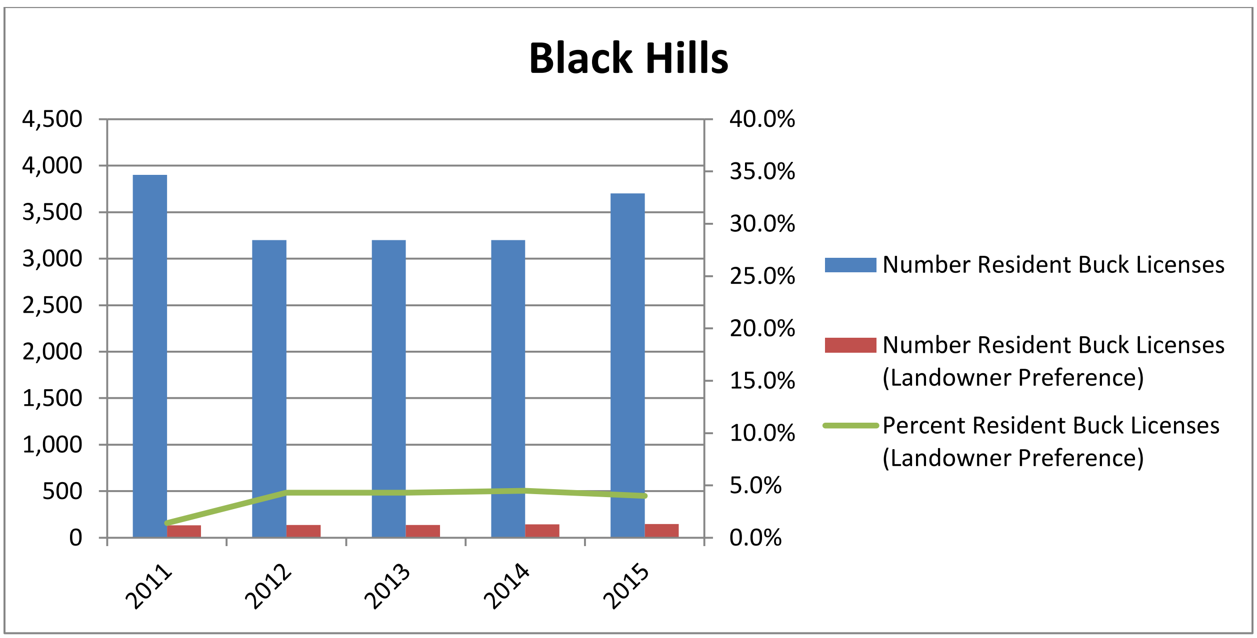



Figure 70. Black Hills resident buck license sales and landowner preference statistics, 2011-2015.

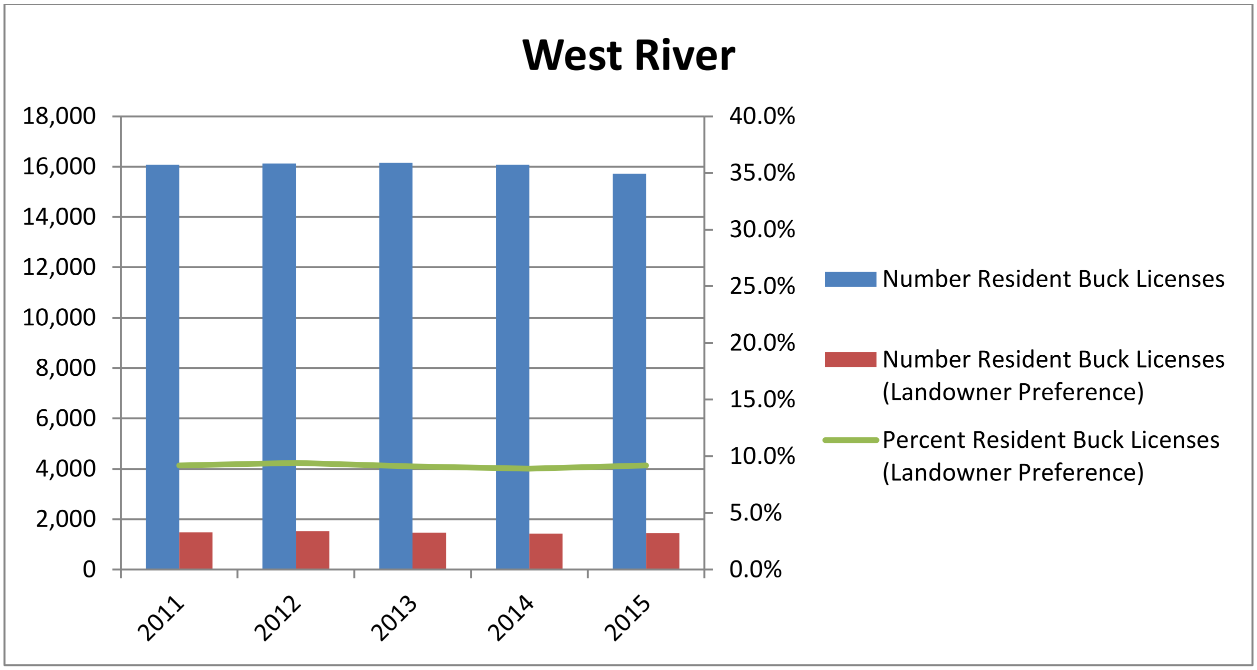



Figure 71. West River resident buck license sales and landowner preference statistics, 2011-2015.

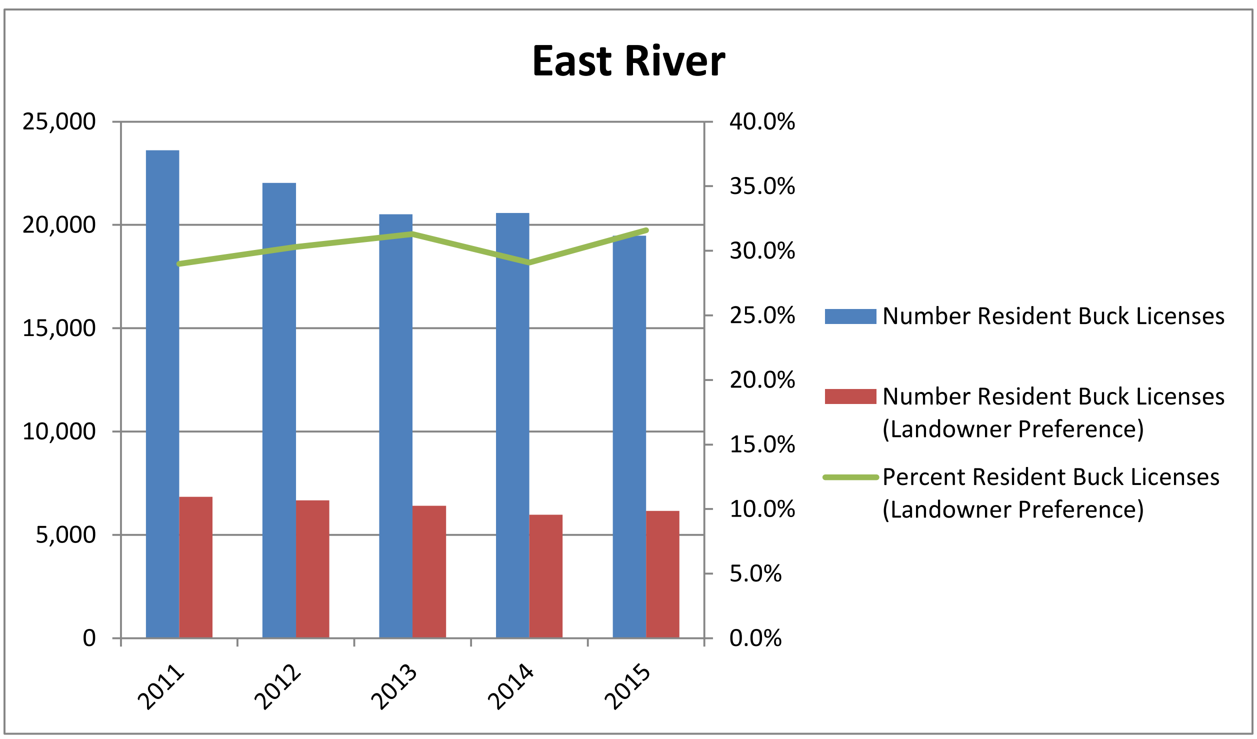



Figure 72. East River resident buck license sales and landowner preference statistics, 2011-2015.

Table 75. Percent of buck license types by hunting unit issued to those applicants with landowner preference for the Black Hills, West River, and East River deer hunting seasons, 2011-2015.

| Percent of Buck Licenses to Landowner Preference | 2011 | | | 2012 | | | 2013 | | | 2014 | | | 2015 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Black Hills | West River | East River | Black Hills | West River | East River | Black Hills | West River | East River | Black Hills | West River | East River | Black Hills | West River | East River |
| ≥50% | 0 | 1 | 13 | 0 | 2 | 11 | 1 | 2 | 17 | 1 | 3 | 15 | 1 | 4 | 15 |
| 40-49% | 0 | 0 | 15 | 1 | 0 | 13 | 0 | 2 | 10 | 0 | 4 | 14 | 0 | 3 | 15 |
| 30-39% | 0 | 2 | 12 | 0 | 5 | 13 | 0 | 2 | 9 | 0 | 4 | 12 | 0 | 4 | 11 |
| 20-29% | 1 | 6 | 15 | 0 | 4 | 12 | 0 | 7 | 13 | 0 | 5 | 4 | 0 | 6 | 5 |
| 10-19% | 0 | 14 | 6 | 0 | 9 | 5 | 0 | 9 | 4 | 0 | 9 | 8 | 0 | 8 | 5 |
| 0-9% | 1 | 27 | 7 | 1 | 36 | 8 | 1 | 37 | 6 | 1 | 43 | 10 | 1 | 42 | 9 |

*The number listed under each deer hunting season by year indicates the number hunting units that correspond to the percentage in the first column.

There are numerous opinions related to landowner preference deer licenses. For those landowners that support/tolerate deer on their lands throughout the year, a license is a way to reward them for the habitat they provide and deer depredation that may occur on their property. Landowner preference deer licenses may increase landowner tolerance and the social carrying capacity for deer on the landscape, which in return maximizes deer hunting opportunities for all hunters. Perhaps there are alternative methods that could be explored and negotiated that would still meet the expectations of providing and issuing landowner preference and in turn improve deer license acquisition opportunities for hunters in the general drawing process, especially in high demand hunting units.

**Antlerless Harvest Strategies**

The management of antlerless deer is fundamental to maintaining or reaching desired deer population levels. The impact of antlerless harvest on deer populations depends mostly on the percent of adult does harvested, annual doe survival, and fawn recruitment. The reproductive potential for deer, especially white-tailed deer, can be very high under ideal conditions. McCullough (1979) estimated that white-tailed deer at low densities and in good habitat can increase at a rate of up to 89%, and Downing and Guynn (1985) estimated 82%. Typically deer population growth rates in South Dakota range from 10-30% when conditions are favorable and harvest rates are moderate. When deer densities are high, it can be challenging to harvest sufficient numbers of antlerless deer to substantially impact populations, even with liberalized harvest seasons and limits. This is especially true for white-tailed deer populations, and less so for mule deer populations due to lower average reproductive and recruitment rates, along with higher harvest susceptibility for mule deer. Conversely, it’s challenging to restrict harvest enough and fairly across all user groups when low deer populations follow liberal regulations.

In the early 2000s, SDGFP began to realize deer populations were climbing sharply and social tolerances decreasing similarly. In an attempt to increase harvest rates on antlerless deer, several management actions were implemented after gathering input from within the agency and from the public:

- Increased license numbers.
- Increased 2-tag and added 3-tag licenses (3rd tag free).
- Changed all archery, Youth Deer, and muzzleloader antlerless licenses from limited deer management unit allocation to unlimited statewide seasons.
- Reduced antlerless license fees by $5.
- Provided over-the-counter access to unsold licenses.
- Added early antlerless season allowing antlerless deer harvest during the pronghorn firearm season.
- Added late season antlerless extensions (one immediately after regular firearm West and East River deer seasons, and one in late December/early January).
- Provided free deer donation coupons for Sportsmen Against Hunger (SAH) program.
- Increased the number of licenses that a person could hold to five in some seasons.
- Offered free antlerless deer licenses to landowners.

Antlerless harvest increased substantially as a result of liberalized regulations and high deer densities, reaching record levels of approximately 44,100 antlerless white-tailed deer harvested in 2010 and 9,300 antlerless mule deer harvested in 2009.

Concurrent to high harvest rates, several other factors contributed to noticeable impacts on deer populations across the state. South Dakota experienced 3 substantially severe winters in 2008/09, 2009/10, and 2010/11 (see Figure 44 in the *Winter Severity* section); the northeast portion of the state received an additional severe winter in 2012/13. Moreover, the summer of 2012 was one of the most significant single-year drought periods recorded in the state. South Dakota also experienced substantial habitat loss beginning in the early 2000s, with over 1.8 million acres of grassland lost to cropland conversion between 2006 and 2012 (Reitsma et al. 2015). Many wetland and shelterbelt habitats have also been removed and converted to row crops during this time period. In addition, in 2012 SDGFP recorded substantial mortalities of deer as a result of disease outbreaks of epizootic hemorrhagic disease and blue tongue viruses (Figure 80 in *Disease* section). Furthermore, as deer populations were decreasing in the Black Hills, mountain lion populations were above management objective. And last but not least, anecdotal information suggested mange occurrences in coyotes were decreasing on the prairie, and coyote populations were increasing.

All of these factors combined (record antlerless harvest, severe winters, severe drought, disease outbreaks, predator densities, and lower adult survival and fall recruitment) appeared to have substantial impacts on deer populations across the state and populations began to decrease immediately. In order to increase deer populations back to desired levels, SDGFP substantially reduced antlerless license availability and modified antlerless harvest regulations. The shift from a regulatory system that maximized harvest and hunting opportunity in order to reduce deer populations across the state, to a system that significantly reduced antlerless deer harvest and hunter opportunity, has not been without controversy and continues to be a management challenge.

In an attempt to simplify antlerless hunting units, merge related but different antlerless regulations, and provide some clarity to staffs on options available under differing unit management objectives, SDGFP developed white-tailed deer (Table 76) antlerless harvest strategies. This table ultimately underwent several revisions but was intended to provide staffs with a consistent approach to harvest management options, while also providing open and transparent information to the public regarding the methods used to manage antlerless deer populations.

Table 76. Antlerless harvest management strategies for white-tailed deer.

| Population Objective | MAINTAIN OR DECREASE---------------------------------------------INCREASE | |
|---|---|---|
| TOOLS | MODERATE - LIBERAL HARVEST ----------------------------------RESTRICTIVE HARVEST | |
| Firearm License Numbers | Moderate to Liberal<br>May have leftover licenses after 3rd draw | Limited<br>No leftover Firearm licenses after 3rd draw |
| Firearm License Types | Single, Double, and Triple Tag Licenses<br>Antlerless-only Type 13, 17, 18, or 19 lic available | Single-tag Licenses only<br>No Antlerless-only Type 13 Licenses[1] |
| Firearm Late Season | 9-day Late Season - East River only | Closed: No Antlerless Licenses Issued[1] |
| Youth Deer | 1 Single-tag Type 03 License | 1 Single-tag Type 03 License |
| Archery Antlerless Deer | 1 Single-tag Type 13 License[2] | No Licenses |
| Muzzleloader Antlerless Deer | 1 Single-tag Type 13 License[2] | No Licenses |
| Landowner Free Antlerless Deer | Up to 2 antlerless whitetail licenses | No Licenses |

[1]Landowner-own-land deer licenses still valid as established by statute.

[2]Up to 2 antlerless whitetail licenses (single or double tag combinations) when more than 50% of the East River and West River firearm units offer double or triple tag antlerless whitetail licenses.

Although regulations implemented by SDGFP are currently meeting objectives to allow deer populations to grow in most management units, there have been questions about whether there could be a simpler system to implement and for the public and staffs to understand, and one that also better meets deer harvest objectives and maximizes hunter opportunity.

The challenge with antlerless deer management is two-fold. First, SDGFP needs regulations flexible enough to encourage maximum hunter participation to obtain maximum harvest rates when deer populations are high. Secondly, the regulatory system must also allow SDGFP the ability to restrict harvest rates and geographic areas of harvest, in a manner that is fair among all hunter user groups and that can be simply understood. Although the current system used by SDGFP, where firearm antlerless licenses are issued per management unit while other seasons (archery, muzzleloader, youth) are issued at the statewide level, does provide maximum opportunity for youth, archery, and muzzleloader antlerless deer hunters, and worked very well when deer populations were high, when deer populations are lower the resulting regulations can be challenging and may not apply fairly across all user groups.

Historically (pre-2006), antlerless tags for youth, archery, and muzzleloader were all issued at the firearm unit level, but as deer populations grew and subsequent license availability grew, it became common for most units to have leftover licenses. In 2006, all antlerless licenses for youth, archery, and muzzleloader seasons were changed to a statewide unit, and the number unlimited, and licenses sales increased in subsequent years. This helped increase antlerless harvest at the statewide level, and was an effective way to issue licenses when deer densities were high. The downside of going to statewide units, however, was the loss of control of where those deer were being harvested. As a result, especially near larger cities and metro areas (e.g., Rapid City and Sioux Falls), harvest from these unlimited statewide seasons approached or exceeded harvest levels from firearm units, while in most units this harvest is not nearly as significant. For example, in 2010, 47% of the antlerless harvest in Minnehaha unit was from archery, youth, muzzleloader, while 53% was from firearm hunters.

As SDGFP decreased license availability for firearm seasons in order to increase deer populations, it became apparent that these unrestricted statewide seasons also needed to be restricted in some units. As a result, using antlerless harvest strategies, the statewide archery and muzzleloader antlerless licenses were restricted primarily to firearm units that offered antlerless firearm licenses (see Figures 27 and 29 in *Harvest Surveys* section). Current strategies focus on managing antlerless white-tailed deer harvest opportunities, while future strategies will need to be developed to manage antlerless mule deer harvest opportunities.

<u>Sportsmen Against Hunger</u>

Established in 1993 by the Greater Dacotah Chapter of Safari Club International in Rapid City, the mission of South Dakota Sportsmen Against Hunger (SAH) is “to encourage and facilitate donation of wild game meat to needy people in South Dakota”. To accomplish this mission, SAH has established a network of participating commercial meat processors and charitable food distributors across the state.

A hunter survey conducted in 2003 (Gigliotti 2004) indicated that deer hunters (77% of respondents) would be willing to harvest additional antlerless deer and donate venison to help those faced with hunger if there were minimal processing costs. Another 12% indicated they would not likely participate in such a program and 11% were unsure. Both West River and East River deer hunters had similar attitudes towards this alternative strategy to increase antlerless deer harvest.

In the mid-2000s, deer populations across much of South Dakota were at record levels above social thresholds which resulted in liberal harvest strategies, including double and triple tag licenses, extended season lengths, and nearly unlimited antlerless deer hunting opportunities in all deer seasons. As a result, SDGFP and SAH began a partnership in 2006 with an effort to encourage the harvest of antlerless deer allowing hunters to more easily assist with deer population management needs, and at the same time, help SAH meet their mission of providing needy families with wild game.

From 2006 to present, SDGFP has partnered with SAH by covering the costs associated with a contractor that facilitates the logistics with participating meat processors, provides coordination with the distribution of processed venison to local food pantries, and provides administrative duties associated with processing certificates. In addition to receiving charitable donations from individuals, SDGFP also provides financing to SAH to help cover the costs of meat processing through certificates. These certificates cover all or most of the costs for the donation and processing fees of antlerless deer with participating meat processors (Table 77).

During times of high deer populations, the donation of harvested antlerless deer through SAH has been a useful tool for deer hunters to help meet harvest management goals. As expected, most deer donated by hunters to SAH occurs from harvest during the West and East River deer hunting seasons (Table 78). In addition to deer, the donation of pronghorn, Canada geese, and other salvaged game has been facilitated through SAH. The number of deer donated and total pounds of processed game meat made available to food panties can be found in Table 79. To learn more about SAH, visit their website at http://www.feedtheneedsd.com/.

Table 77. Total deer certificate expenditures and SDGFP agreement contributions by hunting season, 2006-2015.

| Hunting Season | Deer Certificate Expenditures | SDGFP Agreement |
|---|---|---|
| 2006 | $28,200 | $0 |
| 2007 | $87,900 | $59,500 |
| 2008 | $97,300 | $30,000 |
| 2009 | $102,300 | $88,500 |
| 2010 | $113,750 | $70,000 |
| 2011 | $87,450 | $70,000 |
| 2012 | $55,950 | $18,000 |
| 2013 | $36,420 | $33,500 |
| 2014 | $10,680 | $15,000 |
| 2015 | $13,080 | $0 |

Table 78. Number of deer donated by hunters by deer season and through depredation pool hunts, 2006-2015.

| Year | Archery Deer | Youth Deer | Refuge Deer | Muzzleloader Deer | Black Hills Deer | West River Deer | East River Deer | Depredation Pool Hunts | Total Deer[1] |
|---|---|---|---|---|---|---|---|---|---|
| 2006 | 0 | 0 | 0 | 0 | 71 | 385 | 484 | 0 | 940 |
| 2007 | 177 | 43 | 5 | 82 | 86 | 708 | 616 | 41 | 1,758 |
| 2008 | 184 | 127 | 6 | 150 | 92 | 824 | 538 | 25 | 1,946 |
| 2009 | 167 | 68 | 3 | 88 | 57 | 1,129 | 472 | 2 | 2,046 |
| 2010 | 216 | 79 | 5 | 85 | 27 | 1,084 | 675 | 36 | 2,275 |
| 2011 | 143 | 122 | 3 | 28 | 13 | 929 | 502 | 9 | 1,749 |
| 2012 | 86 | 55 | 2 | 37 | 12 | 494 | 402 | 6 | 1,119 |
| 2013 | 63 | 57 | 0 | 13 | 12 | 219 | 243 | 0 | 607 |
| 2014 | 10 | 33 | 1 | 3 | 10 | 44 | 77 | 0 | 178 |
| 2015 | 14 | 44 | 0 | 7 | 5 | 61 | 87 | 0 | 218 |

[1]Total number of deer donated by hunters includes hunters who did not participate with certificate program, such as covering processing costs or donating male deer.

**Quality Deer Management**

Quality deer management is often synonymous with trophy deer management, and refers to management of deer herds for increased harvest opportunities of mature and large antlered bucks. The presence of mature bucks is frequently touted to be the by-product of proper herd management. In South Dakota deer populations are managed to provide maximum harvest opportunities while still meeting social tolerances. With very limited exceptions, social carrying capacity drives harvest objectives more than biological capacity. With approximately 80% of the land in South Dakota privately owned, public land hunting opportunities are limited and highly sought after by both resident and nonresident deer hunters.

Having low hunter densities and limited disturbance during a hunt also contribute to a higher quality hunt, but the bottom line is many hunters want the opportunity to harvest older age class deer with large antlers. In fact, in the most recent SDGFP hunter survey (Longmire 2017a), 53% of hunters said harvesting a large antlered deer was important. In many western states it is common to see wildlife agencies manage some hunting units for trophy deer harvest opportunities, usually by means of substantially limiting harvest rates. In the Midwest and eastern states, management of quality white-tailed deer hunting opportunities has increased substantially, as witnessed by yearling harvest proportions going from 62% in 1989 to 36% in 2013 (Adams and Ross 2015). In this section several components of quality deer management will be evaluated such as hunter density, limited access units, and trophy management.

Table 79. Number of deer donated by hunters and total pounds of processed game meat made available through Sportsmen Against Hunger donations, 1993-2015.

| Year | Antlerless Deer Donated by Hunters | Antlered Deer Donated by Hunters | Total Number of Deer Donated by Hunters | Total Pounds of Processed Game Meat[1] |
|---|---|---|---|---|
| 1993 | Only total pounds of processed game meat | | | 1,503 |
| 1994 | were obtained from earlier reports. | | | 3,222 |
| 1995 | | | | 5,452 |
| 1996 | | | | 4,304 |
| 1997 | | | | 2,817 |
| 1998 | | | | 3,269 |
| 1999 | | | | 4,764 |
| 2000 | | | | 11,561 |
| 2001 | | | | 10,368 |
| 2002 | | | | 12,323 |
| 2003 | | | | 9,185 |
| 2004 | | | | 27,447 |
| 2005 | | | | 38,847 |
| 2006 | Gender Data Not Available | | 895 | 45,198 |
| 2007 | 1,757 | 326 | 2,083 | 76,532 |
| 2008 | 1,946 | 257 | 2,203 | 94,653 |
| 2009 | 2,039 | 263 | 2,302 | 97,752 |
| 2010 | 2,267 | 293 | 2,560 | 104,178 |
| 2011 | 1,709 | 182 | 1,891 | 80,684 |
| 2012 | 1,120 | 142 | 1,262 | 66,843 |
| 2013 | 605 | 92 | 697 | 48,102 |
| 2014 | 182 | 124 | 306 | 37,643 |
| 2015 | 204 | 144 | 348 | 31,512 |

[1]Total pounds of all processed game meat donated by hunters, salvaged roadkill deer, city-sponsored hunts, "clean out your freeze events", etc.

Limited Access and Hunter Density

In 1963, an early November season opened in Perkins County and the Slim Buttes area in Harding County that was set aside for limited access hunting and restricted harvest to buck deer with 4 points or more on one side. This limited access area became the Slim Buttes Unit the next year and excluded the Perkins County portion. This limited access area ran until 1967 (Richardson and Peterson 1974). In 2011, similar limited hunting access regulations were re-established for Custer Gallatin National Forest (35L), portions of the Grand River National Grasslands (53L), and the Hill Ranch area (27L). The Little Moreau Recreation Area (24B) is also a public land unit with limited access. The 53L unit was removed a few years after implementation, but other three areas remain. Limited Access Units (LAUs) are intended to reduce hunter densities and provide a quality hunt experience. This management strategy has been implemented within numerous states across the nation. For example, Utah has two "premium" and seven limited-entry units. Within these limited entry units, hunter densities for specific seasons (i.e., archery, muzzleloader and firearm) range between 0.02-0.09 hunters/mi.$^2$. Management objectives within the "premium" units are to obtain herd composition ratios between 40-50 bucks per 100 does and maintain an older age structure of bucks (UDNR 2014). Other states such as Idaho and Washington also manage a portion of their deer units using a limited entry design and hunter densities during these specified seasons range between 0.03-0.25 hunters /mile$^2$.

Within South Dakota, hunter densities for the firearm deer seasons at the DAU level over the last five years averaged between 0.35-1.62 hunters/ mi.$^2$ (Figure 73). Between 2011 and 2015, unit firearm hunter densities ranged between 0.13-4.65 hunters/mi.$^2$ and averaged 0.75 hunters/mi.$^2$ for the 91 deer units across the state (Figure 74). Of the 91 deer units, three are managed as LAUs; however, other user groups (e.g., archery, muzzleloader, and youth) have unlimited access in these units if they acquire a free access permit (Table 80). These inclusive public land LAUs include units 24B, 27L, and 35L (Figure 75). Within the LAUs, firearm hunter densities averaged 1.13 hunters/mi.$^2$ for the 2015 firearm season; however LAU 24B had a hunter density of 4.65 hunters/ mi.$^2$. Overall harvest success for the three LAUs averaged 83% compared to the 2015 West River average harvest success of 61%. In 2015, mean satisfaction ratings (on a scale from 1 to 7 with 1 representing "very dissatisfied" and 7 representing "very satisfied") were also above average for the three LAUs at 5.76, compared to the West River average of 5.27.

In a recent survey conducted by the SDGFP, 32% of hunters supported the limited number of firearm licenses in LAUs while 7% opposed the management strategy. When hunters were asked if they would support the creation of more LAUs, 29% supported and 15% opposed the concept with the balance remaining neutral; however, 41% supported the management strategy of hunting less often it if increased their chances of harvesting a large-antlered buck in some units (Longmire 2017a).

Potential exists to establish further LAUs across South Dakota where large contiguous acres of public land are present. Limited access units do provide a quality hunting experience, however, at the expense of a reduced firearm hunting opportunity. SDGFP will further investigate the pros and cons of establishing additional LAUs across South Dakota in the future.

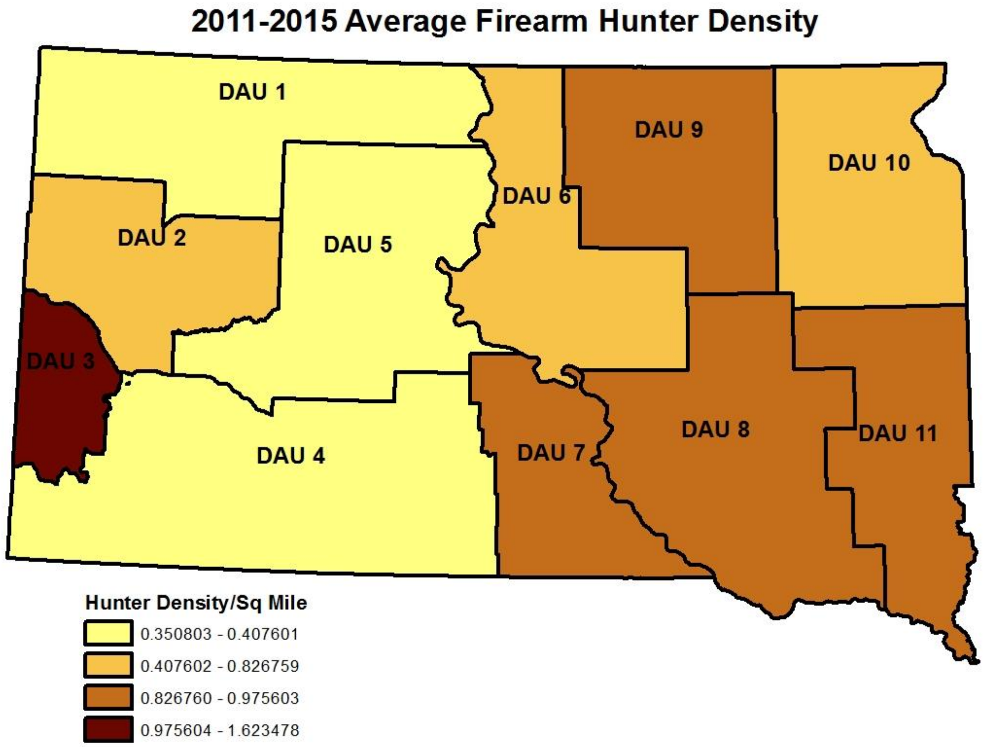



Figure 73. DAU average firearm hunter density, 2011-2015.

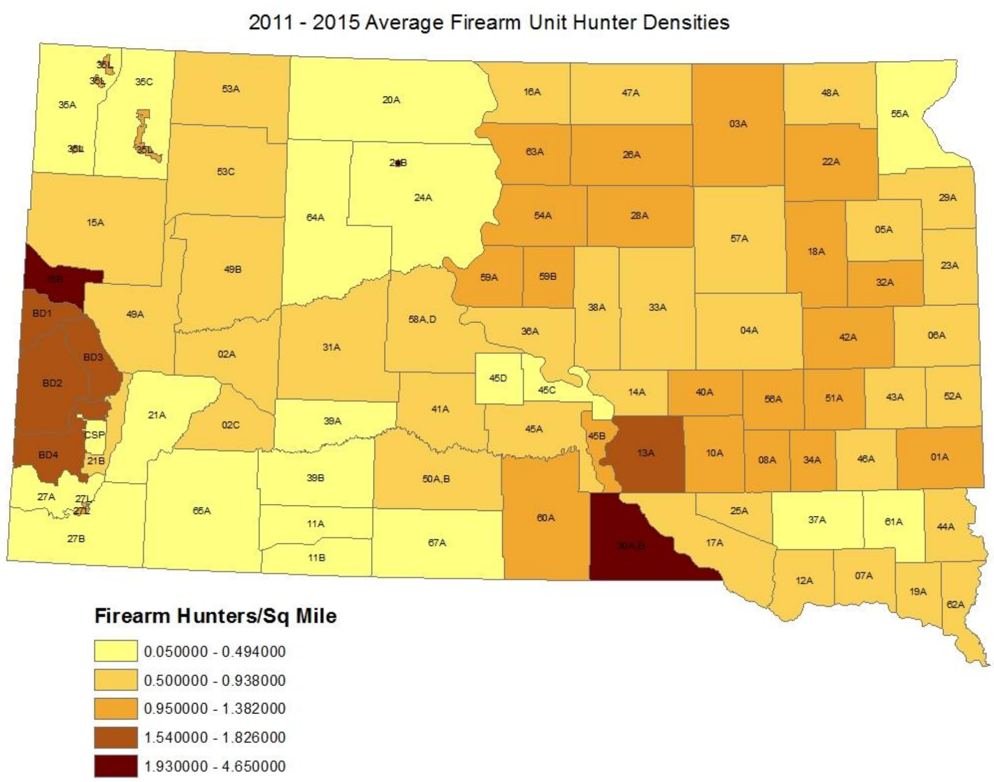



Figure 74. Deer management unit average firearm hunter density, 2011-2015.

Table 80. Limited access units, deer harvest summary by user group, 2014-2015.

| 2014 | Archery | Youth | Mentored Youth | Muzzleloader | West River Firearm | Total Deer Harvested |
|---|---|---|---|---|---|---|
| Custer Nat. Forest | 37 | 2 | 3 | 4 | 66 | 112 |
| Hill Ranch GPA | 10 | 4 | 0 | 2 | 12 | 28 |
| Little Moreau GPA | 4 | 0 | 3 | 2 | 19 | 28 |
| Totals | 51 | 6 | 6 | 8 | 97 | 168 |
| **2015** | **Archery** | **Youth** | **Mentored Youth** | **Muzzleloader** | **West River Firearm** | **Total Deer Harvested** |
| Custer Nat. Forest | 38 | 1 | 2 | 6 | 91 | 138 |
| Hill Ranch GPA | 5 | 1 | 1 | 0 | 13 | 20 |
| Little Moreau GPA | 7 | 3 | 1 | 4 | 22 | 37 |
| Totals | 50 | 5 | 4 | 10 | 126 | 195 |

Trophy Management

Managing deer herds for trophy buck harvest opportunities requires limiting hunter harvest. Jenks et al. (2002) demonstrated that although management for maximum harvest opportunities and trophy white-tailed bucks were not mutually exclusive, in all reality circumstances under which both maximum sustained yield and trophy male production occur are limited by practical and biological constraints. In the end, some harvest opportunities must be reduced in some fashion in order to grow trophy deer.

In order to maximize hunter opportunity, many state wildlife agencies provide units with high or unlimited deer license numbers, usually allowing harvest of buck only deer. Because it takes relatively few male deer to breed the female population, this maximizes buck hunting opportunity. Density of hunters can be high under this management strategy, however, and numbers of older age bucks are usually few. In order to manage for quality or trophy opportunities, some state agencies provide units where licenses are limited to reduce hunter densities and reduce harvest on male deer, which allows more bucks to reach maturity. Some states may impose antler point restrictions as well in an attempt to affect overall abundance of large antlered deer. After decades of antler point restrictions and disappointing results, however, most western states and provinces have discontinued statewide antler point restrictions for mule deer management (MDWG 2013a). Several Midwestern and eastern state agencies still use antler point restrictions to regulate white-tailed deer harvest, which may increase the number of yearling bucks surviving into the 2.5 year old age class in deer units with unlimited license numbers.

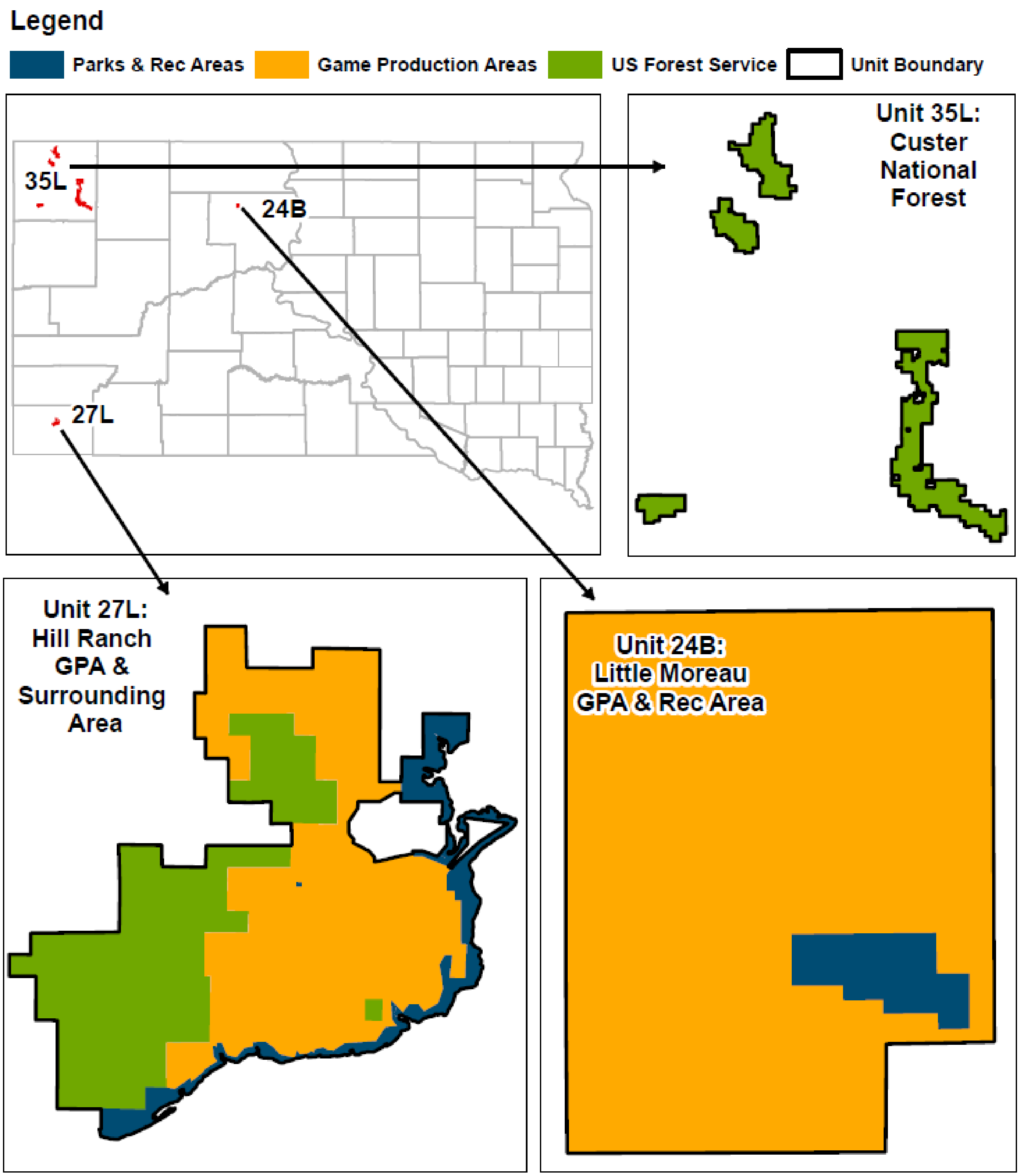



Figure 75. Limited access firearm units: 24B, 27L and 35L.

SDGFP does not currently have any deer management units that are designated for trophy deer management. Limited Access Units, discussed in the previous section, were developed to provide quality hunting areas but objectives for trophy deer or other measures have not been identified. In the Black Hills region, antler point restrictions were most recently imposed from 1996-2007 to improve buck hunting opportunity and buck quality, but this regulation was removed because restrictions implemented on license numbers appeared to have greater impacts. In fact, all firearm season licenses in South Dakota are currently limited and issued via a lottery system. Because limiting license and hunter numbers is probably the most effective method to manage for trophy deer, and because current regulations limit license numbers in all firearm deer units in South Dakota, SDGFP has management options in place that could allow for trophy deer management. However, SDGFP also has deer hunting licenses that are issued statewide or in large geographic units, and some of which are unlimited. For example, archery “any deer” licenses are issued for a statewide unit and are unlimited to both resident and nonresidents. Special buck licenses are limited in number (approximately 1500 licenses in 2016), but depending on license type a hunter is authorized to harvest a deer on only private land west or east of the Missouri River and are not unit specific. Additionally, muzzleloader “any deer” licenses are currently limited at 1,000, but similarly hunters may harvest a deer anywhere in the state. Antlerless archery, youth, and muzzleloader seasons have similar unlimited licenses and statewide type of units. In some management units, harvest from these unregulated user groups exceeds harvest from firearm hunters, therefore currently limiting the potential for trophy management.

In order to determine if management actions are resulting in more trophy deer harvest opportunities, an evaluation process must be in place. Many states evaluate deer management actions in hunting units (trophy vs. non-trophy) by examining herd composition data. For example, in Wyoming, biologists aim for a 20-29 bucks:100 doe post-season ratio in mule deer units managed more for recreational opportunity, whereas trophy units are managed for a 30-45:100 buck:doe ratio (D. Lutz, personal communication). In Montana, 10 bucks:100 does is their management plan minimum, but 15-40:100 are the buck ratios they strive for in special management areas (Adaptive Harvest Management 2001). Other states like North Dakota aim for a minimum 30:100 pre-season buck:doe ratio in all mule deer hunting units (unpublished data). Some caution must be used to interpret buck ratios, however, as buck ratios are not only affected by male harvest mortality and other mortality, but also female mortality (Bender 2006). Thus a significant change in female harvest alone could change buck ratios without impacting the number of males in the unit. In addition, SDGFP collects herd composition data prior to most hunting seasons, which are not comparable to most post-season data and goals set by many western states.

Other ways to evaluate trophy management would be to evaluate harvest data, more specifically age structure of bucks harvested, antler beam diameter or width, and/or number of antler points. In the past, SDGFP collected incisors from hunter harvested deer (see *Incisor Tooth Surveys* section) but sample sizes were rarely sufficient to evaluate individual firearm units. After examination of larger geographical areas, however, it is apparent that yearling buck harvest rates decreased in several parts of the state from 1976 to 2007 which suggests an increasing trend in larger antlered deer during this same time period. For example, 57.5% of the mule deer bucks harvested in the West River firearm season in 1976 were yearling bucks, and the overall trend of yearling bucks harvested decreased to 21% in 2007 (Figure 52 in *Incisor Tooth Surveys* section). Similar trends were experienced in yearling buck harvest proportions for white-tailed deer in the West River and Black Hills firearm seasons, and for mule deer in the

East River and Black Hills firearm seasons. Incisor teeth of hunter-harvested deer have not been collected in South Dakota since 2007, thus further use of this technique to evaluate trophy management is currently not an option.

Antler beam diameter or widths have not been collected by SDGFP, but Nebraska Game and Parks Commission currently uses antler widths to evaluate buck harvest ages (K. Hams, personal communication). Measurements of the inside spread between antler main beams that are greater than 11 inches are classified as 2.5 year old plus, those less than 11 inches are considered to be yearlings. There are also several other Midwestern states that evaluate the circumference measurements of main beam above the burr to classify adults vs. yearlings.

South Dakota does not currently have any buck:doe ratio goals or buck harvest objectives. Limited Access Units are managed for quality hunting opportunities, which should be further defined and evaluated. Other areas, such as firearm Units 2C, 45B, 45D, and 59A are units limited to portions of a county where larger public land complexes exist. Although private lands exist in these units as well, these areas should be evaluated to assess if dividing a larger deer unit into smaller units improved deer hunting quality and/or opportunity. Furthermore, USFWS refuge deer seasons provide unique public land hunting opportunities for hunters and should be included in any assessments on public land deer hunting. And lastly, the Black Hills provide another great opportunity for public land deer hunting and management.

Harvest surveys offer a potential means to evaluate management actions and have been used by SDGFP to evaluate significant changes made in deer harvest regulations in the Black Hills firearms season. A survey of Black Hills firearm hunters in South Dakota showed an overall increase in antler points (eastern method) of harvested whitetails from 6.7 points to 8.2 points from 1996 to 2007, respectively, and mule deer points increased from 4.7 in 1996 to 6.9 in 2007 (Gigliotti, 2007). This change is believed to have occurred primarily due to regulations that limited the number of licenses sold for the Black Hills deer firearm season, but also occurred during a time when antler point restrictions were in place.

A recent public opinion survey of hunters in 2015 provides some insights on South Dakota deer hunter desires for trophy management. When South Dakota hunters were asked to rank the importance of "harvesting large-antlered deer" in their decision to deer hunt, approximately 53% ranked this as important or very important, 34% were neutral, and 13% said it was unimportant or very unimportant (Longmire 2017a). Approximately 41% of deer hunters also said that they would be willing to hunt less often if it increased their chances to harvest a large-antlered buck when they had a license, whereas 35% said no, and 24% were undecided. Overall, about 56% of deer hunters in South Dakota were neutral when asked if they supported the creation of additional Limited Access Areas, 29% supported, and 15% opposed. When deer hunters were asked if they supported limiting archery, muzzleloader, and/or Youth Deer permits on Limited Access Areas (currently unlimited), approximately 60% were neutral, 20% opposed, and 20% supported (Longmire 2017a). Approximately 43% of deer hunters, however, supported SDGFP to further evaluate licensing concepts to regulate the number of deer hunters in specific areas, while 43% were neutral and 14% opposed.

**Disease**

White-tailed deer and mule deer have the potential to acquire and transmit diseases that may impact other wildlife, domestic animals, or deer population growth. In South Dakota, while there are several diseases documented within native deer herds, most diseases do not cause major concerns regarding the sustainability of deer populations within the State. Disease monitoring conducted by SDGFP and other agencies has occurred through research projects, harvest check stations, and opportunistic events. This section will address pertinent diseases, testing results, and the current knowledge of particular diseases that may be found and cause concern for deer management in South Dakota. In any case, emerging diseases may be identified in the future that have the potential to affect populations of both mule deer and white-tailed deer in South Dakota. Monitoring for any potentially new disease or evaluating current disease issues in South Dakota will continue.

Bovine Tuberculosis

Bovine Tuberculosis (TB) is caused by the bacterium *Mycobacterium bovis* and affects many ungulates including, but not limited to, deer, cattle, bison, and elk. During the early stages, wild ungulates with TB often appear healthy as infection is usually localized. However, this disease can become chronic and manifest itself, resulting in emaciation, depression, and intolerance to movement (Davidson 2006). In white-tailed deer, bovine TB is typically characterized by the formation of granulomas in the lungs, lymph nodes, and pericardium (Mackintosh et al. 2002). Jacques (2001) tested 1,638 white-tailed deer and 207 mule deer for Bovine TB during the 1998 and 1999 hunting seasons. Estimated overall prevalence of TB in white-tailed deer and mule deer harvested throughout South Dakota was 0.0% (0.0-0.002%) and 0.0% (0.0-0.018%), respectively (Jacques et al. 2003). Zimmerman (2004) also examined both white-tailed deer (n=44) and mule deer (n=52) in the Black Hills and found no evidence of TB in deer.

South Dakota was recognized as a TB-Accredited-Free state by USDA between 1982 and 2010 until two domestic cattle herds were infected by the disease (SDAIB 2016). In December of 2009, TB was found in a Yankton County cattle herd after a 3-year old cow was confirmed to be infected with the disease. The South Dakota Animal Industry Board (SDAIB) and owners of area cattle herds worked closely together to conduct additional testing for the presence of TB. SDGFP in cooperation with the SDAIB conducted testing on 50 white-tailed deer in the spring of 2010 in the area where the infected cow came from. No TB infected deer were found. In the fall of 2010, the same cooperating agencies conducted surveillance on Yankton county deer and 19 hunter harvested white-tailed deer were tested. These deer also came back negative for TB. In 2011, a domestic cattle herd in Hutchinson County was identified as infected with TB and subsequently quarantined (SDAIB 2016).

In 2017, SDAIB detected Bovine TB in a cattle herd in Harding County of northwestern South Dakota. State and federal animal health officials eventually tested all cattle in this index herd, depopulated all cattle, and found a total of 44 cattle that were positive for TB. Additional investigations into cattle sales and movement found one infected cow in an adjacent herd, and one cow in a herd from Butte County. To determine if TB was present in wildlife populations near the index cattle herd in Harding County, SDGFP conducted disease surveillance on wildlife in the area in late March. A total of 199 samples were collected including 9 raccoon, 37 coyotes, 42 pronghorn, 56 mule deer, and 55 white-tailed deer. At the time of this report, laboratory results from wildlife samples were not available and thus short-term and long-term wildlife surveillance strategies are yet to be developed. Wildlife is not the source of this TB infection in cattle as the strain of the bacteria is very similar to a strain of TB identified in Queretaro, Mexico in 1997. This particular strain of TB has never been identified in the United States, and the method of introduction into the Harding County cattle herd is unknown at this time.

The history of TB sampling in wild deer in South Dakota is limited, but no wild deer have ever tested positive for TB in the state. Surveillance efforts will continue on livestock herds and will be coordinated by SDAIB. Deer and other wildlife TB surveillance efforts and methods will be discussed in the near future as more disease testing results become available.

Bovine Viral Diarrhea

Bovine viral diarrhea (BVD) is a viral disease of cattle and other ruminants that is caused by the bovine viral diarrhea virus (BVDV), which is a member of the *pestivirus* genus (Williams 1999). There are two recognized strains of BVDV: BVDV-1 and BVDV-2. The clinical signs of BVDV infection range from none to severe depending on the genotype of the virus, whether the infection was recently acquired (i.e., acute) or has been acquired for months (i.e., chronic), whether the animal is pregnant, as well as other factors (USDA APHIS 2007). Some of the signs of acute infection are fever, lethargy, loss of appetite, ocular discharge, nasal discharge, oral lesions, diarrhea, and decreasing milk production. Chronic infection may lead to signs of mucosal disease (USDA APHIS 2007).

Cattle are commonly vaccinated for BVD which generally prevents outbreaks of the disease; however, transmission may occur *in utero*, leading to congenital infection of the fetus which can result in resorption, abortion, or stillbirth. Congenitally infected fetuses that survive *in utero* infection (i.e., the live-births) may be born as BVDV-infected calves. The BVDV infection in these calves will persist during the entire life of the calf, and they will shed BVDV continuously (USDA APHIS 2007). Cattle persistently infected with BVDV are a continual risk for viral transmission to susceptible hosts, including white-tailed deer and mule deer. Persistent BVDV infections have been identified in wild populations of white-tailed deer (Passler et al. 2016) and mule deer in Wyoming (Van Campen et al. 2001), and BVDV transmission has been observed to occur among captive white-tailed deer (Passler et al. 2010). Furthermore, some persistently infected deer were described through epidemiologic investigations to survive into adulthood providing strong evidence that these deer can be reservoirs for BVDV in wild deer populations (Van Campen et al. 2001, Passler et al. 2016).

Zimmerman (2004) tested both white-tailed deer and mule deer in the Black Hills for BVDV-1 and BVDV-2. Positive titers for BVDV-1 were found in 14 of 52 mule deer (27%), and 7 of 42 white-tailed deer (17%). Additionally, positive titers for BVDV-2 were found in 3 of 34 mule deer (9%) and 4 of 31 white-tailed deer (13%). Chase et al. (2008) reported two white-tailed deer in southeastern South Dakota during the fall of 2003 with gross and microscopic lesions and virologic findings of infection with BVDV and further investigation concluded that both animals likely died from this disease. Additionally, between July 2003 and June of 2004, approximately 607 white-tailed deer and 60 mule deer were tested for the BVDV virus in South Dakota, and the virus was not found (Chase et al. 2008). Although Van Campen et al. (2001) found evidence of the disease circulating in wild mule deer populations in neighboring Wyoming, there is no evidence that persistent infections in wild deer occurs in South Dakota, and future field surveys are needed to determine the incidence of BVDV. The most significant vector of BVD virus for range cattle is a persistently infected bovine carrier within a herd, and not wild ruminants (Williams 1999).

Brucellosis

Brucellosis (Bang's disease) is caused by the bacterium *Brucella abortus*. Brucellosis in wildlife is generally associated with wild elk and bison in and around Yellowstone National Park and currently is not found in wild or domestic cervids elsewhere in North America. Brucellosis is known to cause abortion in elk, cattle, and bison, and transmission from one animal to another usually occurs at the time of abortion as large amounts of bacteria are expelled with the infected fetus (Williams 1999). Brucellosis does not occur in free-ranging deer outside of the Greater Yellowstone area (Williams 1999). Therefore, it is believed that brucellosis does not exist in wild deer populations in South Dakota.

Chronic Wasting Disease

Chronic Wasting Disease (CWD) is a recent disease of cervids and has received substantial attention in South Dakota over the past 20 years. CWD is a fatal brain disease of deer, elk, and moose that is caused by an abnormal protein called a prion. Animals infected with CWD show progressive loss of weight, poor body condition, behavioral changes, excessive salivation, increased drinking and urination, loss of muscle control and eventual death. While researchers have observed the transmission of CWD prions to deer through contaminated saliva and blood (Mathiason et al. 2006), the infection pathway of the pathogenic protein is not fully understood at this point. CWD is always fatal for the infected animal.

In South Dakota, CWD was discovered in seven captive elk facilities during the winter of 1997-98 and in another captive elk herd in 2002. These positive captive herds were located in Pennington, Custer, and McPherson counties. After the disease was discovered, research was initiated in cooperation with South Dakota State University to determine the extent and prevalence of CWD in wild cervid populations. Jacques (2001) tested a total of 519 white-tailed deer and 128 mule deer for CWD from 1997-1999 and found no positive CWD deer in any areas of the State. CWD was first discovered in the wild in 2001 when a positive white-tailed deer in Fall River County was detected during the 2001 big game hunting season. Since 2001, CWD has been found in 107 white-tailed deer and 79 mule deer within the counties of Pennington, Custer, and Fall River. These include 2 white-tailed deer and 8 mule deer from within the boundaries of Wind Cave National Park, 1 white-tailed deer from Custer State Park, and 175 deer from hunting units within the Black Hills Fire Protection District or surrounding areas (Figures 76 and 77).

As of April 2016, a total of 13,235 white-tailed deer and 6,050 mule deer have been tested. Although prevalence rates from hunter harvested individuals have risen slightly in the last decade, they have remained low (Figures 78 and 79, Tables 81 and 82). As a result, managers in South Dakota have not yet seen any indication that CWD has negatively affected deer population growth rates, but data are lacking on determination of population effects in South Dakota.

Deer as young as 16 months can show clinical signs of the disease which would suggest that this would be a minimum incubation period (Williams 2005). Maximum incubation periods in free-ranging, naturally exposed animals are difficult to determine due to the inability to determine when exposure occurred, but average incubation periods probably range from 2-4 years (Williams 2005). In South Dakota, the youngest deer documented with CWD was a six month old hunter harvested fawn that was diagnosed through laboratory testing. CWD is a disease that cannot be diagnosed by observation of physical symptoms because many big game diseases affect animals in similar ways. In wild cervids, the only practical method of testing for this disease is through lethal removal and sampling of infected tissue. This tissue generally includes the retropharyngeal nodes and/or the obex of deer that are collected from hunter harvested cervids. Schuler et al. (2005) investigated the collection of tonsillar follicles on live deer in Wind Cave National Park and found that sampling of tonsillar material was effective at diagnosing CWD if the correct tissue was collected. Wolfe et al. (2007) also recognized the effectiveness of sampling tonsillar follicles in determining if CWD infection was present, but recognized the practical limitations of testing wild free-ranging deer, as the practice of capturing, anesthetizing, and precisely sampling individual deer limits the broad use of this method. Wolfe et al. (2007) evaluated the use of rectal lymphoid tissue sampling for CWD diagnosis in white-tailed and mule deer and found that sample quality should be considered when interpreting data from the biopsies. The further evaluation of this method of testing for CWD was supported by Wolfe et al. (2007). Geremia et al. (2015) noted that biopsy of rectal lymphoid tissue provided a useful, but imperfect live-animal test for CWD in mule deer as it would be difficult and expensive on free-ranging animals. The use of tonsillar biopsy and rectal lymphoid tissue sampling are alternative methods of testing for CWD on live and dead cervids, but needs to be evaluated in individual sampling schemes.

Researchers have found reduced overall population growth in areas with high prevalence rates. Miller et al. (2008) found in Colorado, that survival of prion infected mule deer females (0.53) when compared to uninfected mule deer females (0.82) was markedly lower and that CWD can affect mule deer populations on a local level. DeVivo (2015) noted the same trend with prion infected mule deer survival (.32) being lower when compared to uninfected mule deer survival (0.76). Dulberger et al. (2010) reported a prevalence rate of 21% in female mule deer in Colorado with a population growth rate of 0.97. This is in contrast to an estimated population growth rate of 1.04 in the uninfected portion of the population. DeVivo (2015) found that average annual CWD prevalence ranged from 21-27% in a mule deer herd in Wyoming which equated to a modeled population growth rate of 0.81 and a corresponding 19% annual decline in the population. Findings suggested that with CWD absence, the modeled population growth would be stable at $\lambda = 1.0$ with further suggestions that the effect of CWD on adult survival was important in shaping population growth rates and CWD contributed to the observed mule deer population decline (DeVivo 2015). Edmunds (2013) found an annual estimated CWD prevalence rate of 23.8% in a white-tailed deer population in Wyoming and this equated to a population growth rate of 0.8960, or a 10.4 % annual decline in the population. To produce a growth rate of ≥ 1.0, or a sustainable population, would require the elimination of female harvest (Edmunds 2013). South Dakota has estimated CWD prevalence rates of 2.3% in white-tailed deer and 4.3% in mule deer in the southwestern area of South Dakota (Figure 78 and 79). These prevalence rate estimates are based on volunteer hunter harvested samples and are current to 2012. Due to reduced license allocation from lower deer populations and the loss of federal funding for CWD surveillance, sample size on deer species since 2012 is not adequate for accurate prevalence rate analyses. More research needs to be conducted to establish an updated prevalence rate in the state.

Dulberger et al. (2010) noted that CWD infected mule deer in Colorado weaned 0.95 fawns and uninfected mule deer weaned 1.34 fawns, but this difference in recruitment did not have an overall effect on population growth. DeVivo (2015) found that fawn recruitment was similar between CWD-negative (average = 0.48) and CWD-positive mule deer (average = 0.56), and that mean annual pregnancy of CWD-negative and CWD-positive females was similar (0.99 and 0.94, respectively). In contrast to Colorado results, DeVivo (2015) found that CWD caused significant overall declines in the southern Converse County mule deer herd in Wyoming. As with the mule deer population in Wyoming, Edmunds (2013) found that there was no difference in pregnancy of white-tailed deer between CWD-negative and CWD-positive females (0.95 and 0.92) respectively, and that recruitment of fawns was not significantly different between CWD positive or negative deer, thus pregnancy and recruitment results indicate CWD does not compromise reproduction in female white-tailed deer. Edmunds (2013) also found that CWD at high prevalence in white-tailed deer in Wyoming was found to significantly lower annual survival of adult deer and was directly implicated as the main cause of decline in this population.

Although research has not been conducted on South Dakota white-tailed deer and mule deer in regards to the effect of CWD on population growth, research by Edmunds (2013) on white-tailed deer in Wyoming, and research on mule deer in Wyoming (DeVivo 2015) suggest that there is a negative effect on population growth of both species that have high prevalence rates. Variable CWD prevalence, duration of epidemics, species of interest, and other extrinsic factors influence the severity of CWD on population declines (DeVivo 2015). Active surveillance aids in determining the distribution and prevalence of CWD and can be used to elucidate changes over time (Conner et al. 2007). Localized population reduction, regulating translocation of deer, and banning baiting and feeding have all been attempted to slow down the spread of CWD (Campbell and VerCauteren 2011).

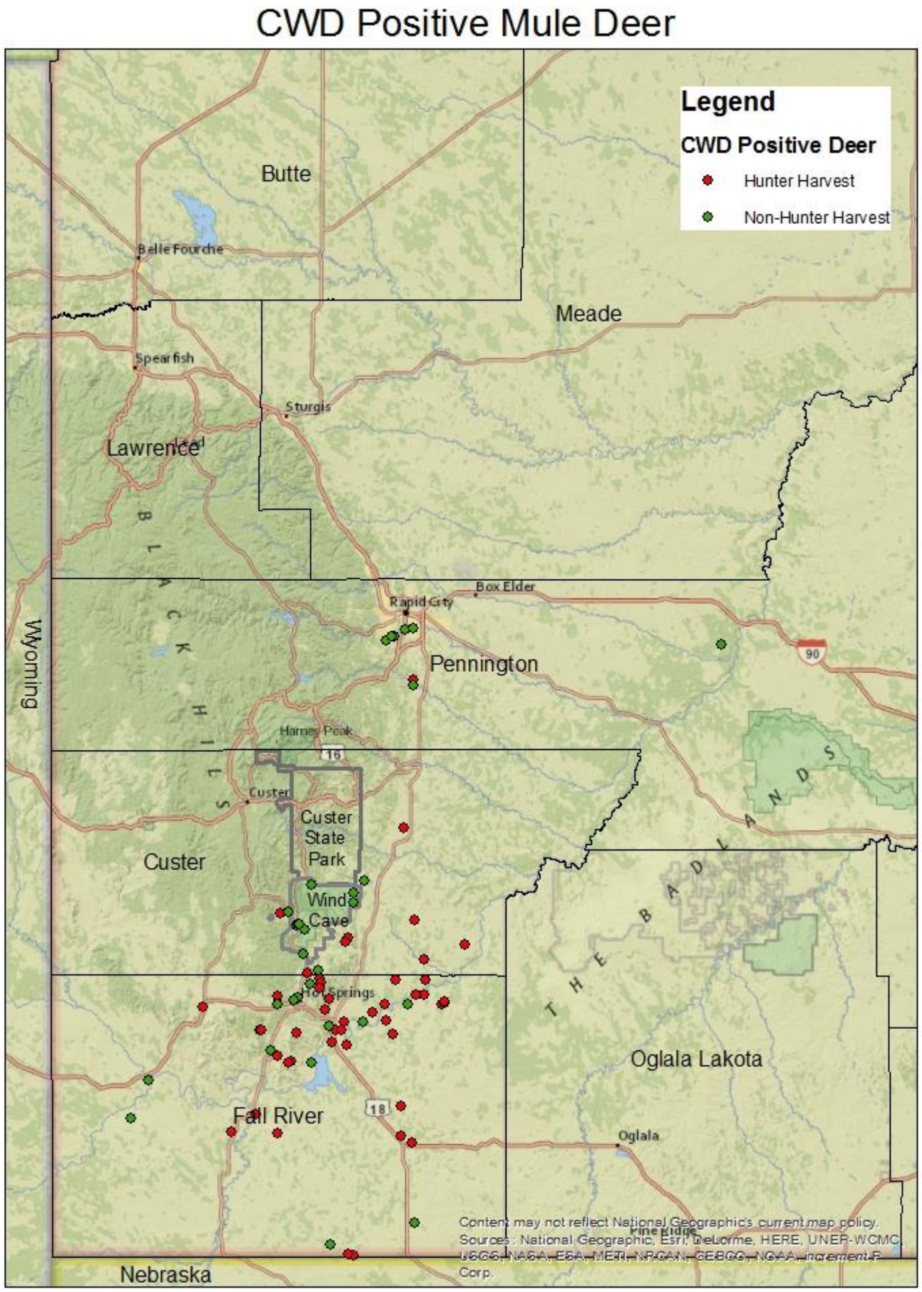



Figure 76. Chronic wasting disease positive wild mule deer in South Dakota, 2001-2015.

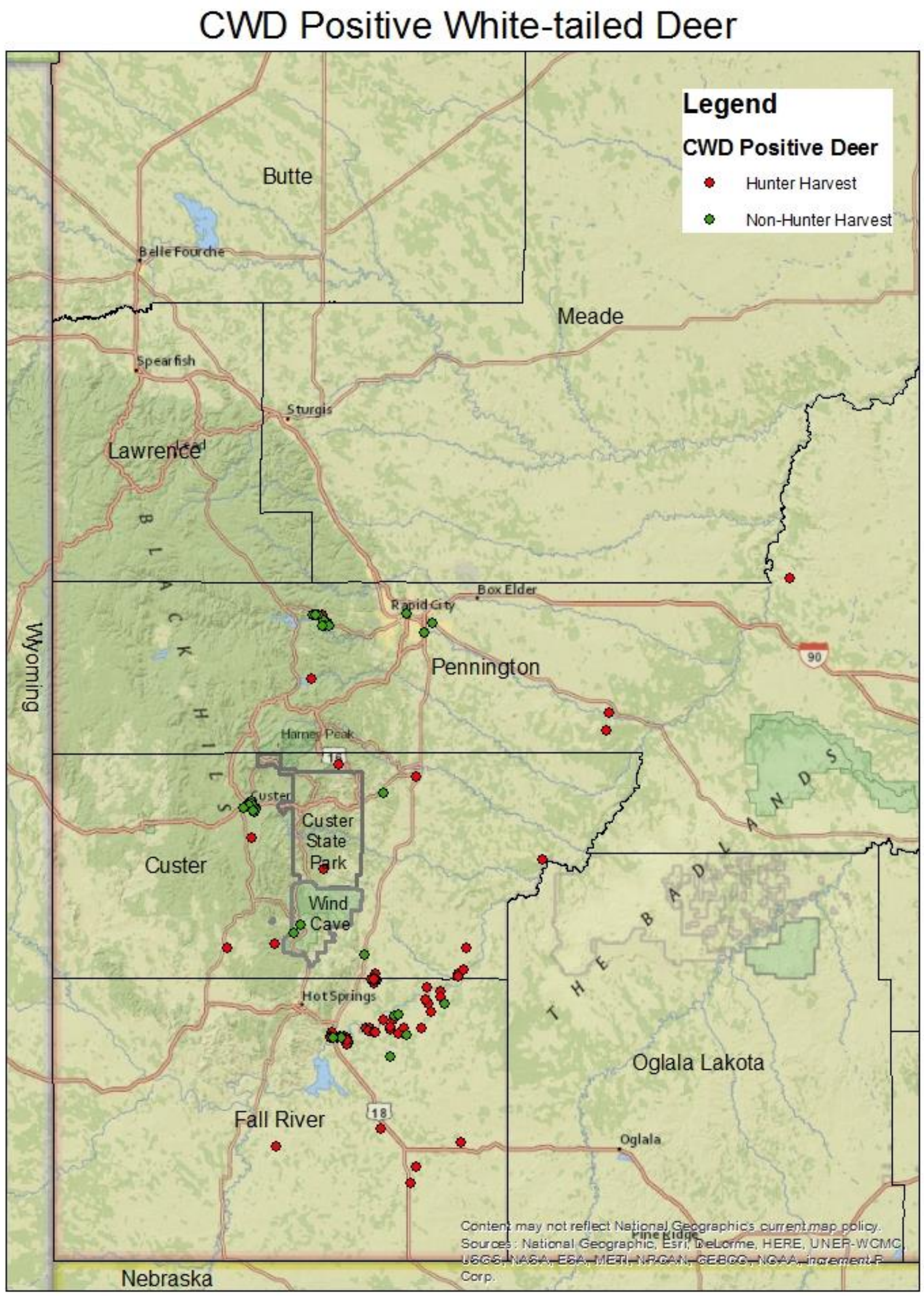



Figure 77. Chronic wasting disease positive wild white-tailed deer in South Dakota, 2001-2015.

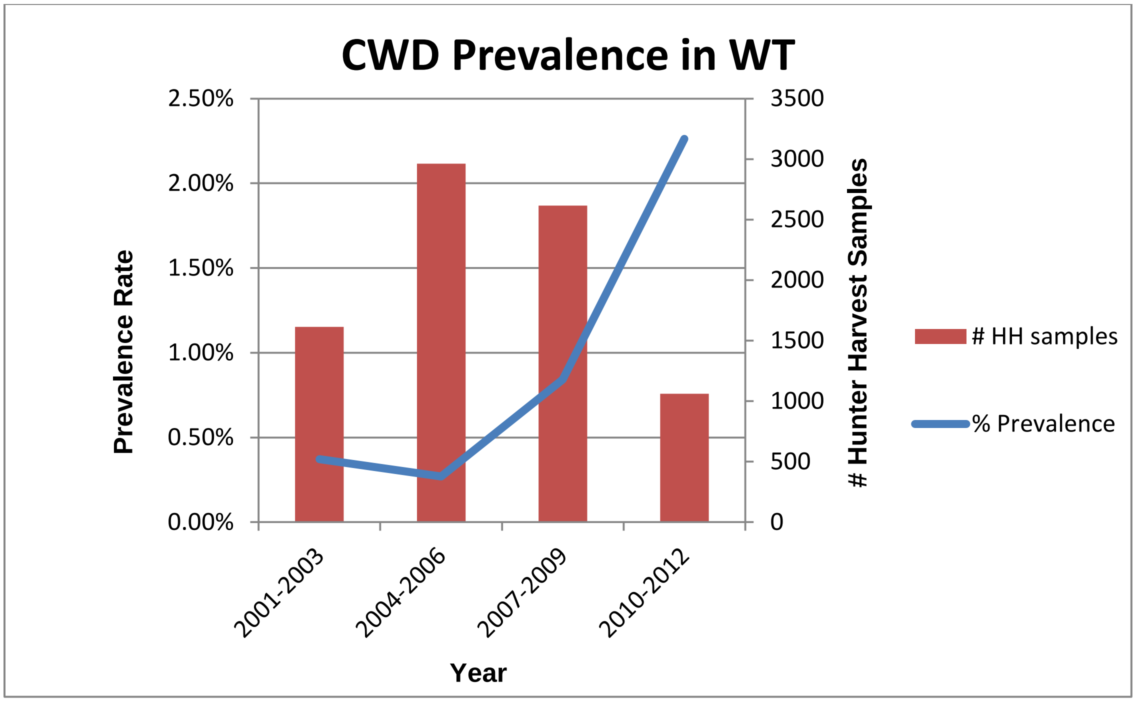



Figure 78. Three-year average prevalence rates for chronic wasting disease from hunter harvested white-tailed deer in South Dakota, 2001-2012.

Table 81. Number of hunter harvested white-tailed deer sampled, number of positive chronic wasting disease deer samples collected, and percent prevalence of chronic wasting disease in white-tailed deer in southwestern South Dakota, 2001-2012.

| Year | Number of Hunter Harvested Samples | Number of Positives | Percent Prevalence |
|---|---|---|---|
| 2001 | 139 | 1 | 0.72% |
| 2002 | 530 | 3 | 0.57% |
| 2003 | 944 | 2 | 0.21% |
| 2004 | 1,092 | 3 | 0.27% |
| 2005 | 1,044 | 2 | 0.19% |
| 2006 | 827 | 3 | 0.36% |
| 2007 | 1,059 | 7 | 0.66% |
| 2008 | 895 | 4 | 0.45% |
| 2009 | 661 | 11 | 1.66% |
| 2010 | 494 | 10 | 2.02% |
| 2011 | 509 | 10 | 1.96% |
| 2012 | 58 | 4 | 6.90% |
| | | | |
| Total | 8,252 | 60 | 0.73% |

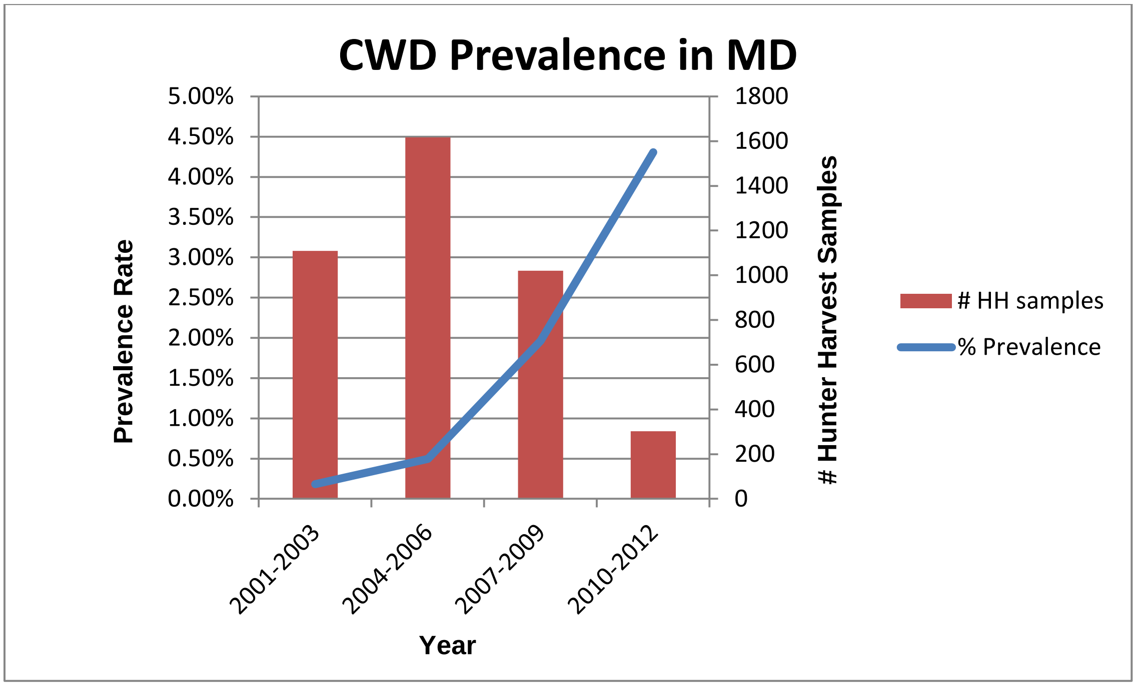



Figure 79. Three year average prevalence rates for chronic wasting disease from hunter harvested mule deer in South Dakota, 2001-2012.

Table 82. Number of hunter harvested mule deer, number of positive CWD deer samples collected, and percent prevalence of CWD in mule deer from 2001-2012 in southwestern South Dakota.

| Year | Number of Hunter Harvested Samples | Number of Positives | Percent Prevalence |
|---|---|---|---|
| 2001 | 94 | 0 | 0.00% |
| 2002 | 464 | 2 | 0.43% |
| 2003 | 551 | 0 | 0.00% |
| 2004 | 585 | 1 | 0.17% |
| 2005 | 581 | 3 | 0.52% |
| 2006 | 451 | 4 | 0.89% |
| 2007 | 408 | 5 | 1.23% |
| 2008 | 334 | 9 | 2.69% |
| 2009 | 278 | 6 | 2.16% |
| 2010 | 175 | 6 | 3.43% |
| 2011 | 115 | 7 | 6.09% |
| 2012 | 12 | 0 | 0.00% |
| | | | |
| Total | 4,048 | 43 | 1.06% |

Hemorrhagic Disease

Epizootic hemorrhagic disease (EHD) and bluetongue (BT) are caused by *orbiviruses* that are spread by biting flies of the genus *Culicoides* (Davidson 2006). The EHD virus has 2 serotypes that mainly affect white-tailed deer, while the BT virus has up to 6 serotypes and can also affect mule deer, bighorn sheep, elk and pronghorn in South Dakota (Davidson 2006). Because clinical disease produced by EHD and BT viruses is indistinguishable, the general term "hemorrhagic disease" (HD) is often used when the specific causative virus is unknown. HD is the most common occurring viral disease of white-tailed deer in the United States, and is endemic to South Dakota. Hemorrhagic disease usually affects deer herds in South Dakota in the late summer or early fall and is the most important disease in South Dakota as it relates to the number deer that can be lost in a short period of time. The frequency and severity of outbreaks vary regionally and annually and are dependent on a herd's level of immunity from past exposure, the virulence of the particular strain of the virus, and the abundance of *Culicoides* vectors (Kreh 2012). During drought years the losses can be exacerbated when deer congregate to drink at nesting sites for *Culicoidesa sp.* (SDSU 2012). In the southeastern US deer herds tend to have antibodies to multiple strains of HD, indicating a high rate of previous viral infection; whereas, in deer in the northern plains region experience less frequent outbreaks of HD with comparatively higher mortality rates (SCWDS 2013).

HD lesions are also variable and can be peracute, acute, or chronic. In the peracute form, animals often die rapidly and exhibit edema of the conjunctiva, head, lungs, neck, and tongue (SCWDS 2016). In the classic acute form of HD, peracute lesions often exist plus animals may display congestion or hemorrhages in the heart, intestines, and rumen, and necrosis on the dental pad, omasum, rumen, and tongue (SCWDS 2016). In addition to the above, deer displaying the chronic form of HD may have cracked or irregular hooves and loss of rumen papillae (SCWDS 2016).

Historically in South Dakota, deer showing symptoms of HD were documented in Mid-August of 1952 when reports of dead white-tailed deer began trickling into SDGFP offices (Bever 1957a). A large number of field post mortems revealed that massive lung hemorrhages and minor hemorrhages in other organs of the body preceded death. Although HD as a disease was not recognized in South Dakota at the time, blood samples and other body tissues sent to various veterinarians and to the state college failed to indicate the agent of death (Bever 1957a). The disease was centered in the south-central part of South Dakota, and was not found in the Black Hills. Bever (1957a) also noted that North Dakota officials recorded a light mortality; Nebraska, a moderate mortality; and in Missouri it was located in enough areas to launch an investigation. None of the states where the disease occurred could determine the cause of death (Bever 1957a).

Shope et al. (1960) first verified the EHD virus in South Dakota deer from tissues submitted from a deer that died in 1956. EHD outbreaks were found in South Dakota among white-tailed deer as well as the occasional mule deer (Trainer 1964). Trainer (1964) also noted that although these reports were the first confirmed cases of the disease, searches of literature and personal correspondences showed that die-offs from a disease showing similar symptoms to

EHD had been occurring in North America since 1890. In South Dakota, investigations continued to learn more about the EHD virus during 1959 (Pirtle 1960) and 1960 (Dahlgren 1961). In 1961-1962, Trainer (1964) isolated the EHD virus in mule deer from a naturally occurring outbreak in both North and South Dakota, thus suggesting that mule deer were susceptible to EHD, but to a lesser degree than white-tailed deer. In subsequent years, the disease was recognized as endemic to South Dakota, and EHD or BT has been recognized as a disease with reoccurring outbreaks since 1952 (Parikh 1968, SDGFP internal data) and has been recorded at least once in all South Dakota counties except 2 in the northeast part of the state. Since 1980, SDGFP has cooperated with the Southeastern Cooperative Wildlife Disease Study (SCWDS) in reporting EHD or BT events in South Dakota. Data are sent from South Dakota to SCWDS for annual documentation of EHD/BT surveillance across the country. Data also exists in South Dakota from 1952 to 1966 with spotty information of EHD/BT outbreaks. Data from 1967-1979 is variable even though deer were dying on occasion from what was believed to be EHD/BT, and there were suspected deaths associated with this disease reported by Reed and Shave (1976).

As understanding of the disease became more prominent, events of deer mortality were better documented in South Dakota. From 2007-2016, improved data collection and recording methods assisted in obtaining more accurate accounts of the actual number of deer and other wildlife that may have died from EHD/BT (Figure 80). During this same time period, documentation of the virus was also obtained through sample submissions the SDSU Animal Disease Research and Diagnostic Laboratory (ADRDL) in Brookings, SD.

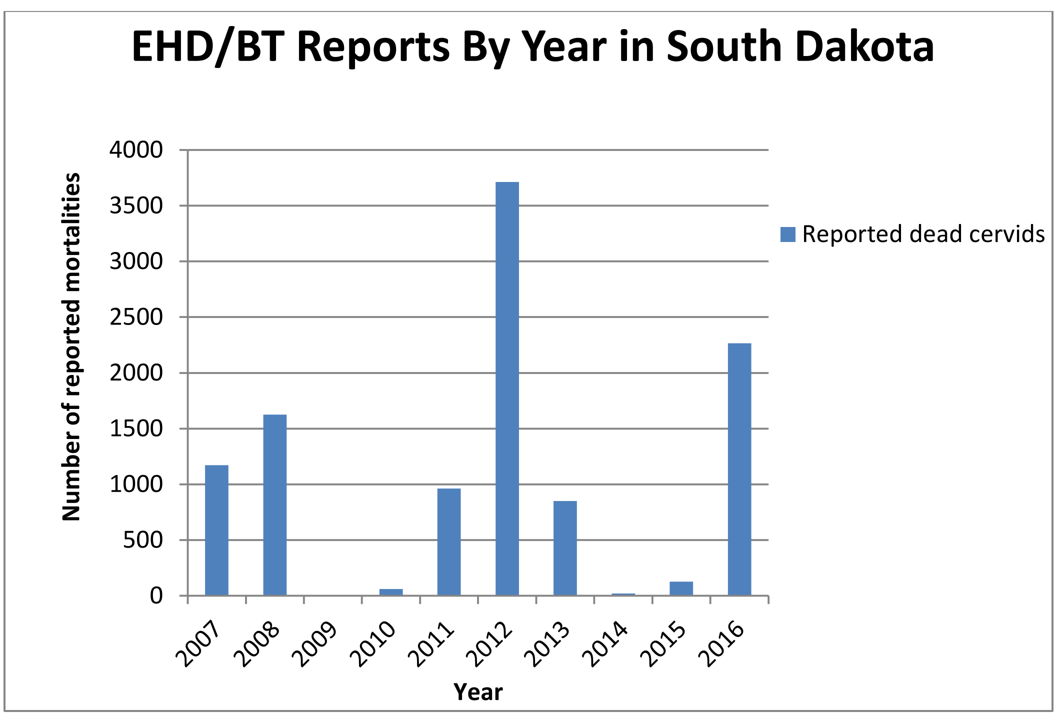



Figure 80. Reported loss of deer, elk, and pronghorn in South Dakota, 2007-2016.

In years when South Dakota has documented large die-offs of deer in particular management units, unsold licenses in these areas are removed after the second draw, and license refunds are offered to hunters. These management actions are taken to address hunter satisfaction concerns over potentially lower deer densities, and to help maintain management objectives if loss of deer was substantial. These actions occurred in various units in 2012 (3,714 reported HD deaths), 2013 (850 reported deaths), in 2015 (108 reported deaths in Sully County), and in 2016 (2,267 reported deaths). In 2016, unsold licenses were removed in 11 East River deer firearm units, and refunds were offered for all firearm deer licenses in all of eastern South Dakota, 2 firearm units in western South Dakota, and all archery, muzzleloader, and Youth Deer units. In 2011, there were about 956 deer that were reported as dying from suspected EHD/BT, but no large concentration of deaths occurred as to warrant tag returns in any hunting units. SDGFP will continue to monitor and record annual mortalities that are associated with hemorrhagic disease and utilize information to manage deer populations accordingly.

### Leptospirosis

Leptospirosis is a worldwide disease of mammals that is caused by the *Leptospira interrogans* spirochete bacteria (Bolin 2003). There are many distinct variations, or serovars, of the *L. interrogans* bacteria, and each host species is susceptible to a unique subset of serovars that produce different clinical symptoms (Bolin 2003). For example, cattle and wild ruminants may contract leptospirosis, but serovars specific to cattle are different than those found in cervids, making interspecies transmission to deer insignificant (Williams 1999). Leptospirosis is spread through direct or indirect contact with infected urine, placental fluid, or milk, and spirochetes can persist in the environment for long periods, especially in cool, wet conditions (Mackintosh et aI. 2002).

Naturally infected white-tailed deer rarely exhibit clinical leptospirosis signs, and white-tailed deer experimentally inoculated subcutaneously with leptospirosis also showed no obvious clinical signs; however, deer experimentally infected with serovariety *L. interrogans pomona* developed nephritis, hepatitis, and hemorrhages (Campbell and VerCauteren 2011). Hemorrhages, liver enlargement, edema, congestion in lungs, and hematuria have been observed in cervids with leptospiral antibodies (Mackintosh et aI. 2002).

Limited information suggests that white-tailed deer do not play a major role in the maintenance and spread of leptospirosis (Campbell and VerCauteren 2011). Furthermore, leptospirosis is rarely found in white-tailed deer (Campbell and VerCauteren 2011) and mule deer (WAFWA 2014), and the risk of humans contracting the disease from deer is low. This bacterium is not considered a high risk to white-tailed deer or mule deer in South Dakota.

### Meningeal Worm

Meningeal worm (*Parelaphostrongylus tenuis)* is a parasitic worm found in white-tailed deer throughout most of eastern North America. White-tailed deer are considered a normal host for *P. tenuis*, and the life cycle of the parasite is usually completed in this species (Davidson 2006), and it is extremely rare among mule deer (Jacques and Jenks 2003). White-tailed deer infected with meningeal worms only rarely display clinical signs of disease; however, in cases of massive infestations, deer may show neurological signs, including partial paralysis, loss of motor function, or circling (Lankester 2001).

The potential for meningeal worms to become established in the western United States is dependent on the presence of suitable terrestrial gastropods (e.g., snails [*Zonitoides sp., Discus sp*.] and slugs [*Deroceras sp*.]) that are required to complete their life cycle (Jacques 2001). Cervids become infected when they accidentally ingest terrestrial gastropods along with vegetation (Lankester 2001). Once ingested, the meningeal worms can produce severe neurologic disease with lesions usually found in the central nervous system that can result in death (Davidson 2006). Because *P. tenuis* is a significant threat to all native cervids in North America other than white-tailed deer, natural resource managers and biologists undertaking cervid translocation activities should consider and take preventative measures to prevent meningeal worm introductions into susceptible herds (Davidson 2006).

Oates et al. (1999) tested 142 white-tailed deer and 21 mule deer in South Dakota, and found 7% infection in white-tailed deer and no infection in mule deer. Very similar results were found in eastern Nebraska with 22 of 300 (7%) white-tailed deer infected and 0 of 53 (0%) mule deer infected with meningeal worm. Oates et al. (2000) reported that *P. tenuis* in western Nebraska was identified in 17 (10%) of 168 white-tailed deer, while only one out of 273 mule deer contained the parasite; furthermore, this was the first naturally occurring infection of *P. tenuis* recorded in a mule deer.

Jacques (2001) tested 2,848 white-tailed deer in South Dakota from 1997-1999 and found 578 (20.3%) deer infected with the parasite. Of these infected white-tailed deer, 98.6% were found east of the Missouri River. No worms were found in 215 mule deer that were examined (Jacques 2001). Jacques and Jenks (2004) noted that because only the meninges and cranial surfaces of the brains of mule deer were examined, and other areas around the brain including the cranial nerves and, medulla were not examined that the percentage of mule deer infected may have been higher than recorded. Zimmerman (2004) examined 52 mule deer and 45 white-tailed deer in the Southern Black Hills and found no evidence of the parasite. In 2001, SDGFP documented the first occurrence of this parasite in mule deer in South Dakota (Jacques and Jenks 2003). Since this first finding of the parasite, SDGFP has documented very few mule deer (n=9) exhibiting neurologic disorders, and upon necropsy, have found evidence of infection with meningeal worm. All of these reports of meningeal worm in mule deer have come from counties along the Missouri River in central South Dakota. In 2008, SDGFP documented a mule deer from Gregory County that was found to be infected with meningeal worm. In 2011-2012, two more mule deer showed neurologic symptoms that may have been meningeal worm, and one of these was confirmed from Tripp County. During 2015-2016, a total of 6 mule deer were either confirmed with meningeal worm, or showed signs of potential parasite infections from the counties of Stanley, Lyman, and Brule.

Although meningeal worm has not been found in large numbers of mule deer in western South Dakota due to the lower prevalence of the host gastropods, the presence of *P. tenius* in white-tailed deer populations indicates that closer monitoring of mule deer populations in areas where both mule deer and white-tailed deer coexist is needed. As shown by the findings above, infections of mule deer with the parasite would be more likely to occur along the Missouri River in the central regions of South Dakota. For mule deer in far western South Dakota, the meningeal worm is not considered a disease of concern at this time. Although very few reports have been confirmed in South Dakota, this is a parasite that must receive recognition and surveillance must continue to document where it is found.

Paratuberculosis

Johne's disease, also known as paratuberculosis, is a contagious, chronic, and often fatal infection of ruminants, including white-tailed and mule deer, that is caused by the bacteria *Mycobacterium paratuberculosis* and is found worldwide (Campbell and VerCauteren 2011, WAFWA 2014). Johne's disease primarily affects small intestines of ruminants, and cases have been reported in domestic (e.g., cattle, goats, and sheep) and wild and captive ruminants (e.g., axis deer, fallow deer, red deer, reindeer, roe deer, sika deer, white-tailed deer, mule deer, elk, moose, bison, aoudad, mouflon, and bighorn sheep) (Campbell and VerCauteren 2011). Progression of the disease may be more rapid in deer than cattle (Williams 1999).

*M. paratuberculosis* is predominately spread by ingesting food or water contaminated with infected feces, but it can also be spread to offspring by ingesting contaminated milk (Mackintosh et al. 2002). Healthy deer showing no clinical symptoms of the disease may carry the bacterium and serve as a primary source of transmission by shedding *M. paratuberculosis* in their feces (Campbell and VerCauteren 2011).

White-tailed deer and mule deer are not a major reservoir for Johne's disease (Campbell and VerCauteren 2011, WAFWA 2014). Management of the disease may include minimizing contact between infected and uninfected individuals, moving or relocating individuals from only *M. paratuberculosis*-free herds or areas, and testing for *M. paratuberculosis* as part of a herd-health monitoring plan (Campbell and VerCauteren 2011). Zimmerman (2004) tested 52 mule deer and 42 white-tailed deer in the Black Hills from 2002-2003 and found no evidence of this disease. Williams (1999) stated that paratuberculosis is not common in beef cattle or wild ruminants and interspecies transmission is not likely. This disease is not believed to be of major concern to deer populations in South Dakota.

Anaplasmosis

Anaplasmosis is a tickborne disease (see *External Parasites* section) of blood cells that is caused by the bacterium *Anaplasma phagocytophilum. A. phagocytophilum* can infect ruminants (including white-tailed deer and mule deer), humans, dogs, and horses (PGC 2016a). The western blacklegged tick in the upper Midwest and the deer tick in the Northeast are the most common vectors of the disease (NIAID 2016). Anaplasmosis causes anemia and symptoms include decreased milk production, loss of appetite, loss of coordination, panting, rapid pulse, and, in severe cases, death (Merck Publishing 2015). The severity of symptoms increases with age, with younger individuals often not exhibiting symptoms (Merck Publishing 2015).

For the disease to persist in a given area, the *A. phagocytophilum* requires an active vector population and a population of persistently infected hosts (Merck Publishing 2015). Suitable conditions for persistence of the disease are not currently present in the Northern Plains as tick populations are active for a relatively short time period, and more importantly, there is not a resident population of infected animals for which to serve as a source of the bacteria (Daly 2016). Research suggests that the strain of anaplasmosis found in white-tailed deer is not associated with human infection (Massung et al. 2005).

The only documentation of anaplasmosis in South Dakota deer occurred in February of 2009. SDGFP received reports of sick and dead mule deer from Jackson and Mellette Counties in south-central South Dakota. Deer found sick had rough coats, were lethargic, and had high tick loads. These “winter ticks” were identified as a new species to South Dakota (*Dermacentor spp)* and are known to carry anaplasmosis. Biological samples from sick deer were sent to the SDSU Diagnostic lab, and 4 of 11 deer (10 MD, 1 WT) tested positive for anaplasmosis.

<u>Adenovirus Hemorrhagic Disease</u>
Adenovirus hemorrhagic disease (AHD) is caused by adenoviruses and has been well-documented in wild mule deer populations (ODFW 2016). The disease has also been observed to kill inoculated white-tailed deer fawns in captivity, leading researchers to believe that wild white-tailed deer populations may be at risk as well (Woods et al. 2001). This family of viruses most commonly causes sporadic cases that affect a few animals in local populations; however, AHD can cause large-scale disease outbreaks under certain conditions (ODFW 2016). In 1993, the first documented deer AHD virus outbreak in the US occurred in California and killed several thousand mule deer in 17 counties; mortality was very high among fawns and moderate among adults (Woods et al. 1996). Deer died in roughly the same proportions during a separate outbreak in Oregon in 2002 (ODFW 2016). The disease has also been documented in Wyoming, with the first case reported in 1999 and subsequent cases have been reported every year since. In 2015, Wyoming saw a spike in ADH infections, but it is unknown if this increase is due to improved diagnostics, the disease itself, or both (WGFD 2016).

Symptoms of AHD infections include rapid, open mouth breathing; excessive drooling; bloody diarrhea; weakness; and large amount of fluid in the body cavity (ODFW 2016). Advanced stages of the disease can lead to ulcers and abscesses in the mouth and throat, and death can occur within 3 to 5 days from the time the deer was exposed to the virus (ODFW 2016).

The AHD virus is primarily spread through direct contact with bodily fluids, so proper carcass disposal, prevention of infected deer concentrating near artificial feeding or water sources, and not moving infected live deer are recommended methods to minimize movement of the disease to new areas (ODFW 2016). AHD in South Dakota could lead to potentially significant localized mule deer losses in some areas. While the disease is not well understood and more research is needed, there is currently no data to suggest that AHD is responsible for long-term mule deer declines in South Dakota.

Deer Nasal Bots

The name deer botfly, or deer nose bot, refers to any species of large, grey-brown flies in the genus *Cephenemyia*, within the family Oestridae. The larval stages of *Cephenemyia spp*. are obligate parasites of cervids that infest the sinuses and throat. Female flies will hatch their eggs *in utero* and eject the larvae into the nostrils of the host while hovering close to the head of the deer, which then migrate to the base of the animal's tongue, where they mature in clusters to a size of 25 to 36 mm until they are ejected by the host (MDNR 2016). Commons signs of infection in deer include nasal discharge, snorting, giddiness, and constant lowering of the head. Occasionally, heavy infections cause death by suffocation or by detached larvae migrating to the lungs (MDNR 2016). However, botflies are generally well-tolerated by deer and typically cause no health problems (MDNR 2016).

Zimmerman (2004) conducted surveillance for nasal bots in the Black Hills and found 20% infection (n=20) with the nasal bots in summer white-tailed deer, and 12% infection (n=25) in winter. Also reported was an infection rate of 5 % in mule deer in summer (n=20), and 53% infection in winter (n=32). The species of larvae found in both white-tailed deer and mule deer was found to be *Cephenemyia jellisoni*. Nasal bots are common in South Dakota, and reports from hunters come in on an annual basis concerned with the finding of these larvae. There is no human health risk associated with this parasite.

Cutaneous Fibroma

Cutaneous fibromas are wart-like growths that can be found on the skin of white-tailed deer and mule deer that are caused by papillomaviruses common among species of the deer family. Fibromas are fleshy, hairless tumors on the surface of the skin that have a black, dry, hard surface that may be warty or smooth, and a dense, white fibrotic core (Davidson 2006). Rarely do fibromas cause deer any problems, but occasionally the location of a large single or multiple clump of fibromas can interfere with sight, eating, breathing, or even affect the ability of the deer to walk, and in some rare cases, larger fibromas may acquire a bacterial infection through a break in the skin (MWFP 2016). However, most mammals develop antibodies and immunity to papillomaviruses and fibromas regress over time (Ghim et al. 2000), so fibromas are not considered to pose a risk to the health of deer populations (Davidson 2006, MWFP 2016).

Tapeworms

*Taenia* is a genus of long, segmented, parasitic tapeworms that can live in the intestines of deer causing an infection referred to taeniasis. White-tailed deer and mule deer can be hosts for *T. crassiceps*, *T. ovis, T. taeniaeformis, T. hydatigena, T. multiceps, T. serialis* and *T. brauni* (CFSPH 2005). *Taenia hydatigena* is the larval stage of the canine and feline tapeworm, and herbivores, such as deer, act as intermediate hosts for the parasite, while carnivores are definitive hosts (Davidson 2006). While *T. hydatigena* is the most common *Taenia* species among deer and other ruminant species (Campbell and VerCauteren 2011), the overall prevalence of the parasite in deer is considered low (Davidson 2006). Deer infested with tapeworms typically show no signs of infection, but in rare cases a deer immune response to migrating larvae can damage vital organs and result in death (Davidson 2006). Richardson and Petersen (1974) found prevalence rates in of 6% (n=84) and 13.3% (n=30) in white-tailed deer and mule deer, respectively. Zimmerman (2004) found *Taenia spp* in 4 of 35 (11.4%) white-tailed deer and 16 of 43 (37.2%) mule deer in the southern Black Hills. Occasional reports from South Dakota hunters report the finding of the cysts in the muscle tissues of harvested deer. Although unsightly, these cysts are destroyed upon proper cooking of the meat.

<u>External Parasites</u>

Ticks of the genera *Amblyomma, Ixodes, and Dermacentor* can transmit pathogens to deer, while ticks of the genera *Boophilus* have mostly been eradicated from the United States and are likely absent in South Dakota (Davidson 2006). Ticks cause harm to their hosts by producing hypersensitivity reactions from their bites; by serving as vectors for bacterial, rickettsial, viral, and protozoal diseases; and by producing tick paralysis through poisonous secretions (Scott et al. 2000). Minor tick infestations are usually sub-clinical (Scott et al. 2000), but massive tick infestations may result in local irritation at the site of feeding, blood loss, secondary infections, and mortality, especially in fawns (Davidson 2006).

Ear mites (*Otodectes cynotis*) are another common ectoparasite of deer that live in the ears of deer and feed on epidermal debris and tissue fluid from the skin (Scott et al. 2000). Due to their non-intrusive method of feeding, the host is exposed to, and immunized against, ear mite antigen (Scott et al. 2000). As ear mites feed, they irritate the epithelium in the ear canal which, over time, fills with earwax, blood, and mite debris, creating a discharge that resembles coffee grounds (Scott et al. 2000). While ear mites are not typically pathogenic unless the deer is heavily infested, their excretions can accumulate within the ear canals, causing yeast and bacteria to grow, further aggravating the infection (Scott et al. 2000). Severe ear mite infections usually result in a scaly, scabby buildup in the ears, and the host may experience a lack of coordination and extreme itchiness (Scott et al. 2000).

Demodectic mange is another disease of white-tailed deer (Davidson 2006) and mule deer (Gentes et al. 2007) that is caused by an external mite *Demodex odocoilei* (Jacques et al. 2001). *D. odocoilei* complete their entire life cycle on deer and mites can be transmitted between deer through direct contact with infected individuals (Davidson 2006). Deer with mild mange infestations may not display symptoms, but severe infestations can cause hair loss and thickening skin (Davidson 2006). *D. odocoilei* have only been found on white-tailed deer (Davidson, 2006).

<u>Brain Abscesses</u>

Brain abscesses are bacterial infections in the skull and brain that are most commonly associated with infections from the *Arcanobacterium pyogenes* bacteria. *A. pyogenes* lives on the skin, gums, and sinuses of deer, and it can cause infection when it enters wounds (PGC 2016b). Brain abscesses can develop when membranes form around the infection, causing swelling and inflammation (Davidson and Nettles 1997 as cited in Campbell and VerCauteren 2011). Symptoms of brain abscesses include a lack of coordination, fear, blindness, depression, weight loss, disorientation, and fever, but diagnosis is typically confirmed by post mortem observation of abscesses inside the brain case (Davidson et al. 1990). However, brain abscesses appear to be uncommon in white-tailed deer (Baumann et al. 2001), but local concentrations of the disease have been reported as high as 35% of a white-tailed deer population (Karns et al. 2009). Little has been reported on the incidence of the disease in mule deer.

Davidson et al. (1990) reported that the occurrence of brain abscess is mostly seasonal in bucks, corresponding to the period following velvet shedding and lasting until shortly after antler casting. As a result, velvet shedding and antler casting by rubbing on antlers on trees was thought to play a role in the transmission of brain abscesses, but Baumann et al. (2001) found no *A. pyogenes* cultures on swabbed trees associated with these activities in an area with a high incidence of brain abscesses in deer. Head trauma from fighting with other males during the rut has been identified as another pathway for the *A. pyogenes* bacteria to infect deer, and *A. pyogenes* in the sinuses of male deer may provide a source for direct transmission between sparring males (Davidson and Nettles 1997 as cited in Campbell and VerCauteren 2011).

Cohen and Belser (2016) sampled 7,545 white-tailed deer from 60 sites in Georgia for signs of brain abscesses, and they detected no signs of abscesses in 2,562 females sampled and 91 likely cases of brain abscesses in 4,983 male deer. A subsequent study by Cohen and Belser (2016) found evidence of brain abscesses in 24 of 683 sampled white-tailed deer across portions of the US and Canada, with 88% of these cases occurring in males. Furthermore, 20% of older (≥3 years) males in the sample population were diagnosed with brain abscesses (Cohen and Belser 2016). The low prevalence rate of brain abscesses in white-tailed deer suggests that overall this disease is not an important natural mortality source; however, a strong bias toward antlered males may affect management efforts to produce older-age males (Cohen and Belser 2016).

**Lead Bullet Fragmentation**

Lead is a naturally occurring element that is used to make bullets because it is dense and malleable. Lead is also known to be poisonous to humans and animals if ingested or inhaled. The majority of bullets that are used by deer hunters are manufactured with a lead based core surrounded by a copper jacket. Lead based bullets are known to fragment upon impact. Cornatzer et al. (2009) conducted a study in North Dakota, where researchers randomly selected 100 packages of ground venison from donated venison and found that 59% of the donated venison had contamination with lead fragments. Research was also conducted in Minnesota on bullet fragmentation and lead deposition in deer and found that 32% of inspected packages of venison contained metal fragments, and conclusions were made that all meat from harvested deer using lead bullets may have the potential to contain lead (Grund et al. 2010). Hunt et al. (2009) noted that radiography revealed metal fragments in ground meat of 80% of tested deer. This research also concluded that people risk exposure to lead from bullet fragments when they consume deer that are killed with lead-based rifle bullets that are processed under normal procedures. Grund et al. (2010) found that lead presence was most prevalent immediately around the exit wound and declined as distance from the exit hole increased. No specific distance from an exit hole was determined to eliminate exposure to lead as samples of lead was found as far away as 45 cm from the exit wound (Grund et al. 2010). The major implications of these findings are that many states in the Midwest have venison donation programs, and the finding of lead and metal fragments in the donated venison may have negative implications for these programs. As an example, Minnesota now requires that all donated venison be radiographed and any packages that show contamination with lead are discarded (http://www.mda.state.mn.us/licensing/inspections/meatpoultryegg/venisondonation/processorinfo.aspx - accessed 9-26-2016).

Hunters and consumers of deer harvested with lead-based bullets must be made aware that there is the potential for exposure to lead through bullet fragmentation when these types of projectiles are used. Conclusions made by Grund et al. (2010) included that anyone concerned about lead exposure should: 1) select a bullet that does not contain lead, 2) not rinse the carcass as this may spread lead contamination, 3) be aware that meat 45 cm from the wound site may contain lead, and 4) be aware that lead-based slugs and muzzleloader bullets will deposit lead into carcasses.

The South Dakota Department of Game, Fish, and Parks currently does not have any regulations against the use of lead bullets for deer hunting, but hunters should be aware of the availability of alternative copper bullets that do not contain lead.

**Captive Cervid Game Farming**

Captive cervid farming is an expanding for-profit market across North America with over 10,000 individual breeding operations nationwide (QDMA, 2012), (Figure 81). Captive cervid operations include both native and non-native deer species (Adams et al. 2016). The primary objectives of for-profit captive game farming operations are to produce animals for breeding stock, to produce large antlered trophies (through selective breeding, artificial insemination, and regimented feeding programs) for shooting facilities, as well as for the production of antlers, hides, scents, velvet, and venison (Miller and Miller, 2016). The captive cervid farming industry is one of the fastest growing industries in rural areas of the United States, and is now a multi-million dollar industry (Anderson et al. 2007). Within North America, captive cervid farming and shooting operations have increased to a level that traditional wildlife management, jurisdiction, and regulatory authority are being challenged (Boone and Crockett, 2015).

Several organizations, most notably The Wildlife Society (2009), QDMA (2012), and the Boone and Crockett Club (2015), have taken stances and developed position statements on captive cervid farming, all citing concerns with this growing industry. A primary concern with captive cervid farming is the violation of several components of the North American Model of Wildlife Conservation, in particular by privatizing a public trust resource (Organ et al. 2016). Additional concerns are, threatened wildlife health through increased risk of disease spread and transmission, not using science for the basis of managing wildlife, unregulated killing which may not be for legitimate reasons, and creating a negative public image and perception of hunting. Issues impacting deer hunting and management were identified during the 2014 North American Whitetail Summit, and the captive deer industry was ranked fifth in this list of greatest concerns (Adams and Ross, 2015).

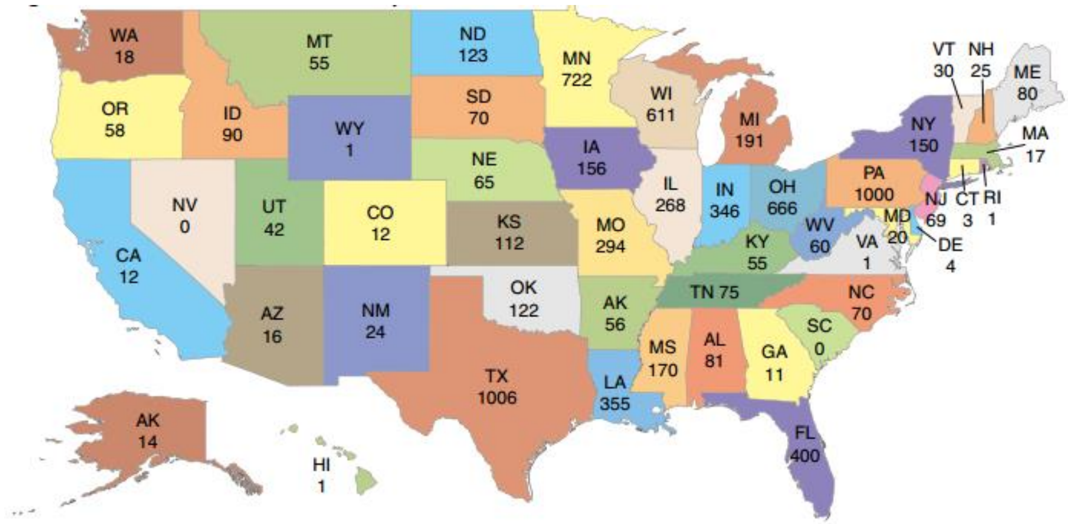



Figure 81. Estimated number of captive cervid farms per state (Anderson et al. 2007).

Within South Dakota, individuals may possess captive cervids if the proper permits are obtained through the SDAIB. Details on the possession, importation, interstate and intrastate movement regulations can be found in South Dakota Administrative Rule 12:68:18 (Nondomestic Animal Control). Specifically, in regards to free-roaming wildlife, “A person may not confine or allow the confinement of free-roaming wildlife. Before the issuance of a permit under this chapter, the board in cooperation with the Department of Game, Fish and Parks may inspect the facility for the presence of free-roaming wildlife. Any free-roaming wildlife must be removed by the applicant to the satisfaction of the board before the issuance of the permit. A permittee must immediately notify the board upon the ingress of free-roaming wildlife of the mammalian class into a permitted facility. The board, in cooperation with the Department of Game, Fish and Parks shall take whatever action it considers necessary in accordance with the provisions of SDCL § 40-3-25 to dispose of such free-roaming wildlife. Facilities may not be constructed for purposes of confining captive nondomestic mammals in such a manner as to interrupt the normal migration patterns of free-roaming wildlife as determined by the board in consultation with the Department of Game, Fish and Parks”(ARSD § 12:68:18:03.07). Captive cervid facilities in South Dakota were first permitted in 1993. At that time, there were 19 facilities; currently, there are 43 individual permitted captive cervid facilities in South Dakota (Figure 82). In 2003, South Dakota had a high of 67 permitted facilities. Of the 43 current permitted facilities, 14 contain white-tailed deer and two contain mule deer (M. Miller, personal communication; Figures 83 and 84). Current facilities range in size from 1-170 animals, with one exception where a facility contains 676 animals comprised of 95% elk and 5% white-tailed deer (M. Miller, personal communication).

The risk of disease transmission from captive cervids to wild cervids is a real concern. In South Dakota, chronic wasting disease (CWD) was first discovered in seven privately owned, captive elk herds during the winter of 1997-98. All captive herds that were infected or exposed were depopulated, with the exception of one herd in Bear Country, Rapid City. Following 15 years of mandatory CWD testing, SDAIB now administers a voluntary cervidae CWD surveillance and control program operated by the USDA.  Since 1997, there have been 6,676 farmed cervids tested for CWD in South Dakota and 129 tested positive (124 elk, 5 white-tailed deer).  In fiscal year 2015, there were 30 herds enrolled in this voluntary program and 77 animals were tested with no positive cases of CWD (SDAIB 2015).

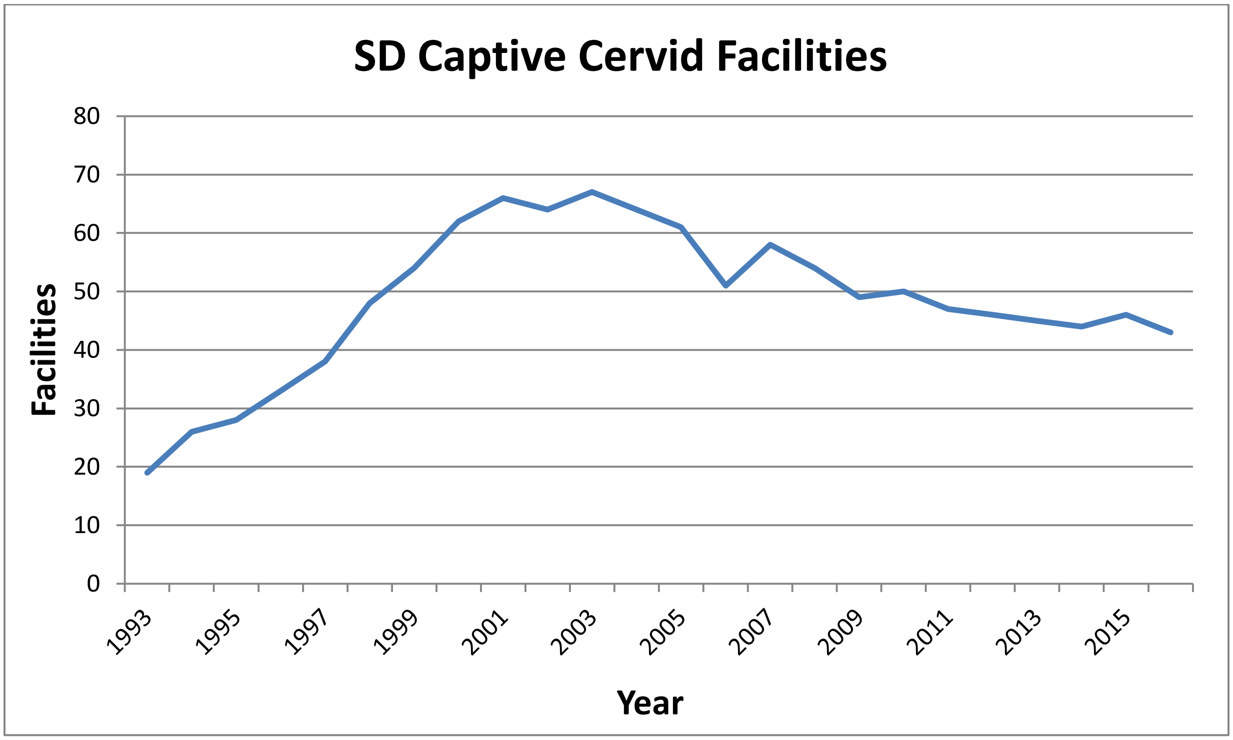



Figure 82.  Captive cervid facilities in South Dakota, 1993-2016.

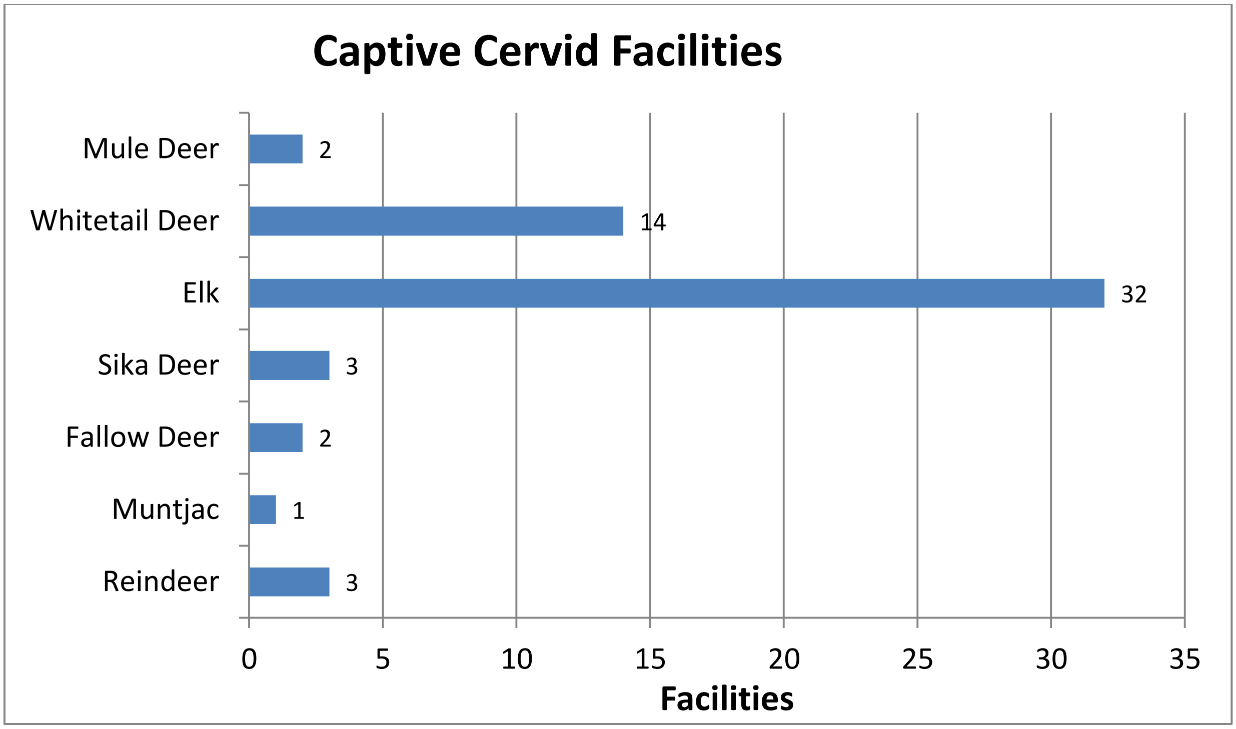



Figure 83. The number of captive cervid facilities per species in South Dakota, 2016. Facilities may contain more than one species.

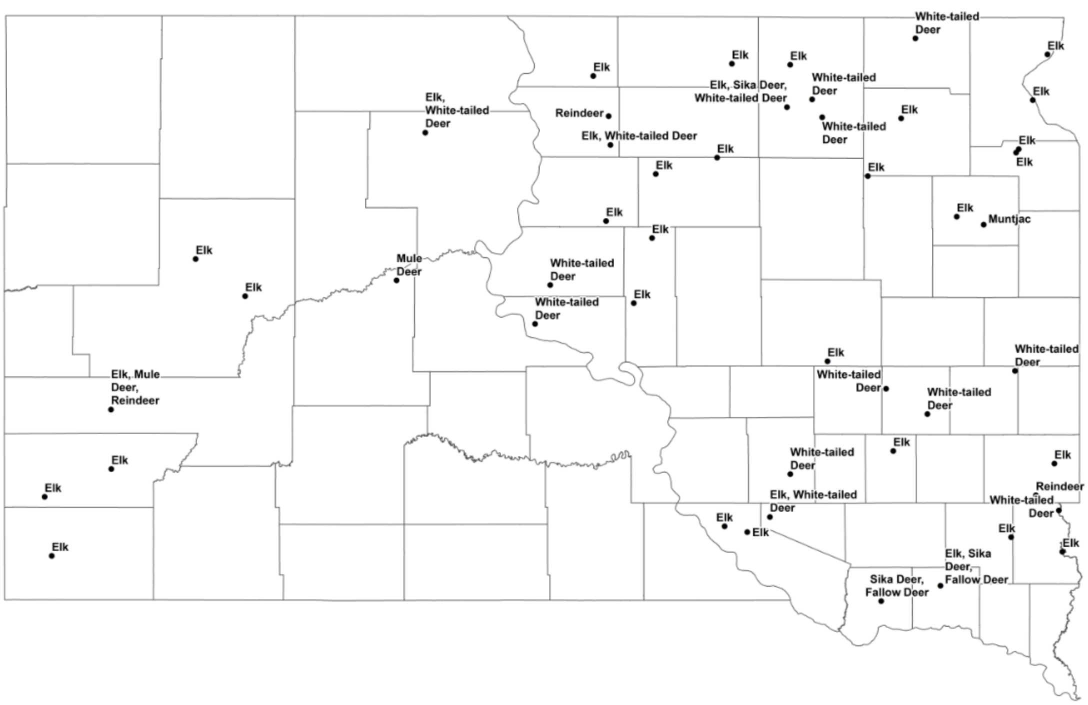



Figure 84. Captive cervid facility locations in South Dakota, 2016.

**Citizen Involvement**

Citizen participation is a process which provides the public with opportunities to influence decisions by directly engaging the public in decision-making and giving full consideration to public input in making that decision. There is no single public; the public is made up of a range of stakeholders holding an array of views and concerns on an issue. Citizen participation must be collaborative and it should incorporate not only citizens, but also organized interests, profit-making and non-profit organizations, planners and public administrators in a common framework (Innes and Booher 2004). The underlying premise of citizen involvement is if citizens are actively involved as participants in decision-making processes it will result in decisions with greater acceptability. Participating in a decision gives people a sense of ownership in the decisions, and resulting decisions are typically more implementable and sustainable since they consider the needs and interests of all stakeholders (Peterson 2012, IAP2 2016).

SDGFP has a specific mission, which defines its purpose with respect to wildlife management. Urbanization, management objectives, and conflicts over issues such as private property rights and hunter access combine to create a complex atmosphere within which deer management occurs. Opinions regarding appropriate deer management often vary widely among members of the public. Segments of the public may have interest in deer based on different values than managing agencies and often different from each other (Leong et al. 2009). Deer management decisions can evolve into public issues when stakeholders believe they may be impacted by either deer themselves or the means for managing deer. Management decisions made within this context often involve walking a line between fulfilling SDGFP's conservation mandates and satisfying the public.

Public participation processes that use dialogue-based approaches emphasizing mutual learning and treat participation as an opportunity for cooperation between SDGFP and stakeholders can help navigate the complexity of wildlife management. Successful public participation processes incorporate the best available information and expertise of all stakeholders. They involve collaboration, dialogue and interaction, and are both open and inclusive (Innes and Booher 2004). There are some commonly accepted principles that can be applied in the development and implementation of a citizen participation program: 1) involve the public early and continuously; 2) seek participation from a broad range of stakeholders; 3) establish clear purpose and goals, ensuring the public's role in the process is real, practical, and shared among stakeholders; 4) use of a number of techniques to give and receive information and to provide opportunities for dialogue; and 5) provide information that is clear, easy to understand, and free of technical jargon (Roberts 2012).

Non-participants in public engagement can be grouped into two broad groups: those who are willing but unable to participate, and those who are able but unwilling to participate (Cropley and Phibbs 2013). There are several things that may limit an individual from participating in decision-making processes. Some may view the process as political and believe their contributions will not be taken seriously. Others may find the complexity of the process overwhelming. In many cases, the timing or logistics of attending a meeting presents the biggest challenge (Roberts 2012).

A variety of methods or options can be used to address these challenges. For instance, meetings could be held at a variety of times including days, nights, and weekends at a variety of locations considering where people live, work and play. Facilitating participation from a distance (e.g., internet, webinar, telephone, writing, etc.) can help to offset challenges created by geography. Cultural or language barriers can be addressed by working with leaders of ethnic communities to understand and accommodate cultural differences, and if needed, provide interpreters or materials in multiple languages. Materials provided should be in a variety of formats using clear and easy to understand language free of technical jargon. The way to achieve and maintain legitimacy is to follow a decision-making process that is open, fair, inclusive and credible with the public and actually involves the public (Creighton 2005). Public information programs can be used to stimulate interest or at the very least allow for an informed choice not to participate (Creighton 2005, Peterson 2012).

Public participation tools and techniques should be selected to reflect the context of each decision – the process, stakeholders, objectives for citizen involvement, barriers to participation, and the successes and failures of previous efforts. While not everyone will be interested in participating in every public policy decision, the department should foster openness and be creative in selecting methods to encourage as many people as possible to participate.

**Multiple Use on USFS Lands**

The Multiple-Use Sustained Yield Act of 1960 authorizes the USFS to conduct activities for five major uses pertaining to renewable surface resources (mining is not renewable): range (livestock grazing), timber, wildlife (and fish), outdoor recreation, and watershed purposes. Eventually, the establishment and maintenance of designated wilderness areas was added to the list of allowed multiple uses on USFS lands.

<u>Wilderness on USFS Lands</u>
The Black Hills National Forest manages Black Elk Wilderness where deer hunting is allowed. The Custer Gallatin National Forest, Nebraska National Forest and Dakota Prairie National Grasslands have no designated wilderness areas within South Dakota. However, Nebraska National Forest has two areas within South Dakota identified as recommended future wilderness and manages these areas to retain wilderness characteristics. These special management areas have certain restrictions compared to non-wilderness areas on USFS lands, including but are not limited to restrictions on motorized uses, placement of survey markers in the ground, and certain wildlife management activities.

<u>Livestock Grazing</u>
Most USFS rangelands are subjected to annual livestock grazing as a recognized multiple use. Livestock grazing on timbered USFS lands occurs primarily in meadows and open habitats

during the vegetative growing season. Livestock grazing on the National Grasslands may be year-round. Timing, intensity, and duration of grazing affect habitat quality and quantity. Non-structural range improvements to recapture natural openings and meadows generally are aimed to increase available livestock and big game forage. Proper grazing practices which rejuvenate grasses and deeply accumulated litter can be positive for deer if grasses, forbs and shrubs respond well. Season-long grazing in the same area, repeated annual grazing in the same area and overgrazing can reduce much needed spring and summer residual understory for parturition and fawn beds and nutritious forbs for year-round deer diets.

Timber

The types of silvicultural treatments (commercial and non-commercial) on USFS lands which benefit deer depend upon what aspect of habitat is needed within seasonal and home ranges compared to existing conditions. Land management often drives vegetative systems by changing existing habitat conditions. Actions include employing mechanical logging, non-native vegetation control, pesticide applications, prescribed fire and livestock grazing. The typical build-up of small diameter pine and needles which smother the understory vegetation and absence of large diameter trees are not beneficial habitat components. Habitat may be improved by selectively thinning some dense stands, mechanically disturbing dense pine mats, reseeding exposed mineral soils with native seed mixes and retaining uneven-aged pine stands.

Accepted USFS silviculture practices treat, or create, the following pine stands: even-aged, two-aged or uneven-aged systems. Even-aged prescriptions on Black Hills National Forest and Custer Gallatin National Forest in South Dakota generally include shelterwood, clear-cut and seed tree systems (USDA 1986b, 2006). The common shelterwood system removes a portion of the mature overstory and leaves a very low basal area of residual mature trees to reseed the area (USDA 1986b, 2006), thus creating a two-aged pine stand. The shelterwood system is very successful in South Dakota ponderosa pine forests. It creates and perpetuates an even-aged overstory and mid-or understory of pine which are essentially “sheltered” by the residual overstory pine, and then eventually cut and rotated as growing stock. Retained mature overstory pine are seed trees. Once mature overstory pine is removed, mid-story sapling pine flourishes to become the next generation of mature pine (Smith 1962, Alexander 1987).

Outside of mountain pine beetle infestation treatments and fuel load reductions near human developments, Black Hills National Forest typically reduces the tree density in even-aged, even-spaced stands to 60-80 $ft^2$/acre. This equates to a moderate overstory canopy cover (40-60%) of sub-mature (5-9” diameter breast height) and mature (greater than 9” diameter breast height) trees. Some direct and diffused sunlight is able to reach the forest floor but the primary goal of these logging prescriptions is to encourage pine reproduction. Forest openings which encourage understory vegetative growth are very temporary; maybe lasting up to 5 years. Deer and other herbivores will not be able to depend upon these openings for an extended period of time but if logging operations are carried out across a broad landscape, temporary forest floor openings should be created throughout time.

Even-aged treatments are implemented more than other silviculture treatments for mature pine because the emphasis for the USFS is to regenerate pine and sustain a commercial product. Even-aged treatments can include temporary artificial forest openings which create structural diversity and edge habitat. On all USFS timbered lands, patch clear cuts (meaning all pine trees are removed) of commercial ponderosa pine are limited to 40 acres. On Black Hills National Forest, patch clear cuts outside of bighorn sheep and mountain goat ranges are generally limited to about 10 acres in size. SDGFP frequently recommends patch clear cuts in most USFS pine treatments to create temporary openings and edge habitat to benefit wildlife, including deer.

Wildlife species use all ecological stages of vegetation succession and therefore, when forests and woody draws are actively managed, there will be benefits to some species and losses to others. Some species, such as deer, have a wide range of habitat tolerances and preferences depending upon adjacent human uses, time of year, weather, gender, predator risk and parturition (see *Deer Research* section). A mix of habitat variables across the landscape, from early to late succession, benefit both deer species. None of the USFS lands in South Dakota are managed specifically for either deer species. Instead, a wide range of land management practices are used for multiple purposes and outcomes across the USFS landscape. Deer may or may not benefit from site-specific timber treatments.

Regardless of the silviculture system implemented to cut pine, early successional understory production (Pase and Hurd 1957) and plant diversity (Uresk and Severson 1989, Uresk and Severson 1998) decrease as pine basal area and canopy cover increase. This inverse vegetative response relationship is important to understand for deer habitat management. For example, deer benefit from silviculture prescriptions which retain areas with closed pine canopies for security and thermal cover. Those same silviculture prescriptions can be tailored to remove more pine and reduce pine densities, thus maintaining or creating understory openings which favor grasses, forbs and woody species. While pine cover may be reduced or become ineffective, forage and browse have increased. Taller grasses also offer deer fawn bed sites (Uresk et. al 1999).

Implementing uneven-aged prescriptions are not common practices because managing for multiple ages requires additional prescription considerations and results in less annual growth of commercial pine. Ecologically, there are discussions of whether uneven-aged stands were historically common with known return fire intervals (see fire discussion). In a timber producing forest such as Black Hills National Forest, emphasis is on producing a commercial product. However, uneven-aged treatments such as individual tree selection and group selection are implemented when a continuous mature tree presence is needed (USDA 1986b, 2006) for wildlife species such as the Northern Goshawk. Group selection creates temporary pockets of openings (similar to a patch clear cut but much smaller) while retaining a mix of pine age classes and densities. These openings and additional forest edges create a diversity of vegetation within a pine timber stand. Non-commercial treatments within any silviculture system include thinning small-diameter trees, retaining natural openings in the forest and removing conifer encroachment from meadows.

Timing of vegetation treatments is important to mitigate various human-caused disturbances to deer during parturition and neonate development.  Prescribed fire is generally conducted in the spring (contrary to when natural lightning-caused fire occurred but is more manageable and less of a risk).  Spring fires may reduce understory vegetation and downed logs used as parturition sites and fawn hiding cover.  Logging operations any time of the year may temporarily exclude deer from an area depending upon the pre-treatment vegetation conditions and the desired post-treatment conditions.  Long-term benefits may far outweigh short-term losses.  Deer can be attracted to log yarding and slash areas to forage on lichen attached to trees that normally would have been out of reach on standing live trees.

Quality habitat is generally more important to survival and perpetuation of deer on public lands than sheer number of acres of a certain habitat type.  High quality habitat enables deer to spend less time and less energy seeking necessary elements to exist within their home or seasonal ranges.  Because of the patchwork of public and private land ownership on Black Hills and Custer Gallatin National Forests, some deer will seek part of their daily or seasonal habitat needs on private lands.  One desired outcome of diverse, high-quality winter habitat is to reduce the time spent by wildlife on adjacent private lands (USDA 2006).

The current Black Hills National Forest geographic boundary between big game winter range and non-big game winter range was developed during the first Black Hills National Forest Plan in the early 1980s.  These geographic areas have experienced wide-spread landscape changes brought about by the Jasper fire in 2000.  Jasper fire altered deer habitat by significantly reducing mature pine stands of pine to occasional pockets of mature pine which survived the fire.  The next Black Hill National Forest Plan revision may need to re-evaluate more recent deer movements and preferred habitats in response to landscape changes.  Geographic boundaries between USFS resource management emphasis areas may need to be changed to consider deer and other ungulate habitat needs.

Wildlife on USFS Lands

Wildlife and fisheries are recognized as multiple-uses on USFS lands.  All USFS offices in South Dakota have specific plan guidelines and standards to manage for some specific wildlife species.

Recreation on USFS Lands

All South Dakota USFS offices and websites offer paper and downloadable access maps.  SDGFP provides a public hunting atlas and downloadable maps to use on hand-held devices.  Map attributes differ by agency and may include land ownership boundaries, roads, land marks, etc.  Maps can aid hunters to find areas away from high density roads or identify road closure areas if the goal is to hunt in a more secluded area.  Game retrieval, roadside camping, on-site lodging, dispersed camping and firewood gathering on public lands are regulated by the respective governing agency.

Commercial outfitting and guiding on USFS lands is regulated through special use permits issued by the USFS.  Those interested in offering outfitting and guiding services are advised to contact the governmental management office at least a year in advance of hiring out their guiding skills.

Daily use fees for entrance, motorized trails, campgrounds and picnic areas may be required. The public is encouraged to call the local state or federal land management offices to determine if there are special permits required for photographing, video-taping or providing guiding services to view wildlife if the resultant product is for commercial or for-profit gain. Check regulations for baiting wildlife for photography or viewing purposes.

USFS identifies over-the-snow vehicles as motorized recreational vehicles designed for use over snow which run on track and/or skis. By definition, this expands the traditional definition of snowmobiles. "Snowmobile" is a more familiar term to the general public and for the purposes of this plan, will be used to represent all over-the-snow vehicles.

In June 2014, the USFS sought national public comment on a proposal to standardize sustainable access for snowmobile use on national forests and grasslands (USDA 2014c). Use and policy for snowmobile recreation are managed by individual USFS Offices. The public is encouraged to contact the respective USFS office because the use and policy for snowmobile recreation are managed by individual offices. For example, at the time of this plan, Fort Pierre National Grassland does not permit snowmobile use on its lands, but Custer Gallatin and Black Hills National Forests do permit the legitimate use of recreational snowmobiling. Maps of snowmobile trails managed by SDGFP or in cooperation with the USFS are available on SDGFP website. Currently 310 miles of groomed trails in South Dakota and 40 miles immediately across the Wyoming border are available to snowmobilers (USDA 2015b). An area determined to be wildlife winter range on Black Hills National Forest immediately west of Spearfish, South Dakota, and 5 miles into Wyoming is closed to snowmobiling. The Black Hills snowmobile season runs December 15 through March 31. Snowpack within the trail system is variable with reliable snow generally in the northern portions of the trail system. Most deer will have migrated out of the deepest snow areas by the bulk of trail traffic in January and February.

Research has been conducted on the effects of winter recreation on wildlife and natural resources in western landscapes outside of South Dakota (Olliff et al. 1999). There has been no comprehensive study or impact analysis conducted on the effects of winter recreation on wildlife in South Dakota. Responses of deer to over-the-snow motorized vehicles include trail avoidance and physiological responses such as elevated heart rate, blood pressure, and breathing rate.

**Travel Management on USFS Lands**

Of all USFS lands in South Dakota, Black Hills National Forest has the most motorized routes available for public use. Prior to Black Hills National Forest Travel Management Plan (USDA 2010a), road densities were the highest of any national forest across the nation at 2.2 mi./mi.$^2$ (Rumble et al. 2005). Despite significant changes in 2010, there are still localized high road densities (>1 mi./mi.$^2$) and very few areas for non-motorized use. Black Hills hunters who prefer a quieter hunting experience can seek out the Norbeck Wildlife Preserve and USFS seasonal closure areas (generally closed to motorized vehicles). These areas are outlined on the Black Hills National Forest motorized vehicle use maps (MVUM).

Grand River National Grassland (USDA 2007), Fort Pierre National Grassland (USDA 2008), Custer Gallatin National Forest (USDA 2009a, USDA 2015b), and Buffalo Gap National Grasslands (USDA 2010b) have completed travel management and motorized access plans. Publics are encouraged to use the black and white MVUM maps for updated motorized information as compared to the traditional colored visitor use maps. All types of USFS maps are currently available at USFS offices and websites.

Recreational use of public lands can produce unintentional and deliberate harassment of wildlife. Abundant literature exists on the effects of roads and motorized vehicles to habitat and wildlife species. Major impacts of roads and their zone of influence include direct loss of habitat, fragmentation of contiguous habitats into smaller and isolated parcels and excessive conversion of interior habitat to edge habitat (Ebert 1972). The impacts of motorized vehicles include numerous direct effects (vehicle collisions) and indirect effects to wildlife such as unnatural movements, displacement, greater visibility and increased vulnerability to humans and predators and disproportionate hunter spacing. Motorized and human disturbances due to roads can result in larger home ranges. Flight response will cause increased demands for energy input and deer may require additional browsing time to accommodate greater movements.

**Winter Feeding and Baiting**

Inslerman et al. (2006) define winter feeding as the act of intentionally placing any food for use by wildlife on an annual, seasonal or emergency basis and baiting as the act of intentionally placing food attractants to manipulate the behavior of wild animals. In South Dakota, the use of salt to attract big game is prohibited (SDCL § 41-8-16). Furthermore, the use of a bait station is prohibited from August 15 to February 1, and from March 15 to May 31, inclusive, to attract any big game animal. A bait station is a location where grains, fruits, vegetables, nuts, hay, minerals, or any other natural food materials, commercial products containing natural food materials, or by-products of such materials are placed or maintained as an attractant to big game animals for the purpose of hunting. The use of scents alone does not constitute a bait station (ARSD § 41:06:04:03).

Severe winters can cause many people to be concerned about the welfare of deer and their ability to survive winter months. Deer adapt to survive winter by growing a thick coat of hair, increasing fat accumulation the summer and fall, reducing metabolism in winter, utilizing thermal cover, exhibiting migration strategies and substantially reducing activity (Marchinton and Hirth 1984, DelGiudice et al. 2002). SDGFP currently does not conduct winter feeding and discourages the public from feeding deer. When persistent severe winter conditions concentrate deer onto private property, SDGFP may utilize short-stop baiting as a strategy to keep deer off private lands and away from stored livestock feeds. Short-stop bait typically consists of corn or alfalfa hay. Because of the many issues associated with feeding deer, SDGFP uses short-stop baiting as a last resort to address depredation issues when other management techniques are not successful or practical.

Baiting and winter feeding of deer can have negative impacts on deer. Repeated use of baiting and feeding areas poses a long-term risk of disease transmission. When diseases such as chronic wasting disease or bovine tuberculosis are present in deer populations, high contact rates at baiting or feeding areas facilitate disease transmission (Inslerman et al. 2006). Moreover, baiting and feeding practices likely change deer movement patterns, migration strategies and concentrate deer at the feeding site (MDWG 2013b). Baiting and feeding can alter normal avoidance behavior of deer toward humans and human activities. When deer are concentrated into an area it can attract predators and subsequently predation on deer can increase. Feeding deer can contribute to overpopulation particularly in localized areas. This overpopulation can lead to over browsing of the natural vegetation creating a lack of available forage and thus starvation (Williamson 2000). High-carbohydrate browse can be important for deer to get through the winter because these foods produce quick energy and body heat; however, sudden changes to a deer's diet may be harmful and in some cases fatal. Introducing corn to very hungry deer when there is very little other food available can make it difficult for the deer to digest the corn. Deer stomachs are adapted to digest certain types of food in winter. Deer are ruminants that have a four part stomach with microbes that help digest forage intake. In winter, the microbes within the deer stomach are different from the microbes in spring, summer, and fall. Deer require a period of time to acquire the microbes necessary to digest certain types of food. They do not have the ability to change quickly with a sudden introduction of high-carbohydrate food. This can cause acidosis (grain overload) or enterotoxemia (overeating disease) which can make the deer sick and in some cases can kill a deer (Wobeser and Runge 1975). The costs associated with an effective feeding program can be excessive. During the winter of 1988-89, the cost of feeding deer in northern Minnesota over a 46,000 square mile area was determined to be $1,071,492 and required more than 17,000 hours of staffs time as well as 230,000 hours of volunteer time (MDNR 1991). The cost to feed mule deer in Colorado for 100 days was determined to be $174.81 per deer that survived (Baker and Hobbs 1985).

**Nutritional Supplements**

Nutritional supplements are becoming increasingly popular within the hunting industry, and are primarily marketed to increase deer antler growth, as well as overall body condition, and to also perform as an attractor to draw deer onto one's property or specific hunting location. However, little research is available on the widespread use of nutritional supplements, and there is much debate on how effective commercially available supplements are at increasing antler growth and overall body condition. As these nutritional supplements are designed to draw deer to a particular area to feed on the supplement, there is an increased risk of disease spread and transmission, as well as altering foraging patterns and vegetative communities (Timmons et al. 2010, Garver 2011).

**Predation Management**

Understanding the relationship predators have on deer populations is essential for making informed management decisions, improving modeling techniques, and understanding the annual rate of population change for deer populations (Ballard et al. 2003). Predator-prey dynamics are impacted by a multitude of variables such as changes in habitat quality and quantity, stochastic weather events, foraging competition with other ungulates, predator species and densities, abundance of alternate prey and deer harvest strategies. Managing predators to increase deer populations is a complex issue; thus, numerous studies across the nation have investigated predator impacts on deer recruitment and population growth, resulting in highly variable management recommendations.

For example, Kilgo et al. (2014) removed coyotes from 3 replicate units over three years to examine the effect on predation rates of white-tailed deer neonates in South Carolina. A total of 216 neonates were monitored over a four year period and pretreatment survival was 0.23, with survival during the three years of removal being 0.51, 0.20 and 0.43, respectively. Because of the variability in neonate survival during the removal period, the authors concluded that coyote removal is not an effective method for increasing neonate survival in southeastern United States. Similar results were reported from Brown and Conover (2011), where 12 large study areas with a mean of 1,035 $km^2$ in Wyoming and Utah were used to determine if coyote removal could be effective at increasing productivity and abundance of mule deer and pronghorn. They monitored pronghorn and mule deer for one year prior to removal followed by a 10 month aerial gunning removal period on 6 treatment sites. No significance difference existed in mule deer productivity between removal sites and non-removal sites (56.0 fawns/100 does vs. 61.9 fawns/100 does, respectively). Mule deer abundance also was not significantly different in removal sites compared to non-removal sites. Harrington and Conover (2007) reported similar results where population performance was unchanged for both mule deer and pronghorn regardless of number of coyotes removed. Contrary, Hurley et al. (2011) demonstrated in Idaho, decreasing mountain lion predation increased adult doe survival and allowed for a slight increase in population performance; however, significant changes in population growth were not documented. Results also suggested a decrease in the number of coyotes resulted in increased fawn survival through summer; however, overall fawn recruitment remained unchanged. As a result, the authors noted that the benefits of predator removal appear to be short-term and likely will not change long-term population dynamics.

<u>Compensatory vs. Additive Mortality</u>

The concepts of compensatory and additive mortality directly relate to the survival rate of a given population. Additive mortality refers to a given mortality factor that results in an immediate reduction in the total survival of a population, while compensatory mortality refers to mortality that causes no reduction in total survival, up to a threshold number of mortalities, under the assumption that the individual dying due to the compensatory factor would have died of some other cause. For example, if a hunter kills a deer, the mortality event would be considered additive if that buck would have otherwise survived through to the next season (or other time period used to quantify the survival rate), but if the deer would have died that season due to some other cause (e.g., disease, predation, starvation, weather), then the argument can be made that the mortality was compensatory.

Bartmann et al. (1992) tested the compensatory mortality hypothesis for predation in a mule deer population in Colorado using three experimental manipulations: reducing winter deer density, simulating hunter harvest, and reducing predator density. They found no response in fawn survival rates when winter deer densities were reduced, which was attributed to not having reduced the density far enough to alleviate resource competition significantly; however, in the simulated hunting harvest, deer densities were reduced between 0 and 67% and fawn survival rates varied inversely with density. On the other hand, reducing local coyote populations caused deer population densities to increase, resulting in decreased predation, but an increase in deer starvation. Overall, there was no change in the survival rate of fawns. In both cases, starvation was the leading cause of fawn mortality, indicating a nutritional limitation at all densities and demonstrating that a strong compensatory mortality process operated in this mule deer population. Monteith et al. (2014) reported similar results for mule deer populations in Nevada and stated the nutritional carrying capacity and proximity to a populations food supply plays a critical role in determining the level of compensatory or additive mortality effects. If nutritional limitations exist, populations become density-dependent and more young are produced than the habitat can support, resulting in predation being more compensatory.

Even though predation rates may not be high enough in a particular area to significantly affect deer population performance by itself, when added to the other sources of mortality caused by hunting, weather, accidents, drowning, etc., predation may have a significant impact (Mech 1984). Because predator management may or may not increase deer population abundance, managers must consider all factors in determining whether predator management is appropriate and prescribe an effective predator management plan if justified.

Predators of Deer

In South Dakota, coyotes, mountain lions, and to a lesser extent, bobcats (*Lynx rufus*) and domestic dogs (*Canis lupus familiaris*), are the primary predators of deer (Gerads et al. 2001, Schmitz 2006, Thompson et al. 2009). In assessing the total amount of mortality due to predators, coyotes have the greatest potential impact on deer populations within South Dakota (Young and Goldman 1946). Predation occurs across all age classes of deer and throughout all seasons (Compton 1980, MacCracken and Hansen 1982, Turner et al. 2011), although fawns and aging deer are more vulnerable to predation than healthy young adult deer (Nelson and Mech 1990, Grovenburg 2012b).

Coyotes inhabit the entire state and occupy all habitat types. Coyotes are opportunistic predators and have the ability to change their diet both seasonally and spatially depending on prey availability (MacCracken and Hansen 1982, MacCracken and Uresh 1984). *Leporids* and rodents tend to dominate coyote diets when they are abundant (Clark 1972, MacCracken 1981, MacCracken 1982, MacCracken and Hansen 1982). Additionally, coyote diet composition is influenced by prey availability, season, and geographic region (MacCracken and Hansen 1982, Turner et al. 2011) and also includes fruit and vegetable crops, domestic animals, and opportunistic scavenging (MacCracken 1982). Coyotes are most active from dusk to dawn, and often rest during the day and only move when disturbed. In most regions deer are usually included in coyote diets during at least some seasons; however, the effect of coyote predation on deer populations varies considerably (Mech 1984). Coyotes typically hunt alone and mostly target fawns (Truett 1979, Compton 1980, Grassel 2000), but occasionally coyotes form packs to hunt larger prey (Hamlin and Schweitzer 1979, Gese and Grothe 1995). A study conducted in the Black Hills investigating coyote diets that were either preyed or scavenged upon, documented that white-tailed deer represented the majority of relative dry matter (43.5%) present in feces examined across all seasons. It was also noted that white-tailed deer were the most abundant prey source in winter scats, making up 71.6% of the relative dry matter (MacCracken and Uresh 1984). The authors concluded that white-tailed deer were a significant food resource for coyotes inhabiting the Black Hills. Similar results were reported by Gerads et al. (2001), where deer (*Odocoileus spp.*) made up 64.4% of coyote scat examined in the Black Hills; however, on the prairies of western South Dakota small and medium sized mammals (e.g., *Microtus spp.*, prairie dogs) comprised the majority (68.6%) of coyote diets. Deer and pronghorn only made up 9.2%.

Mountain lions are native to South Dakota and primarily occupy areas in and around the Black Hills, but may occasionally travel through other parts of the state. Deer are the major prey source of mountain lions in North America (Anderson 1983). Mountain lions are obligate carnivores that consume deer-sized prey throughout their range in the western hemisphere (Sweanor et al. 2000). Mountain lions are a stalk and ambush predator (Robinette et al. 1959) generally associated with some type of cover; allowing them to reach a close proximity to prey before attempting an ambush. Some authorities believe that one mule deer, or the equivalent, per week is a normal requirement of the animal, which means that consumption of the smaller white-tailed deer would be even greater (Young and Goldman 1946, Anderson and Lindzey 2003, Knopff 2010). However, mountain lions may scavenge opportunistically, reducing predation when carrion availability is high (Knopff 2010).

In an effort to better understand the feeding habits of mountain lions occupying the Black Hills, along with quantifying prey selection and kill rates, 41 mountain lions (29 female; 12 males) were captured and collared throughout the Black Hills with GPS telemetry from 2009-2012. Over 5,500 cluster locations (i.e., potential feeding sites) were investigated, of which 1,506 were feeding sites (kills = 1,246; scavenge = 260). Results indicated that deer (*Odocoileus spp.*) comprised the majority of mountain lions diets (83%; Smith 2014). The most common prey species, when identifiable, was white-tailed deer (62.9%). Mule deer made up 3.7% of feeding sites. Kill rates averaged 0.79 ungulates/week (95% CI = 0.70-0.88) and varied significantly among individuals (range = 0.13-1.75 ungulates/week) and season (e.g., summer, $\dot{x}$=0.92 ungulates/week; winter, $\dot{x}$=0.62 ungulates/week). Annual kill rates averaged 52 ungulates killed for females with cubs > 6 months, 42 for females with cubs < 6 months, 39 for adult females, 38 for subadult males, 35 for adult males and 33 for subadult females (Smith 2014). Juvenile animals made up >55% of a lions diet. Mountain lions selected for neonates in June (75%) and

July (82%) and into August (51%). Mountain lions may kill more juvenile ungulates to keep up with the biomass loss from lack of consuming adult ungulates.

Many studies (Hornocker 1970, Logan et al. 1996, Kunkel et al. 1999) have found that mountain lions target the most vulnerable individuals in a population (e.g., old, young, or malnourished), suggesting mountain lion predation may not always be an additive source of mortality (Bishop et al. 2009). Logan et al. (1996) suggested that the mountain lion birth pulse in the spring coincides with the fawning season, conferring survival advantages through the abundance of vulnerable prey. Furthermore, Knopff (2010) observed that mountain lions shifted prey composition seasonally as predicted by the juvenile and reproductive vulnerability hypotheses. Surprisingly, several studies (Robinette et al. 1959, Hornocker 1970) have reported mountain lions targeting bucks relatively more than does, regardless of age or physical condition, attributing the difference to an increased vulnerability of bucks as a result of sexual segregation in resource selection, especially after the rut; however, Logan et al. (1996) suggested that these results may be the result of inherent biases in the way deer populations and mountain lion kills were sampled.

Bobcats primarily occur in western South Dakota and areas along the Missouri River. Bobcats also exhibit an opportunistic feeding strategy but do rely more on stealth and patience to catch their prey. Bobcats primary prey source are *leporids* (rabbits and hares), typically comprising between 30-70% of their diet (Higgins et al. 2000, Mosby 2011). In a diet analysis performed by Mosby (2011) across South Dakota, deer species were only found in 4% of the 105 stomach analyzed. Similar results were reported by Tycz (2016) who documented ungulates occurred at low rates in the stomachs analyzed, averaging 4% in western South Dakota, 7% in the Black Hills and 10% in eastern South Dakota, indicating deer are most likely a secondary food source for bobcats occupying South Dakota.

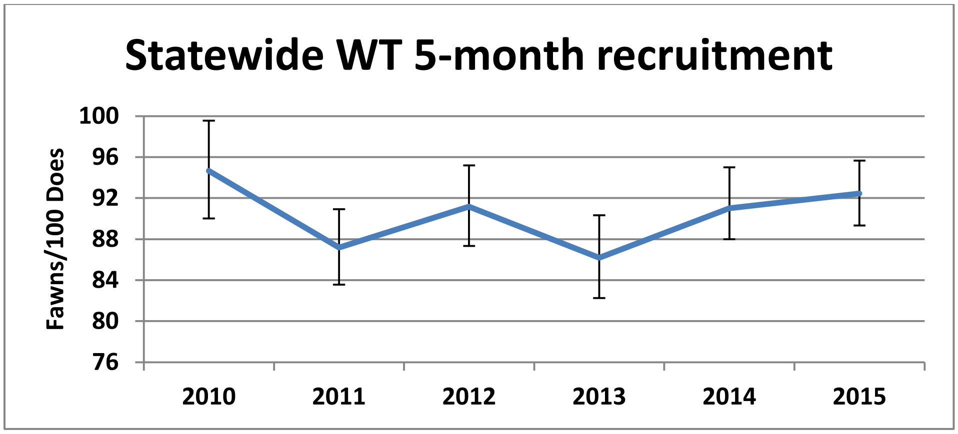
Domestic dogs occupy all areas of South Dakota and evidence suggests domestic dogs do chase and kill deer opportunistically especially during severe winters when deer are susceptible to predation. Recent studies have demonstrated how both lethal and non-lethal (avoidance) impacts of domestic dogs can shape the distribution of wild ungulate populations (Silva-Rodriguez and Sieving 2012). Peek (1984) pointed out that even if sufficient natural cover remains in the Black Hills, housing developments may not necessarily alter deer use of the area, but free ranging dogs from housing developments could preclude presence of deer. Furthermore, Griffin et al. (1999) reported that the harassment and killing of deer by domestic dogs is a perennial problem in the Black Hills on deer winter range. SDGFP has received reports of deer being harassed and killed by domestic and feral dogs. In March of 2009, six white-tailed deer were killed by domestic dogs that were caught in netted cage traps during SDGFP capture and collaring efforts (S. Griffin, personal communication). Lowry and McArthur (1978) documented 39 incidents of dogs chasing deer in the Idaho Coeur d' Alene River drainage, resulting in 12 direct white-tailed mortalities, all occurring in February and March. Causey and Cude (1980) fitted 23 feral dogs with radio telemetry collars in Alabama and observed marked individuals chasing white-tailed deer 16 times with no confirmed kills. Progulske and Baskett (1958) reported dogs had a relatively small impact on deer populations due to mortality, but were known to harass deer during all months of the year in Missouri. Reports of domestic dogs predating and harassing whitetail and mule deer fawns and adults has also been documented in South Dakota, however, quantifying the impacts domestic dogs have on deer populations proves to be difficult because evidence of death is very similar to coyote predation.

<u>Monitoring Impacts of Predation</u>

Two critical metrics in determining deer population performance are annual adult female survival and fawn survival to reproductive age. Fluctuations in adult female and fawn survival can result in different deer population trajectories, heavily influencing population growth and decline (see Table 44 in *Population Models* section). Analyzing trends in seasonal herd composition data (fall recruitment ratios) can be a useful tool in determining if predation on fawns within South Dakota is a limiting factor. Fall recruitment rates have been stable to increasing over the last six years for both white-tailed deer (86-95 fawns/100 does) and mule deer ( 56-81 fawns/100 does) (Figure 85) despite known predation events occurring across the state, suggesting predators are not a limiting factor on a broad scale. However, predation on fawns can potentially impact fawn recruitment on a localized scale. In addition, a suite of covariates such as body condition, birth date, birth weight, disease and severity of environmental conditions may affect whether or not fawns are recruited into a deer population (Singer et al. 1997). Simply monitoring predation rates does not indicate how predation contributes to doe and fawn survival, especially if mortalities are compensatory (Hurley et al. 2011, Robinson et al. 2014). One way to isolate the contribution of predation to deer population dynamics is through predator removal studies (Beasom 1974, Austin et al. 1977, Bartmann et al. 1992, Hurley et al. 2011, ODFW 2015).

Predator removal studies represent the best empirical method to observe the impact of predation on a deer population. However, because the effect of predation on prey populations is often an interaction of predator life history, climate, prey density, and habitat quality, it can be difficult to control for environmental factors during these studies (Hurley et al. 2011). In the past, studies often failed to account for predator density (Beasom 1974) or prey carcass search efficiency (Austin et al. 1977). Modern experimental design has been improved significantly and has included factorial design to account for interspecific competition among sympatric predator populations, alternate prey abundance, and climate (Hurley et al. 2011), as well as predator removal effort (Brown and Conover 2011). During predator removal surveys, fawn:doe ratios and fawn survival rates are both commonly used to assess predator impact, under the assumption that predators primarily target fawns (Beasom 1974, Austin et al. 1977).

In southern Texas, Beasom (1974) removed a total of 188 coyotes and 120 bobcats from an approximately 5,400-acre experimental plot and monitored fawn:doe ratio of the resident deer population both in the experimental plot and an adjacent control plot for two years. The first year was a severe drought year, and fawn:doe ratios of 0.47 and 0.12 were reported for experimental and control plots, respectively. The following year more favorable climatic conditions led to higher deer productivity in both areas, but the same relative difference (experimental: 0.82; control: 0.32) in fawn:doe ratios remained, indicating a significant impact on the deer recruitment; however, there was no hunter harvest in the study area.



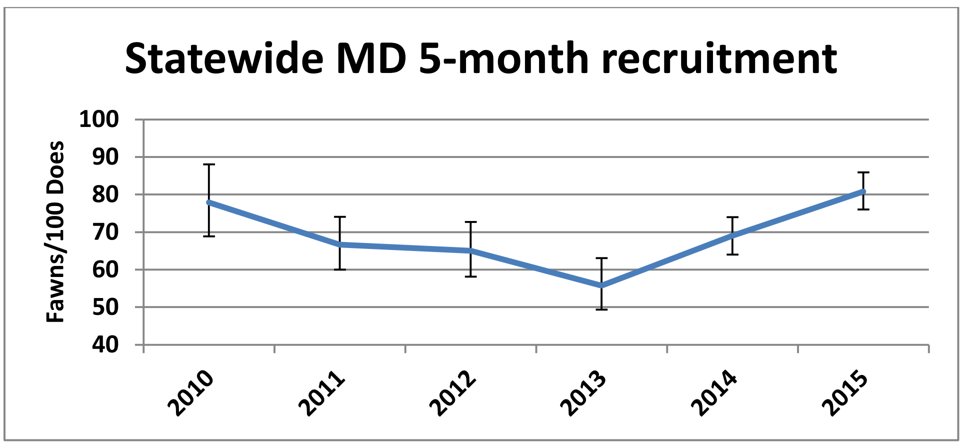




Figure 85. Statewide white-tailed deer and mule deer 5-month recruitment estimates (fawn:doe), 2010-2015.

In southeastern Idaho, Hurley et al. (2011) conducted a 2 x 2 factorial survey to observe the individual and combined impact of predation by both mountain lions and coyotes on the resident mule deer population. Neonate mortality was mostly influenced by weather, fawn mass, and mountain lion removal, while coyote removal decreased neonate mortality only when *leporids* were not abundant. Mountain lion removal also decreased winter mortality for adult female mule deer and improved fawn:doe ratios, but coyote removal had no effect on December fawn:doe ratios. Mule deer population dynamics were not strongly affected by the coyote-only or mountain lion-only removal, but mountain lion removal the prior year and winter severity had the largest influence (27% of variance) on the population growth rate. The lack of response in fawn:doe ratios or mule deer abundance to coyote reduction at this extensive (landscape) scale suggests that decreased neonate mortality due to coyote removal is partially compensatory.

Predation in South Dakota

Region specific predator data are important in accurately predicting spatial and temporal changes in deer populations (Brinkman et al. 2004). Available ungulate prey species in South Dakota include mule deer, white-tailed deer, bighorn sheep, mountain goat, pronghorn, and elk. In addition, many mid to small mammalian and avian species occur in this region (Peterson 1995, Higgins et al. 2000). White-tailed deer occupy the entire state and mule deer distribution decreases towards the eastern region of the state. Domestic livestock (primarily cattle, sheep and horses) also represent potential prey items in South Dakota.

Coyotes are the primary predators of deer in the intensively farmed regions of South Dakota (Nixon et al. 1991, Brinkman et al. 2004). Predation tends to be a minor component of overall deer mortality in agriculture-dominated landscapes when compared to human-related causes of mortality (e.g., hunting, vehicle collision); however, coyote predation is the principle cause of fawn mortality in these landscapes (Nixon et al. 1991, Brinkman et al. 2004, Grovenburg et al. 2011d).

In an intensively farmed region in southwestern Minnesota, on the border of eastern South Dakota, Brinkman et al. (2004) captured and radio-collared 77 female white-tailed deer >8 months old (61 adults and 16 juveniles) and 39 neonates (17 males and 22 females). The survival rates for both the adult/juvenile and neonate groups were high (77% and 84%, respectively), but the dominant source of mortality for adult/juveniles was hunting, while coyote predation was the leading cause (67%) of mortality for neonates.

Robling et al. (2014) conducted a 3-year (2010-2012) study of mule deer survival rates in two areas in west and central South Dakota: one area was in the Cheyenne River breaks region in Meade and Pennington counties which are characterized by cedar and juniper timbered breaks and deciduous timber-bottoms surrounded by grassy hills and scattered agricultural croplands, and the other study area was in the Fort Pierre National Grasslands (FPNG) characterized by rolling grasslands with very few wooded draws interspersed by grazing operations and croplands. Adult deer from the Meade-Pennington site experienced low *canid* predation rates (approximately 10% probable predation), while deer from FPNG experienced higher *canid* predation (approximately 30% probable predation); however, a significant portion of deer at the Meade-Pennington (56%) and FPNG (30%) sites died of unknown causes, some of which may have resulted from predation.

Grovenburg et al. (2011c) estimated annual survival rates (70-80%) and seasonal survival rates (summer 96-98%; fall 76-83%; winter 96-98%) for adult female white-tailed deer within 4 different ecoregions that ranged from heavily forested regions to grasslands that spanned southeastern Minnesota to central South Dakota. They found that survival rates did not vary significantly across these landscapes, but they were significantly higher than survival rates in the Black Hills (50-62%; DePerno et al. 2000) where predation and other natural causes of mortality accounted for 71%. These findings suggest that predation is not a significant source of mortality for adult deer in prairie habitats (e.g., grasslands) outside of the Black Hills, and that deer management in these regions relies on hunter harvest to maintain deer populations within state management goals.

In the grasslands of north-central South Dakota, Grovenburg et al. (2012b) reported that 23 of 81 radio-collared white-tailed deer fawns died over a 3-year study, and that predation accounted for 52% of mortalities, of which coyotes were responsible for 83%. They developed models to identify seasonal and spatial characteristics that influence fawn survival rates and found that survival rates varied significantly across each year during summer, and that fawn survival was significantly higher in areas with large patches of grassland and wetland cover.

From 1998-2003, 81 adult white-tailed deer were collared in the Black Hills (66 females; 15 males). Natural causes of mortality among white tailed deer accounted for 72% of all deaths. Coyotes were among the top predators of white tailed deer totaling half of all natural mortality cases (36%, n=18), while mountain lions accounted for two mortalities of white tailed deer in the southern Black Hills (4%, *n*=2). The majority of female white-tailed deer mortality events (50%, n=25) occurred in the spring when breeding age females were in late gestational stages of pregnancy (Griffin et al. 1994, Griffin et al. 1999). From 1999-2001, 21 adult female mule deer were collared in the southern Black Hills. Predation accounted for 69% (n=11) of the total mortalities. Of the 11 mortalities, evidence suggested mountain lions were responsible for 9 mortalities and canid species accounted for the other two mortalities. Increased susceptibility to predation does occur during this time because metabolic rates increase significantly and pregnant females seek out protein rich food resources and forage more often (DePerno 1998).

From 1991-1993, 61 white-tailed deer neonates were captured and collared in the north-eastern Black Hills. Mortality rates averaged 60% for the 3-year study and predation from coyotes, bobcats and domestic dogs were the leading cause of death (35%). A similar study was conducted in the central Black Hills from 1994-1997, annual mortality rates averaged 70%. Of the 37 mortalities that occurred during the study duration, predation accounted for 60% (coyote 30% and bobcat 30%; Benson 1996, Benson 1998). Schmitz (2010) documented a pooled annual survival rate of 52% (*n*=46) for mule deer fawns in the southern Black Hills. Annual survival from 2003-2006 ranged from 44-70%.

On the prairies of western South Dakota, 66 neonate mule deer were captured and radio-collared from 1978-1980. During those years, annual mortality was 59%, 56%, and 36% with coyote predation accounting for 86% of the deaths (*n*=28) (Steigers 1981).

<u>Managing Predators</u>
Wildlife managers are increasingly being challenged to accommodate a broader perspective of ecosystem management. Many studies have demonstrated the consequences of predators on prey populations, but how managers should use this information is not easy to decide. Predator control can be effective at enhancing survival and recruitment in populations of prey in limited situations. Mapping out ecological interactions prior to implementation of predator management efforts can help identify the best management actions, as well as any potential unintended consequences. For example, keeping coyote and cougar populations in check may

require reducing alternate prey (Gibson 2006, Wielgus 2007), or reducing predator numbers to increase abundance of prey can have counter-productive results such as increasing disease and parasite infections in prey (Packer et al. 2003). In some cases, predator removal as a means to bolster prey populations may not be the most effective means of game management. For example, Hurley et al. (2011) concluded that while coyote and cougar removal may influence mule deer population vital rates, the benefits are likely marginal and short term, and will not appreciably change long-term population dynamics of mule deer. As a result, predator-prey interactions as they are related to game management are based on the understanding that: 1) predator-prey ratios in any system may vary considerably; and 2) the predator-prey ratio is crucial in determining the degree to which predators may limit prey (Mech 1984). Furthermore, environmental and human-related cause-specific mortality of deer greatly influence prey density and thereby alters predator prey ratios, thus changing the effect of the predators (DelGiudice et al. 2002).

Predators are highly sought after and offer recreational opportunities for hunters and trappers. In South Dakota the mountain lion hunting season continues to be the number one management tool in maintaining a sustainable and socially acceptable mountain lion population. The 2015/16 Black Hills mountain lion hunting season length was 97 days, occurring from December 26, 2015 - March 31, 2016, with a harvest limit of 60 total lions or 40 female lions. During the 2015/16 mountain lion hunting season, 3,102 licenses were sold, resulting in 10,856 hunter use days (95%: 9,972-11,759) and 41 harvested lions (Figure 87). Within the Black Hills Fire Protection District, the use of dogs is prohibited except during specified hunting intervals in CSP during established seasons. A year-round season exists throughout the prairie landscapes outside the Black Hills Fire Protection District. A more conservative harvest season exists for bobcats, including a 52 day hunting and trapping season (December 26 - February 15), excluding CSP. During the 2015/16 season, 254 bobcats were harvested by approximately 2,079 furbearer license holders statewide (Figure 87). Current market value for bobcat pelts often influences hunting effort and overall harvest (Figure 87).

In contrast to mountain lions and bobcats, coyotes are ubiquitous throughout the state and an unrestricted year-round hunting and trapping season is in place. Market pelt price does seem to significantly impact coyote harvest rates in South Dakota, and in 2015 approximately 19,341 coyotes were harvested statewide (Figure 89) by hunters and trappers; the highest coyote harvest densities occurred in Deuel, Mellette, Corson, Brookings and Moody counties (Figure 90). In addition, in fiscal year 2015 the Animal Damage Control (ADC) program administered by SDGFP removed 7,623 coyotes in targeted areas where depredation was occurring.

Currently two state statutes legalize the killing of domestic dogs pursuing, injuring or killing any big game animal on public and private lands. Codified law (SDCL § 40-34-11) states a law enforcement officer may destroy any dog found pursuing, injuring, or killing any big game animal on public lands. Codified law (SDCL § 40-34-12) states a landowner or tenant may destroy any dog that pursues, injures, or kills any big game animal on lands owned or controlled by that owner or tenant without incurring any liability.

In summary, determining if predation is a limiting factor can be extremely difficult because predator-prey dynamics are complex situations and fawn recruitment and adult survival is likely dependent on a combination of multiple factors that vary spatially and temporally throughout different regions of the state. If predation is discovered to be a limiting factor, developing solutions to benefit deer populations requires adaptive management strategies, where effective monitoring allows managers to learn and adjust management through time. Ballard et al. (2003) emphasizes the following guidelines for determining if a more aggressive approach in predator management would likely increase deer populations:

- Deer populations are below the habitat's carrying capacity
- Predation identified as a major cause of mortality
- Populations of alternative prey species are limited
- Predator management efforts must be targeted and result in a significant decline in predator numbers
- Predator management efforts are focused within a geographic area (e.g., <400 mi.$^2$)
- Predator management efforts are timed just prior to predator and/or prey reproductive periods

In South Dakota, the primary predators of deer are coyotes and mountain lions and the amount to which they influence deer population growth rates remains largely unknown. Continued monitoring is necessary to ensure predation does not become a limiting factor and predator management strategies need to be adjusted accordingly.

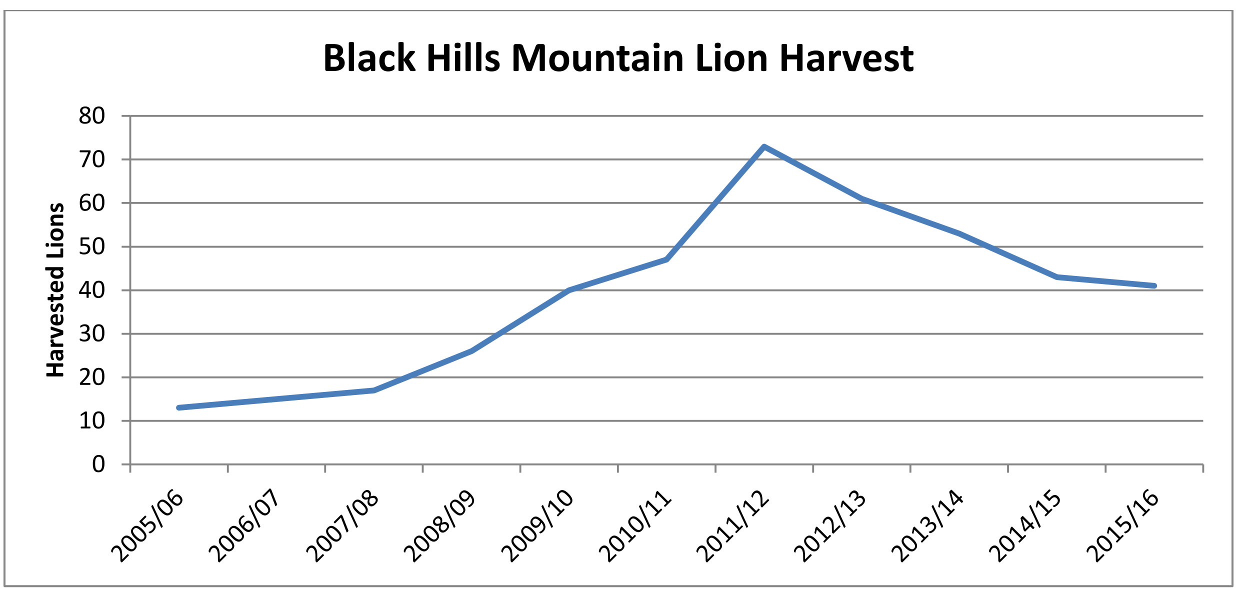



Figure 86. South Dakota Black Hills mountain lion harvest, 2005-2016.

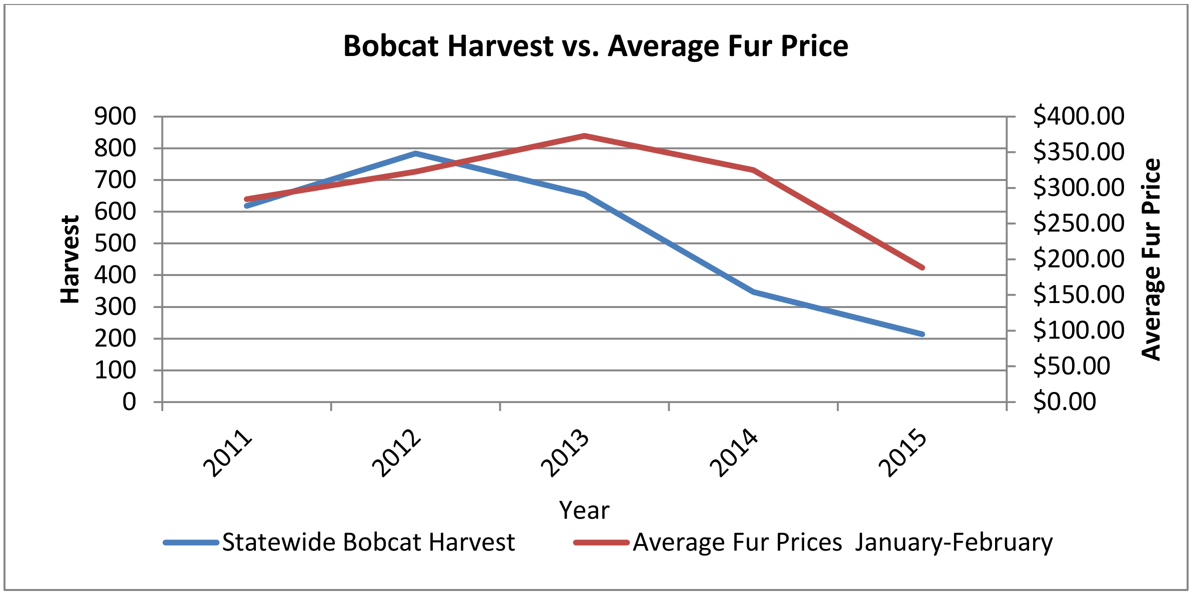



Figure 87. South Dakota bobcat harvest and average fur price, 2011-2015 (SDGFP 2016).

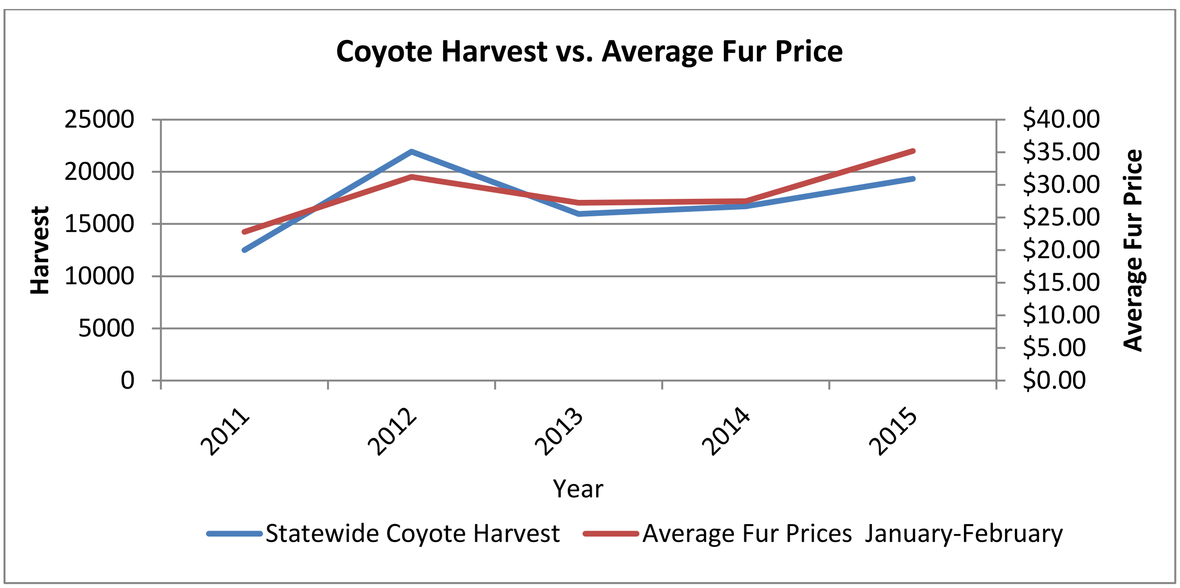



Figure 88. South Dakota coyote harvest and average fur price, 2011-2015 (SDGFP 2016).

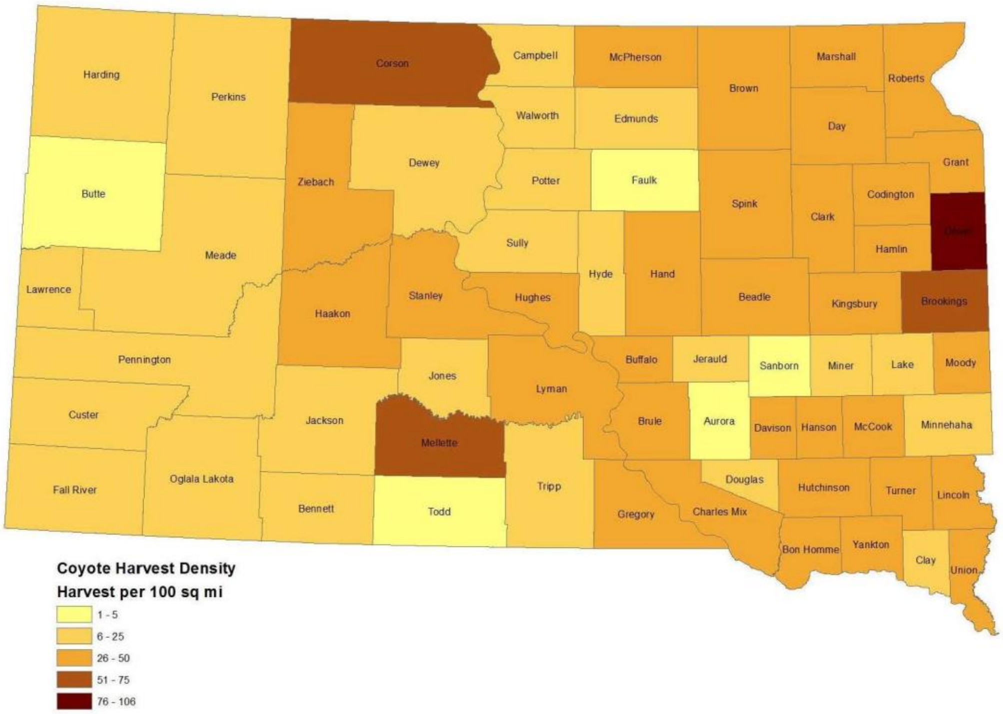



Figure 89. 2015 statewide coyote harvest densities.

## Law Enforcement

The SDGFP employs a cadre of 78 Conservation Officers who have the responsibility to both manage natural resources and enforce associated laws and regulations. They work within an assigned district, comprised of multiple counties, but have statewide jurisdiction. Conservation Officers are often the face that represents the department to the public within their district. They oversee and promote outdoor recreational opportunities while promoting public safety. This diverse and daunting task can be broken down into four main categories as it pertains to deer management:

- *Law Enforcement:* Conservation Officers enforce state laws and department regulations to ensure compliance, encourage wise and equitable use of the state's wildlife resources.
- *Wildlife Management:* Conservation Officers manage wildlife resources to conserve and perpetuate species and provide recreational opportunities for the public.
- *Habitat Management and Private Lands Programs:* Conservation Officers develop plans to improve deer habitat and recreational opportunities on department-owned and leased lands and develop and coordinate wildlife habitat programs on privately owned lands.
- *Public Relations and Public Education:* Conservation Officers act as a liaison between the department and the public to resolve conflicts and enhance and maintain a positive public image.

Common Infractions

Conservation Officers issue, on average, 1,200 violation notices directly related to hunting activity each year. These come in the form of written warnings or citations. When a citation is written, it may or may not require the defendant to appear in court. Many of the laws regulating deer and other big game animals are Class 1, or high-grade, Misdemeanors and require the defendant to appear in court. Other infractions, such as some Class 2 Misdemeanors, may have a fine/bond amount established by presiding judges that allow an individual to sign a power of attorney form and subsequently pay the prescribed amount in lieu of appearing in court. However, all individuals who receive a citation are afforded the ability to appear in court to contest the charge. Criminal fine monies are allocated to the school fund in the county of the violation, while court costs help fund statewide programs such as 911 and law enforcement training. Conservation Officers spend considerable amounts of time patrolling during the East River, West River, and Black Hills deer seasons. Additional patrols occur during the Youth Deer, Archery Deer, Refuge Deer, and Muzzleloader Deer seasons.

The average number of citations issued during big game seasons can be found in Table 83. Two of the most common violations committed during the fall hunting seasons are trespassing and the use of artificial light. Officers, on average, issue around 140 citations for hunting trespass annually. These investigations begin with a call from the aggrieved landowner who discovers the individual(s) hunting on their property without permission. Typically, there are around 250 annual calls for service for trespass alone. There are two categories of hunting trespass; knowing and unknowing. The penalties are more severe for the former, as this is a premeditated offense. On the other hand, there are situations and circumstances wherein an individual may be trespassing and not be aware. An example would be where a hunter strays off land where they do have permission onto other private land due to unmarked property boundaries. In South Dakota, it is the responsibility of the hunter to know they have permission before they enter private property to hunt.

The other primary hunting violation officers investigate during the fall is the use of artificial light, or spotlighting. Night patrols are commonplace for officers to deter illegal activity during nighttime hours when deer are active and vulnerable. While the law is certainly in place to prevent the unlawful take, or poaching, of deer during the night, it is just as much a safety measure. Shooting a firearm during the nighttime is inherently dangerous because most do not have an intimate knowledge of what lies behind the target and the associated layers of darkness, whether it is rural residences, livestock, farm machinery, or other property. The general concept of law is that persons may not use an artificial light to spot or locate an animal while in possession of a firearm or other implement capable of taking said animal. Additional provisions exist that deter recreational spotlighting (without weapon present) during the fall/winter. Notable exceptions exist for landowners conducting control of predators/varmints on their own property and those that use dogs to tree and subsequently take raccoons. Conservation Officers issue around 80 citations each year to individuals that violate the artificial light law. Officers receive around 150 annual calls to service from landowners for spotlighting activity.

Table 83. Average citations issued during big game seasons, 2010-2015.

| Type of Citation | # of Citations |
|---|---|
| Trespass | 142 |
| Use of artificial light, or spotlighting | 78 |
| Shooting Big Game from the Road Right-of-Way | 38 |
| Hunting in Wrong Unit/Violate Conditions of License | 33 |
| Failure to Tag/Improperly Tag Big Game Animal | 33 |
| Hunting Without Big Game License | 30 |
| Unlawful Possession of Big Game | 21 |
| Use of Salt/Bait to Attract Big Game | 15 |
| Use of a Vehicle to Chase/Disturb Big Game | 11 |
| Hunting Big Game During Closed Season | 11 |
| Failure to Wear Fluorescent Orange During Firearms Season | 9 |
| Wanton Waste of Game | 9 |

<u>Additional Deterrents</u>

The existence of deer hunting laws and regulations, combined with the presence of Conservation Officers afield, serves as a deterrent for most hunters to resist the temptation of breaking the law. A small percentage of the population intentionally disregards these measures, however, and does not fear the consequences of potential criminal fines that could be levied against them in court. There are several measures, outlined below, in place to serve as additional deterrents for would-be deer hunting violators.

***Revocation of Hunting Privileges***

Aside from criminal fines, perhaps the biggest punishment an unscrupulous hunter fears is the loss of their respective hunting privileges for extended periods of time. Certain violations, upon conviction, mandate the revocation of the violator's hunting privileges without hearing for a minimum period of one year. Offenses that include the mandatory loss of hunting privileges for a period of *one year* include:

- Any hunting law punishable as a Class 1 misdemeanor
- Shooting from a motor vehicle
- Shooting big game from a road right-of-way
- Artificial light
- Hunting without a license
- Hunting during a closed season
- Knowing trespass

Persons convicted of taking or possessing two or more big game animals in excess of the daily or possession limit automatically lose their hunting privileges for a period of *three years.* Additionally, the sentencing court may impose consecutive revocations of the person's hunting privileges if the person is convicted of two or more violations for which revocation of the privileges is authorized. During an average year, approximately 250 hunters receive a revocation of their hunting privileges.

***Interstate Wildlife Violator Compact***

The Interstate Wildlife Violator Compact (IWVC) is an agreement among participating states to share information regarding sportsmen fishing, hunting, and trapping violations, which is patterned after the Nonresidents Driver's License Compact. The IWVC obligates members to report wildlife violation convictions to Compact members, gives the members the capability to honor each other's suspensions, and provides the method to exchange violator data between member states. Essentially, a violator convicted in one Compact member state may be barred from hunting, fishing, and trapping in other member states.

There are 44 states, including South Dakota, who are participating members of the Compact. This allows states to share convictions and suspensions with each other and provides a way in which violators can be held accountable in their home state for out-of-state violations. While each state has its own criteria for suspension and reporting, this partnership filled a void through which many violators could be held to a higher standard than was the case in the years before the Compact was formed. Additionally, this agreement allows states like South Dakota to "cite and release" member-states' residents from custody for most wildlife violations; a process that didn't exist prior to the IWVC.

While the Compact's impact is far-reaching, the most often utilized part of the agreement is the ability to honor other state's suspensions and revocations. If a violator has a privilege revoked in a member state, other states have the ability to deny those privileges within their state. While each state's suspension or revocation process is different, the agreement provides an opportunity to hold violators accountable. The IWVC continues to be a very valuable partnership in regulating illegal hunting in the United States.

***Liquidated Civil Damages/Trophy Provisions***

When wildlife is illegally taken, an opportunity is taken away from another hunter. Many biological factors lead to animal survival, from birth to maturity. Liquidated civil damages serve as a "replacement value" for the loss of those particular animals from the population. These legislatively mandated monetary penalties are levied in addition to criminal fines. Specifically, state law provides that any person (other than a minor under the age of sixteen years) who willfully and unlawfully kills, destroys, takes, or possesses in this state any deer (1) without an applicable and valid license, (2) at a time or place when and where taking or possession of such deer is prohibited, or (3) in excess of the legal limit if exceeded by one or more is liable to the state for civil damages. The civil damages are $1,000 for each non-trophy mule deer or white-tailed deer. The civil damages for each trophy mule deer or white-tailed deer (Table 84) may not be less than $2,000 and may not exceed $5,000. If a person has taken or is in possession of more than two times the lawful daily or possession limit of deer, such person is liable for twice the damages. The monies are allocated to the Department for further management, except in the case of trophy deer wherein the trophy monies are earmarked for the school fund in the district where the animal was illegally taken.

Table 84. Legal definitions for trophy deer classifications in South Dakota.

| **State Definition of Trophy/Non-trophy Deer** | |
|---|---|
| Trophy mule deer | Any mule deer having a Boone and Crockett gross score of one hundred sixty points or greater |
| Trophy white-tailed deer | Any white-tailed deer having a Boone and Crockett gross score of one hundred forty points or greater |
| Any mule deer or white-tailed deer not defined as a trophy | Non-trophy |

***Turn In Poachers Program***

The Turn-In-Poachers (TIPs) program is a partnership between SDGFP and the non-profit organization, Wildlife Protection, Inc. This joint venture was born out of a desire for South Dakota's sportsmen and women to "police" and report violators. With approximately 78 Conservation Officers called upon to cover approximately 75,000 square miles of land and 1,200 square miles of water in South Dakota, it is evident that they can't be everywhere all the time. Most times the best witnesses are the landowners and resource users themselves. So, in an effort to provide easy and convenient ways to report violations, TIPs has become a core component of SDGFP's law enforcement efforts.

Through TIPs, a 24 hour, seven day a week toll free number [1-888-OVERBAG (683-7224)] has been set up to field reports from the public regarding hunting, fishing, and trapping violations. Information on violations may also be reported through a link to the SDGFP website at: http://gfp.sd.gov/agency/law-enforcement/TIPs/default.aspx. Just like those calling in on the telephone, the information entered in this form may be reported by those who wish to remain anonymous.

This partnership between government and the private sector allows those who provide information to be compensated for their information. Since the inception of the program in 1984, over $160,000 in rewards has been paid out to people who observe and report violations. The funding for this program comes from a variety of areas, but the most prominent source is sportsmen donations.

In the 2015 TIPs year (July 1, 2015 - June 30, 2016), 449 investigations and 193 arrests could be directly attributed to information provided through the TIPs program. From this information, violators were fined $30,794 and required to pay $13,900 in civil damages. Judges sentenced violators to 940 days in jail for their crimes (all but two days were suspended). TIPs paid out $4,495 in rewards.

The best known aspect of TIPs program is the reward program after a violation has been committed; but, there are other elements to TIPs. At the direction of the Wildlife Protection, Inc. Board of Directors, several electronic and print advertisements have been disseminated to the public in the past. In addition, TIPs radio spots were contracted and serve as a constant reminder to the general public for the need to practice good sportsmanship and ethics while on the water and in the field.

For over 30 years, the South Dakota Turn In Poachers program has been a shining example of what can be done to protect a public trust resource when government, private industry, sportsmen and the general public come together to address a common problem (Table 85).

Table 85. Summary results from the TIPs program, 1984-2016.

| **TIPs Program Totals 1984 to June 30, 2016** |
|---|
| 11,294 investigations |
| 3,954 arrests |
| $750,719 fines |
| $580,287 civil penalties |
| 35,957 days of jail (32,786 suspended) |

**Energy and Mineral Development**

Natural resources are under constant stress from human population growth and economic exploitation. Industrial development in the form of urbanization is identified as the primary cause of species endangerment, and a leading threat to biodiversity in the contiguous US (Krausman et al. 2008). Manufacturing, energy development, mining, transmission lines, pipelines, storage facilities, and increasing demands of agriculture all decrease the availability or effectiveness of wildlife habitat. Habitat loss is the most prevalent cause of species endangerment (Czech et al. 2000). Whenever wildlife habitat is lost, so are opportunities for management (Polfus 2011). Confronted by industrial development, biologists, land managers, and other scientists are challenged to understand and mitigate its impacts on wildlife populations and habitat loss.

Effects of energy and mineral development to wildlife or habitat resources can be direct, indirect, or cumulative. Direct impacts result in wildlife mortalities resulting from such things as collisions, poisoning or other chemical hazards. Direct impacts to habitat are losses from conversion to another use. Indirect impact to deer population occur over time from habitat conversion and pose the greatest threats to deer population worldwide (Klien 1992). A developmental impact added to another related or unrelated activity is referred to as cumulative effect. These include both direct and indirect impacts and total effects from past, present or future expected impacts (CEQ 1997). Cumulative wildlife impacts are confronted by understanding development's individual impacts on wildlife populations and habitats. Known impacts to deer populations are identified and mitigation and extent of energy and mineral development in South Dakota are discussed below.

<u>Oil and Gas</u>

The geographic scope, intensity, and pace of the United States' energy development have potential to impact fish and wildlife habitats on a large scale (Lutz 2011). Severity of direct oil and gas impacts depend on activity levels. Deer vehicle collisions are a direct impact dependent on the amount of vehicle traffic servicing oil and gas fields (Dyke 2011). Direct impacts to habitat are also dependent on the level of activity of habitat conversion to well pads, roads, and associated infrastructure. These developments impact deer indirectly as habitat loss, fragmentation, and displacement stress from increased human activity. Impact to habitat is compounded when it impedes critical life stages or occurs on ecologically significant habitat (Sawyer 2005) to ultimately affect population viability.

Sawyer et al. (2009b) delineated direct and indirect impacts to deer at Wyoming oil field well pads, roads, pipelines, and ancillary facilities. His study determined mule deer avoidance generally increases with a decrease distance to well pads. This finding extends loss of habitat far beyond the perimeter of habitat conversion at a well pad. Sawyer determined that deer use would be half the normal deer use within an average distance of 1.2 miles from active well pads. Additionally, Sawyer documented that human activity and noise also results in physiological stress and avoidance behaviors in mule deer.

Wyoming has developed a ranking system for oil field impacts in crucial mule deer winter range (WGFD 2010). Their ranking creates thresholds to identify when habitat becomes less effective within zones surrounding wells, facility, road corridor, and areas of human, vehicular or equipment movement.

Using Wyoming's thresholds (Table 86), 8 mi.$^2$ of "Extreme" rankings occur in northwestern South Dakota (Figure 91). Although South Dakota does not identify any part of the state as crucial winter range, 126 mi$^2$ rank "High" around active drill sites. The extent of "Moderate" rankings is expanded statewide when cumulative effects such as roads and other land conversions are included.

Table 86. Wyoming ranking system for oil field impacts in crucial mule deer winter range.

| | |
|---|---|
| Moderate | 1 well pad location or up to 20 acres of disturbance per square mile |
| High | 2-4 well pad locations per mi$^2$ ,or 20-60 acres of disturbance per mi$^2$ |
| Extreme | >4 well pad locations or >60 acres of disturbance per mi$^2$ |

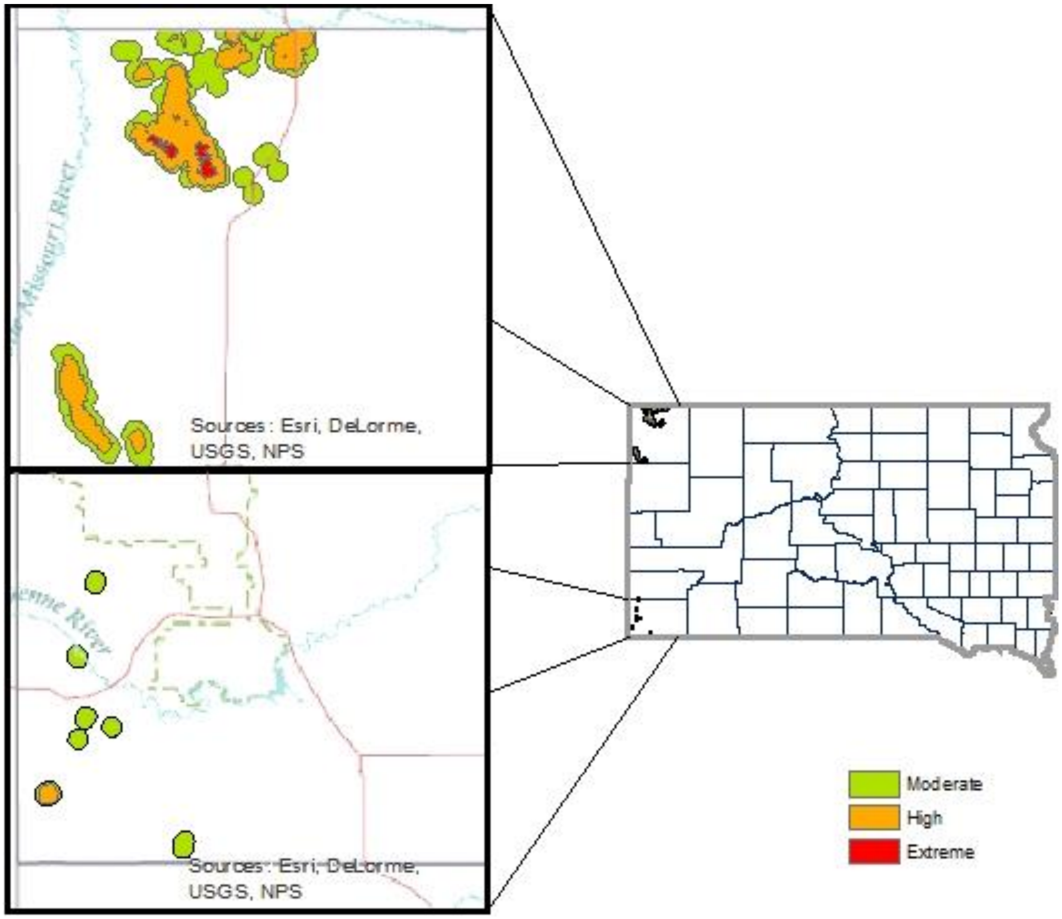



Figure 90. 2016 South Dakota oil field impacts using the Wyoming ranking system.

During the time of historically high crude oil prices, the most optimistic statewide oil development scenario predicts northwestern South Dakota as having six drilling rigs each drilling an average of one new well per month for the next fifteen years (The Office of Governor Dennis Daugaard 2012).

Mining

Mining methods include surface, underground, and insitu recovery. Similar to oil field impacts, direct impacts to habitat from mining is most detrimental in more ecological significant habitat. Indirect impacts on deer populations depend upon the amount or intensity of disturbance, placement of disturbance and the quality of affected habitats (Sawyer 2001). A large mine or a “complex” of smaller operations can impact a significant amount of area, especially when coupled with known avoidance responses of deer. Arrangement of disturbance refer to mine placement impeding important seasonal migration patterns, destinations, or diurnal passage to forage and resting cover. Mine placement impacts are exacerbated when they hinder movements to, or occur in, wintering areas or other high value habitats. Figure 92 shows the distribution of mining and wind energy activities in South Dakota.

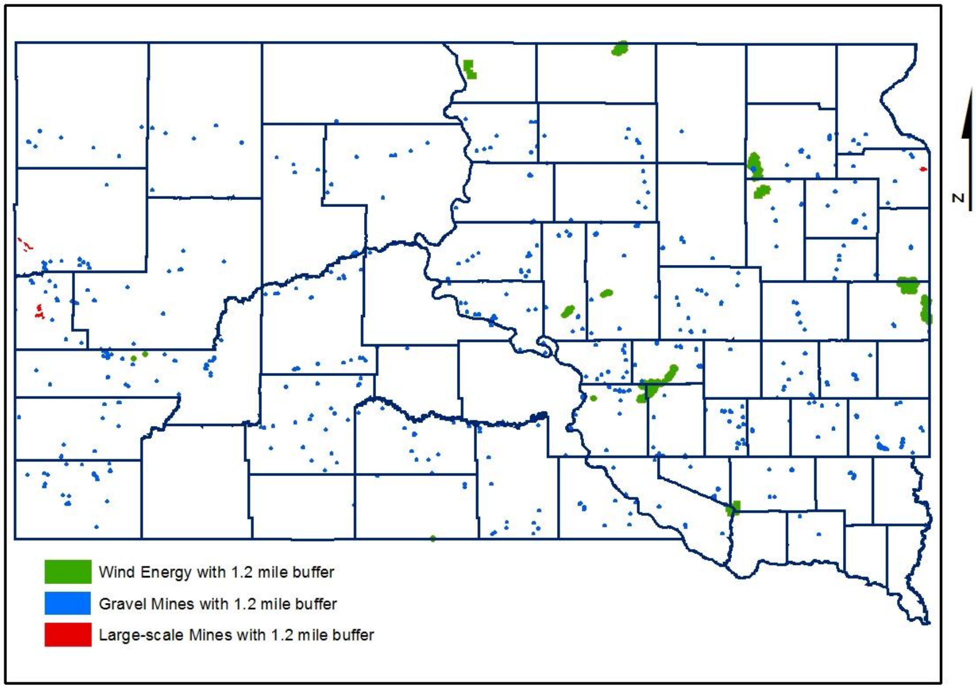



Figure 91. 2015 South Dakota mining and wind energy generation sites.

South Dakota mining law recognizes the importance of wildlife resource protection. Large-scale mine sites must undergo “special, exceptional, critical, or unique lands” determination (SDCL § 45-6B-33.3), and identification of critical wildlife resources (SDCL § 45-6B-92) during permitting. Land may be determined unsuitable for mining if important resource impacts cannot be adequately mitigated (SDCL § 45-6B-33).

Reclamation of disturbed land can have a positive effect on deer when vegetative structure and nutrient content of forage is improved (Medcraft 1986, Lutz et al 2011). Land reclaimed specifically for wildlife and even unreclaimed abandoned mine sites can provide distinct habitats not found in the surrounding landscape. In the Black Hills, 3 of the 5 large-scale heap leach gold mines selected wildlife habitat as an option for post-mining land use (SDCL § 45-6B-45). Once reclaimed, all of the mines will have increased the forage component in the typically heavily forested Northern Black Hills. In addition, the Custer Gallatin National Forest is actively reclaiming abandoned uranium mines and exploration pits in Harding County and since 2009, 100 exclamation pits and abandoned mines have been reclaimed (K. Hansen, personal communication). Deer select reclaimed mine sites if high quality forage is available. Medcraft et al. (1986) found mule deer selected forage at a reclaimed Wyoming coal mine more often than adjacent unmined land.  Additionally, mine areas offer security from public entry that can result in high deer production and survival rates from the lack of natural predators, nonexistent hunting pressure, and enhanced forage.

Insitu mining creates a network of individual "well fields" consisting of injection, recovery and monitoring wells.  Solution storage ponds, process plant facilities and other infrastructure are concentrated similarly to other large manufacturing facilities.  Insitu mining can offer relatively large areas with low human activity and enhanced vegetation from reclaimed exploration and well site installation activity.

Quarries, gravel pits, and other open pit surface mining directly impact less than 0.5% of the acreage in SD.  Impacts are expected to be comparable to those found during oil field impact studies' where deer use will increase with increased distance from human activity.

ARSD § 74:29:07:02 requires mine operators to minimize harmful impacts to wildlife at their operations.  SDGFP habitat staffs works directly with mine operator regulators to minimize hazardous conditions.  SDGFP personnel are also available to assist anyone wanting to enhance forage quality and add structural diversity to disturbed lands.

<u>Wind</u>

With almost nine-tenths of South Dakota identified as "suitable" for large-scale wind development, wind facilities are proposed in all areas of the state (EIA 2016).  The National Renewable Energy Laboratory estimates that South Dakota could generate many times its current electricity needs from wind.  These data suggest that over time, wind generated energy development will occupy a significant amount of surface area in South Dakota.

Very little research is available evaluating wind energy development impacts on larger mammals (Lutz 2011).  Wind generation studies of wildlife impacts have primarily focused on avian and bat species.

Study of direct habitat impacts can be assessed by determining land area converted to turbine pads, roads and other facilities.  Definitive Information on deer avoidance and indirect habitat impacts from wind energy generation is not yet commonly recognized.  Population-level wildlife impacts have not been documented (NAS 2007).  The potential for significant population level impacts are a concern; however, as habitat for many wildlife species already experiencing long-term declines are being targeted for wind energy projects (AWWI 2015).

Wind energy generation directly affects more habitats per unit of energy produced than hydrocarbon, nuclear, solar, or geothermal (Naugle 2011).  The number of wind turbines transmission lines, and access roadways determine the degree of impact from wind generation.  Access road installation is the primary direct impact from wind energy development (Denholm et al. 2009).  The number of "wind farms," placement of these facilities, and the quality of affected habitats may all cause indirect impacts on a much larger scale.  Wind turbines positioned on ridgelines to increase efficiencies may conflict with important deer habitat.

Wood (1988) found wind deflecting and scoured hillsides as the most important factor influencing mule deer winter bedding and feeding site selection in the prairie environments of Montana. Following seven years of study in Wyoming, Sawyer et al. (2005) found mule deer returned annually to traditional winter ranges, but over that time exhibited only slight tolerances to the presence of turbines. Both studies suggest unchecked turbine placement intensifies the degree of direct habitat loss.

"Siting Guidelines for Wind Power Projects in South Dakota" (https://gfp.sd.gov/wildlife/docs/wind-power-siting-guidelines.pdf) are recommendations offered by SDGFP to address activities and concerns associated with siting and permitting of wind turbines. The potential growth of wind generation in South Dakota highlights the need for wildlife managers to continue their involvement in wind development planning to identify and avoid turbine placement in limited or quality deer habitats (USFWS 2012b).

Biofuels

State and federal mandates and incentives promote biofuel development in the United States (USDOE 2016). Biofuel mandates have increased demand for crop and crop products, competition for land use, and development of new sustainable agricultural management strategies (Rupp et al. 2012).

Biofuel production's impact on wildlife species depend on what crop or feed stocks are grown, where they are grown, how crops are managed, and the landscape extent and context (Dale et al. 2010). Crop production increases are often associated with large-scale agribusiness and increased mechanization. Use of larger equipment to increase production often results in the elimination of small fields and windbreaks that provide forage, escape, and resting cover for deer (Brown 1992). Expansion of extensive single crop or fallow fields places further demands on habitat, especially in areas of already limited habitat.

Cellulosic biomass refers to crop residues or materials obtained from plants. Biomass collected during timber harvest or thinning presents an opportunity for a large renewable energy resource. Cellulose biofuel production from crop residues and timber stand thinning may have varying effects on deer. Timber harvesting in areas providing inadequate thermal and hiding cover habitat may be detrimental (Gibbs et al. 2004), while on the other hand, forest thinning typically improves understory forage production. Biomass collection from a forest has potential to enhance deer populations if done sustainably (USEPA 2009).

Summary

Whenever natural areas or otherwise undeveloped land is converted for other uses, deer population's habitat base is directly impacted. Energy and mineral development can significantly threaten habitats and species with both direct and indirect impacts. Degree of impacts is determined by the extent, placement and the quality of habitat affected. Cumulative effects will continue to present wide-ranging deer management challenges.

South Dakota laws and regulations are in place, along with SDGFP wildlife staffs, to mitigate some of the impacts from mineral development. Large-scale wind energy development has potential to dramatically increase in South Dakota and has relatively few regulations in place for protection of wildlife resources. Direct impacts to habitat and deer can be mitigated during project development but indirect impacts to the state's deer population are dependent on habitat loss from development activity. Mitigation of habitat loss from energy and mineral development will challenge SDGFP to identify and protect significant habitats. Deer managers will continue to monitor and manage factors influencing population trends; however, all wildlife management depends on a secure habitat base (Fox et al. 2009).

**Urban Deer Management**

Urban communities continue to expand and deer populations often adapt to these landscape changes. White-tailed deer have adapted to anthropogenic landscapes and have become overabundant in many urban locations (Urbanek et al. 2011). These new environments challenge wildlife managers to develop effective deer management strategies because traditional management techniques such as hunting are typically not acceptable or practical in these areas. Many times deer populations frequently move in and out of city limits which pose another challenge to wildlife managers. South Dakota, although a rural state, is no exception to urban deer issues and has several communities which have seen substantial urban expansion within the last 30 years and human-deer conflicts continue to increase. The city of Sioux Falls has grown rapidly (Figure 93) and the conflicts between humans and deer have increased. While deer populations haven't met their biological carrying capacity in these communities, the deer density has created conflict with citizens and has met social tolerance thresholds in some cases. Urban deer management is a complex issue and there are many different attitudes and perceptions surrounding this topic (VanAllen Baker and Fritsch 1997). High deer densities can lead to conflict from people that live in these areas because of increased damage to landscape plantings and trees as well as increased risks of being involved in deer-vehicle collisions. Deer-vehicle collisions are a serious safety concern for motorists (Bashore et al. 1985). In a recent survey of landowners, Longmire (2017a) reported that 74% of respondents were concerned about having a deer-vehicle collision. In addition, the conflicts that surround these issues are often between people that enjoy seeing the deer and people that are frustrated with the damage that can be associated with urban deer. This issue has been controversial in some communities in South Dakota and in Rapid City the issue of urban deer management even went to a public vote in 1995 where it was approved by the majority of voters to authorize the City of Rapid City to enter into agreements with SDGFP to establish and maintain a deer management program within city limits.

SDGFP has developed guidelines that it will not operate its wildlife damage management program within city limits as 100% of the funds used to operate these programs are generated by a surcharge on most hunting licenses (Fisk 2016). However, SDGFP will cooperatively work with the communities that experience human-deer conflicts and also assist with deer survey efforts, issuance of kill permits, and technical advice regarding techniques used to reduce deer damage. SDGFP also regularly attends citizen task force meetings to provide input and answer questions as well as assists with the development of urban deer management plans. SDGFP requires that an urban deer management plan that incorporates public input and the prohibition of feeding deer by residents within city limits be in place before SDGFP will authorize lethal control. Other techniques used across the United States such as: trap and relocation, birth-control, fencing, and compensation, are all non-lethal techniques that can be used to manage urban deer. However, several of these techniques (trap and relocation, compensation, and birth-control) have been proven ineffective to address citizen concerns (Messmer et al. 1997) and most wildlife agencies do not support the use of trap and relocation due to high mortality rates, high financial costs, and potential risk of spreading disease (Ishmael and Rongstad 1984, Urbanek et al. 2011). SDGFP shares these concerns and does not use trap and relocation, compensation, or birth-control. Habitat modifications, planting different kinds of landscaping, fencing, and repellents are also techniques used to deter deer damage but have limited success or low citizen support to implement (DeNicola et al. 2000).

Lethal control is the most commonly implemented practice by many of the affected communities in South Dakota. Kilpatrick and Walter (1997) found that most community residents in Connecticut wanted a solution that provides immediate results and supported lethal control. SDGFP works closely with interested communities to develop a management plan that identifies several metrics so that management strategies are not driven by emotion. The metrics include the number of deer surveyed along identified routes, the number of citizen complaints regarding deer damage, and the number of deer-vehicle collisions inside the city limits. These measures, along with public input can help communities determine the management actions they seek to manage their urban deer populations. Education of homeowners on the effectiveness and costs of management alternatives should be an important component of the planning process (Kilpatrick et al. 2007).

Lethal control usually is in the form of a kill permit from SDGFP to local city authorities (i.e., police department or parks department) but can also be in the form of an urban hunt. For example, in Sioux Falls the city works with SDGFP and allows archery hunting to occur in a small area of the city to better manage the local deer population and reduce deer-vehicle collisions along the eastern edge of the city. In other areas of the city that are not conducive to this type of hunting, SDGFP issues the city a kill permit for a pre-determined number of deer that are killed by members of the police department. SDGFP encourages cities to utilize hunting as an effective form of urban management whenever possible, as this technique is very cost effective and safe in the proper environments. Regardless of method, the euthanized deer are always salvaged for human consumption and distributed through charitable donations and these management efforts always target antlerless deer. Most times, the number of deer that a community desires to remove is a small number (i.e., less than 50), but Rapid City has removed a large number of deer during several years (Figure 94). This large removal is because of the urban-forest interface that occurs along the western edge of Rapid City. Often times, certain neighborhoods will extend along a riparian area into the forest which creates a corridor for deer to travel into the city as well as impact property owners along the way. Other communities that have worked with SDGFP to manage urban deer populations include the cities of Aberdeen, Custer, Hot Springs, Pierre, Sturgis, and Whitewood. Managed hunting within city limits or along the edges of cities has proven successful in many areas of the United States (Urbanek et al. 2011). South Dakota has also experienced success with urban hunting in some areas. Several communities have managed their deer populations and conflicts with hunting combined with bans on feeding deer.

As urban sprawl continues in South Dakota, wildlife managers will be challenged with urban deer management issues. The complexities of urban deer issues and the limitations and controversy that surrounds some techniques make quick-fix solutions unlikely and may take an integrated approach (DeNicola et al. 2000) Society should be prepared to acknowledge deer within a city and expect the deer-human conflicts that are associated with their existence. As deer become more habituated to these human environments, deer-human conflicts will only increase (Urbanek et al. 2011). Urban deer management is based largely on social concerns and if social tolerance limits are exceeded, social or political pressures could force SDGFP to decrease deer populations in adjacent hunting units even when the management objective in the hunting unit may be to increase. SDGFP has taken the position to allow these cities to manage their own deer herds to the level they believe is appropriate as long as it doesn't have negative impacts to the deer herds that surround the community. Citizens and city officials must understand that the elimination of deer from within city limits is not feasible or practical and that humans need to co-exist with deer in urban environments. Urban deer management is a relatively new management topic but will continue to be a necessary component of overall deer management (DeNicola et al. 2000). Finally, SDGFP has a proven history of cooperatively working with communities that experience deer-human conflicts and will continue to work on innovative solutions to address these challenges.

**Deer-Vehicle Collisions**

Deer-vehicle collisions are a serious safety concern for motorists and can also be a substantial source of mortality for deer populations in some areas (Bashore et al. 1985 and Putman 1997). As road densities and the number of people that travel these roadways increases in South Dakota, deer-vehicle collisions continue to be a complex issue for wildlife managers as well as transportation agencies. Wildlife agencies are responsible for deer management while at the same time, transportation agencies are responsible for the public's safety on roadways. Deer occur across South Dakota and the potential to have a deer-vehicle collision exists on any road within the state. When agricultural fields or urban development occur adjacent to trees on the landscape, these heterogeneous habitats are selected by white-tailed deer (Stewart et al. 2000, Haffley 2013). Wildlife managers are also challenged to evaluate the impacts of deer mortality caused from deer-vehicle collisions, regarding overall population growth rates. While the density of roads in South Dakota is relatively low compared to many other states, deer-vehicle collisions readily occur (Figure 95). From 2004 to 2014, the South Dakota Department of Public Safety (SDDPS) recorded 46,960 wildlife-vehicle collisions and on average approximately 5,000 wildlife-vehicle collisions are reported annually (J. Serbousek, personal communication). These reports do not differentiate between wildlife species (e.g., deer, elk, or pronghorn) but one can reasonably assume most of these collisions are with deer due to their density and abundance across the state. There are also many collisions that go unreported due to minimal damage to vehicles, lack of insurance coverage, and other reasons.

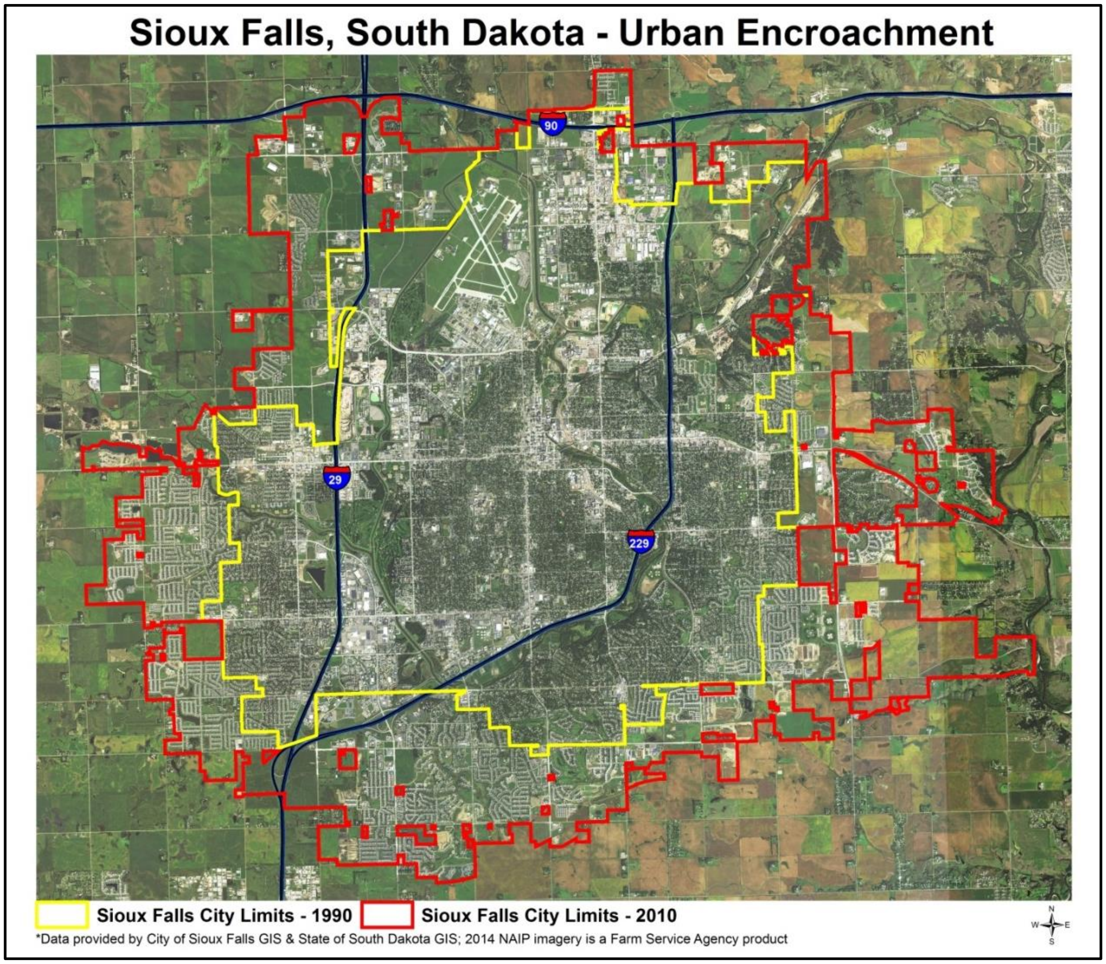



Figure 92. A map of the city of Sioux Falls, South Dakota comparing city limits and the area of urban sprawl, 1990 to 2010.

Another way to measure deer mortality caused from deer-vehicle collisions are carcass collections. SDGFP and the South Dakota Department of Transportation (SDDOT) jointly fund carcass collections across the state on major state highways and interstates. These collections average around 3,000 dead deer collected, annually. This is only a portion of the deer killed by vehicles as some animals may wander away from the roadside to die and the collection routes are only run on major state highways and interstates (i.e., no county or township roads). Additionally, some of these carcasses are likely reported as crashes and are then included in the SDDPS figures. Nonetheless, deer-vehicle collisions are a concern for wildlife managers and public citizens. Furthermore, Longmire (2017a) reported that 74% of landowners that responded to a survey in 2016 were concerned of striking a deer with their vehicle. SDGFP has also been involved with several cities in South Dakota where citizens have expressed concerns of striking deer. These areas exhibit abundant deer populations as well as high volumes of traffic around several of South Dakota's largest cities (Figure 95).

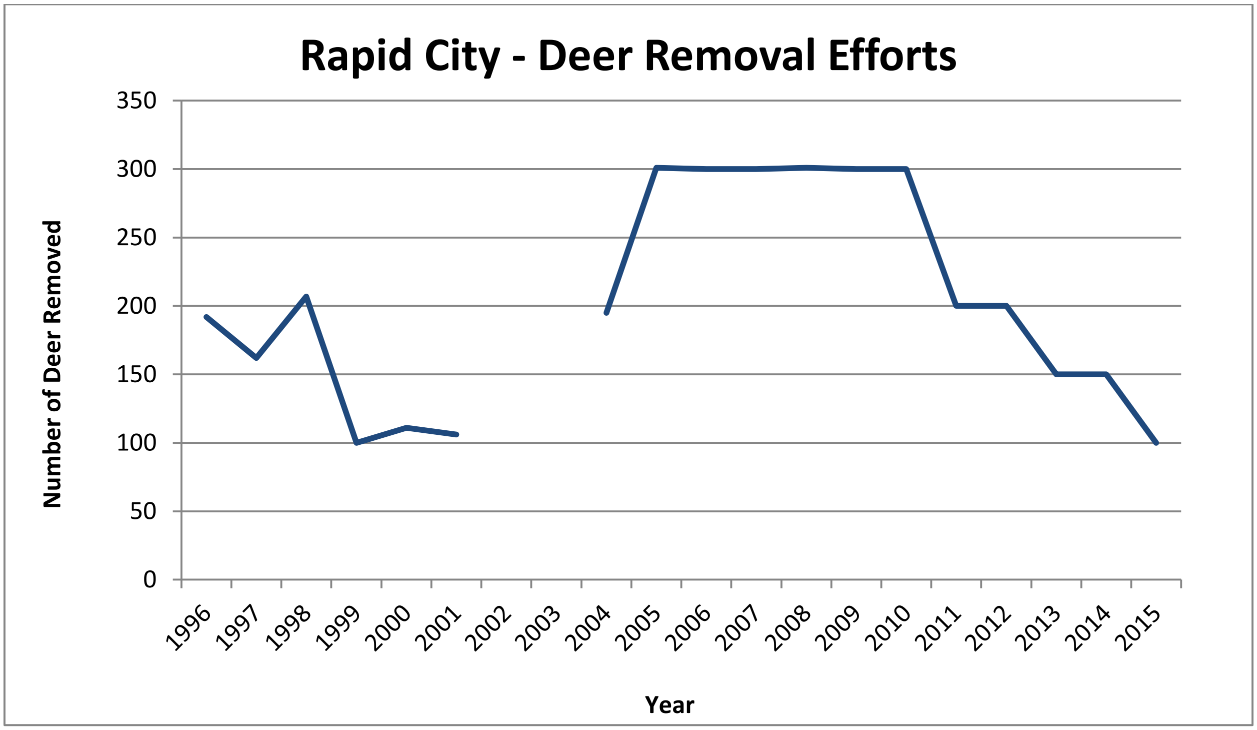



Figure 93. Deer removal efforts via SDGFP kill permit authorization for the city of Rapid City, 1996-2015.

Huijser et al. (2009) estimated that the total cost of a single deer-vehicle collision throughout the United States and Canada averaged $6,617. Using that estimate combined with the SDDPS records (i.e., an average of 5,000 deer-vehicle collisions a year), deer-vehicle collisions cost the citizens of South Dakota an estimated $33 million, annually. However, Olson et al. (2014) found that surveys for mule deer carcasses in Utah near migration corridors were five times higher than were recorded in crash reports. White-tailed deer and mule deer occur in South Dakota and make seasonal movements; however, no documented migration corridors have been detected. Nevertheless, the work completed by Olson et al. (2014) suggests that the actual number of deer-vehicle collisions reported from SDDPS is low. In addition, several studies in other nearby states have documented high mortality rates in female deer caused by deer-vehicle collisions. Bissonette and Olson (2013) and Romin and Bissonette (1996) reported that female mule deer consisted of 65% and 68%, respectively, of all deer-vehicle collisions they documented. Haffley (2013) also stated that vehicle collisions were a major source of mortality in female white-tailed deer during his study in southeastern South Dakota. Deer-vehicle collisions have the potential to be a significant source of mortality in some areas of South

Dakota and more comprehensive research is needed to evaluate this important impact to deer populations.

Deer management is based on many biological factors, but also incorporates social concerns and if social tolerance limits are exceeded, social or political pressures can compel wildlife agencies to decrease deer populations. West and Parkhurst (2002) noted a linear relationship between people's perception of striking a deer and the density of deer in that person's county of residence. Mitigation measures (e.g., fencing, under/over-passes, warning signs and lights) can be an alternative in some areas to decreasing deer populations to address the public's concerns of deer-vehicle collisions (Clevenger and Waltho 2005). Mitigation to reduce deer-vehicle collisions, however, can be complex and expensive to implement (VerCauteren et al. 2006, McCollister and Van Manen 2010, Bissonette and Olson 2013) as well as challenging to accurately monitor to determine if the mitigation was successful (Ford et al. 2009). There are areas where certain landscape features (e.g., rivers, shelterbelts, wetlands) focus deer movements, but South Dakota has not formally investigated these relationships. Forest-agriculture edges and presence of trees on both sides of the highway were associated with greater frequencies of wildlife-vehicle collisions in North Carolina (McCollister and Van Manen 2010). Tall crops like corn could also increase the likelihood of a motorist striking a deer. The only mitigation measures that South Dakota regularly implements are traditional warning signs, news releases to remind motorists to use caution, and messaging boards located along certain highways and interstates. SDDOT installed seven-foot high chain link fence along a six-mile stretch of interstate but no formal evaluations were completed to determine if deer-vehicle collisions decreased in this area. Several studies have indicated that warning signs are not effective at reducing deer-vehicle collisions, but Found and Boyce (2011) stated that warning signs can be effective at reducing deer-vehicle collisions when placed in targeted, high-risk areas. SDDOT installed deer reflectors along a small portion of Interstate 90, but were never evaluated and eventually removed during another construction project. Unfortunately, few states conduct any scientific evaluation of mitigation techniques to determine their effectiveness (Romin and Bissonette 1996).

Increasing deer-vehicle collisions create complex social, ecological, and technical problems (Sullivan and Messmer 2003). There is a strong desire for multiple agencies (e.g., SDDOT, SDGFP, and SDDPS) to have more reliable information regarding deer-vehicle collisions for management and planning purposes in South Dakota. This information is the foundation for mitigation projects that could benefit both motorists and wildlife (Ford et al. 2009). These agencies are currently collaborating on a research project that will assist all agencies involved with the development of better methods to comprehensively track all types of deer-vehicle collisions and provide possible mitigation strategies. The identification of critical areas where potential mitigation strategies could be implemented is one of the largest challenges to overcome. Once that step has occurred, the agencies that are involved can then evaluate cost-benefit analyses and possible gains regarding public safety and collectively determine a path forward. Ironically, in a survey of state wildlife agencies and state transportation agencies completed in 2000, both groups believed that reducing the deer herd size was the most cost-effective method compared to 23 other strategies (Sullivan and Messmer 2003). Deer-vehicle collisions will continue to occur in South Dakota and challenge wildlife managers and transportation officials to develop effective solutions.

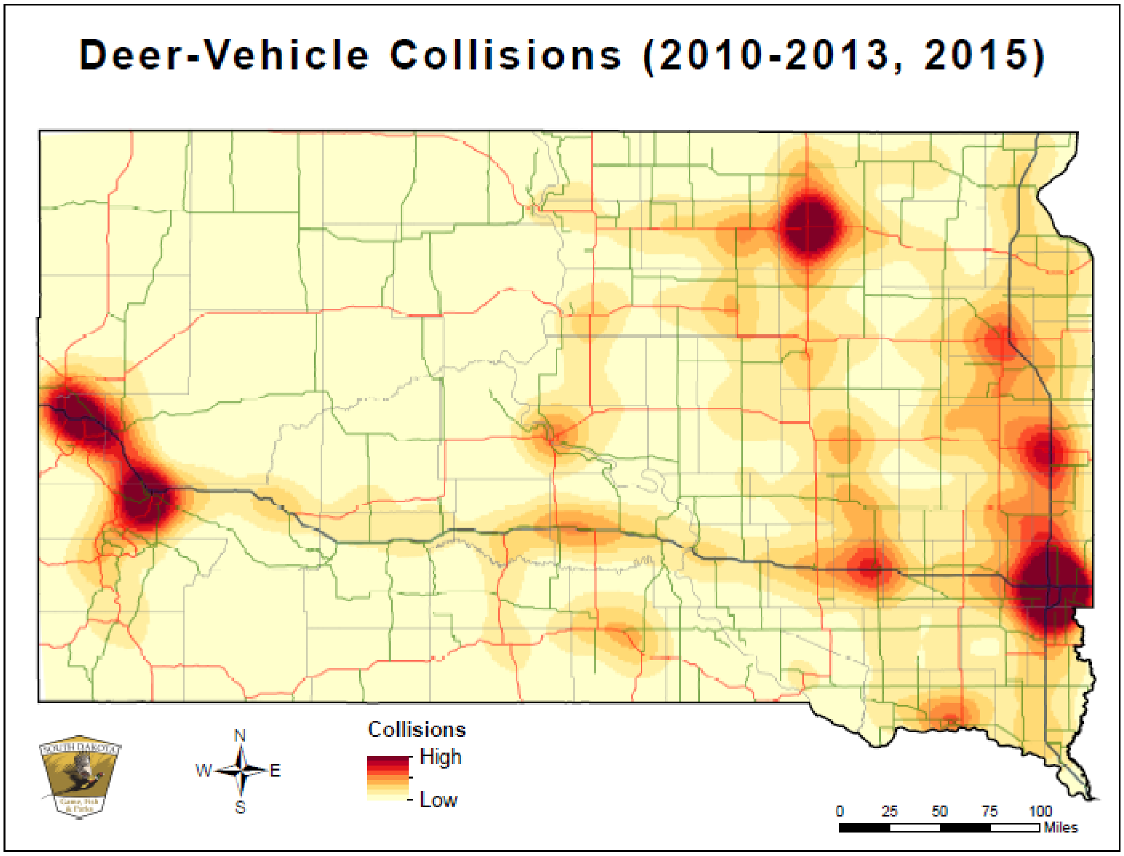



Figure 94. Map of deer-vehicle collisions in South Dakota developed with accident record data obtained from the South Dakota Department of Public Safety, 2010-2013, 2015.

**Population Monitoring**

White-tailed deer and mule deer populations in South Dakota are monitored using numerous survey methodologies with various efforts and related expenditures. Some surveys provide statistically valid estimates of deer population parameters in all areas of the state, while others provide estimates only in limited areas. SDGFP continues to weigh the cost vs. benefit of current surveys and needed future efforts.

Harvest survey sample sizes are selected by determining the minimum number of useable responses needed to ensure at least a +/- 5% sampling error at the 95% confidence level for the smallest strata that are being sampled (typically the hunting unit). The total number of hunters in a unit varies from unit to unit depending on the number of licenses available. In units with low numbers of licenses, all hunters receive a survey. In those units where there are large enough numbers of licensed hunters, a random sample is drawn. In a typical year, across all deer season, approximately 50% of all deer hunters are surveyed. Current harvest sampling effort is meeting needs and expectations.

Herd composition survey sampling effort has traditionally been at the firearm unit level, and in recent years sufficient sample sizes have been obtained. Future sampling will occur at the DAU level and will require less effort overall. An approximate sample size of 200-400 independent group observations per species per DAU is needed to ensure sufficient precision in herd composition estimates. Current sampling efforts are providing valid age ratios and estimates of fall recruitment, with acceptable and useful levels of precision (Table 36 in *Herd Composition* section). Sex ratios obtained from herd composition surveys are similarly precise, although assumed detection probabilities between the sexes likely bias estimates.

Reproduction data historically collected from vehicle-killed deer in late winter provide some great baseline data over an approximate 10 year time frame (1977-1989). Sample sizes and records, however, are insufficient to evaluate yearly differences and reports only reveal general collection areas (i.e., East River, West River, and Black Hills). Recent efforts to collect reproductive data have been initiated via necropsies of deer collected from vehicle-killed pickup contractors, and from ultrasonography of deer captured during winter radio-collaring efforts. While these data provide some basic comparisons with historical records, more data are needed to statistically assess if deer reproduction varies temporally and/or spatially in South Dakota. Obtaining sufficient sample in each DAU will be logistically and biologically challenging in many parts of the state due to the limited availability of vehicle-killed deer and limited sample sizes obtained from radio-collared animals.

Abundance surveys provide important data to manage both white-tailed deer and mule deer populations in South Dakota. Aerial sightability surveys are an efficient way to estimate deer abundance, and SDGFP has developed a sightability model that is valid for surveying white-tailed deer in the majority of habitats found in eastern South Dakota (Robling 2011). Surveys need to be conducted at the DAU level, and a model needs to be developed for areas not suitable for fixed-wing observations.

Research on the feasibility of estimating deer abundance using spotlight counts from road transects and distance sampling analyses was recently conducted for white-tailed deer populations in the Black Hills (Cudmore 2017). SDGFP is now implementing spotlight surveys to estimate the abundance of white-tailed deer in the Black Hills.

SDGFP has also developed a mule deer sightability model applicable for surveying open mule deer habitats in western South Dakota (Robling et al. 2014). Similar to the white-tailed deer sightability model, however, this model is only good in relatively open habitats and unfortunately much of the mule deer population can be found in the rugged terrain. Again, the development of a sightability model using a helicopter is needed to estimate abundance of mule deer via aerial surveys in South Dakota.

Survival monitoring efforts using radio-collared animals have increased substantially in recent years. Survival data are critical in the prediction of population growth rates, and in the absence of abundance survey data are used in population reconstruction techniques to estimate deer abundance. In 2016, SDGFP had approximately 1,400 deer (780 white-tailed deer, 640 mule deer) radio-collared for survival monitoring and population estimation purposes. While these data will provide more information about survival rates and abundance than ever before, this sampling effort only provides data for 3 of the 9 (33%) mule deer monitoring DAUs and 3 of the 11 (27%) white-tailed deer monitoring DAUs. The Integrated Population Model used by SDGFP is built around a 3-age class (adult, juvenile, fawn) and 2-sex class (male, female) population model, and 11 DAUs. The best radio collar DAU sampling strategy would involve collaring at least 100-150 deer of each sex-age class (6 classes total) in order to evaluate spatial and temporal differences. Current DAU radio collar sampling strategies prioritize obtaining DAU specific rates for adult female survival (1 class) with sample sizes being maintained at approximately 100 individuals in each sampled DAU. Survival of adult males will be explored in a few areas by maintaining a sample size of approximately 50 adult bucks. Sampling rates for fawns include approximately 50 individuals, which is supplemented in the following winter with 50 juvenile captures. Currently, SDGFP sampling efforts provide valuable management data on adult does, the most influential sex class on population growth. Data collection may be insufficient to detect differences between years and/or areas in other sex-age classes, unless differences are substantial.

Sampling effort for survival monitoring and abundance estimates must be further evaluated. Current efforts focus on the most important contributor to deer population growth, the adult females. Substantial variation in juvenile survival rates may occur in severe winters, however, and needs further study. Area differences in fawn survival rates may also exist, but will be difficult to detect at current sampling levels. Furthermore, although male deer contribute the least amount to population growth, buck harvest is important to deer hunters and more information on buck survival rates may improve SDGFP’s ability to manage this highly sought after resource.

**Habitat Monitoring**

<u>Black Hills USFS</u>

The USFS has various methods used to inventory and track tree species and successional stages of trees by stand. All USFS Units have Regional methods (USDA 1996) and Plan suggestions for monitoring shrubs and woody browse. For example, on Black Hills National Forest, browse use of willows, shrubs, woody vines or young deciduous trees in any year by livestock or wildlife is scheduled to be monitored (USDA 2006). Monitoring shrub use has not been consistently performed and SDGFP recently entered an agreement with the USFS to attempt better monitoring of shrubs (USDA and SDGFP 2016). Browse is limited to 40% of the total individual leaders produced in that year and is not to be confused with 40% use on each and every leader. Mapping the distribution of shrub cover and monitoring shrub utilization by any browser (domestic or wild) is uncommon on many USFS lands. Shrubs are critical habitat components for deer species, small mammals, songbirds and ecological functioning. SDGFP future projects with USFS offices should concentrate on shrub inventories, condition, utilization and management needs.

To address the ecological and social needs to provide forage for all ungulates on Black Hills National Forest, wild and domestic, the USFS elected to set proper herbivore use guideline, or percent forage utilization by weight (Table 87). Use at 50% generally is thought by the USFS to leave the rangeland in satisfactory condition. Unsatisfactory condition implies that herbivory did not occur at expected levels. Use was not established in the first 1983 Forest Plan but was added to the Plan in 1988 (USDA 1988). The maximum use levels remain the same today (USDA 2006).

Table 87. Black Hills National Forest Plan Guideline for allowable forage use and residual levels. Livestock and wild herbivore allowable forage use or residual levels on rangelands by grazing system and range condition (Percent Utilization by Weight Each Year).

| | Pre-existing Allotment Condition | |
|---|---|---|
| **Season Of Use** | **Satisfactory Condition** | **Unsatisfactory Condition** |
| Continuous Use (Spring/Summer) | 0-45% | 0-40% |
| Continuous Use (Fall/Winter) | 55-60% | 0-55% |
| Deferred Rotation | 0-50% | 0-45% |
| Rest Rotation | 0-55% | 0-50% |

Note: Use levels for riparian areas are different (USDA 2006).

The USFS monitors range utilization and residual forage during the growing season and employs various methods to track range condition and annual pasture/allotment utilization as staffing, funding, and District priorities allow. Monitoring may be reported in annual reports for each USFS office. The degree of monitoring and the associated reporting varies among Units and Units Districts from year to year. Therefore, monitoring results cannot be directly compared from year to year or among Districts.

For range monitoring, there are two major types; short-term and long-term. Short-term, or implementation, monitoring is used to determine how the USFS Plan directives are being met. Per each term grazing permit, the permittee is responsible for proper utilization of the forage by their livestock, and the USFS monitors livestock use to ensure the permittee is in compliance with the permit. Short-term range monitoring techniques vary depending on the resources being monitored. Key areas of livestock use are the main sites monitored. Examples of short-term monitoring include, but are not limited to:

- Range readiness used in the spring determines soils and vegetation conditions. Black Hills National Forest reports that “rangelands are generally ready for grazing when soils have become firm after winter and spring precipitation, and when plants have reached the defined stage of growth, at which time grazing may begin under the specific management plan without long-lasting damage" (USDA 2013).

- Ocular utilization estimates are a qualitative visual evaluation of utilization of riparian and upland herbaceous or woody browse by all grazing and browsing species. Ocular estimates are based on a description representing a broad range (class) of utilization rather than a precise amount (USDA 1996, USDA 2013). It is a subjective, non-quantifiable method of monitoring.
- Stubble height measures the residual height on streamside vegetation which a certain amount is needed to be left at the end of the grazing period or at the end of the grazing season for maintenance of plant vigor and stream bank protection and to aid in holding sediments for rebuilding degraded stream banks (USDA 2013).
- Photographs and photo-points are easily repeated to document visual changes on the landscape over time. Photos are used along monitoring plots and transects.

All USFS offices in South Dakota with the exception of Black Hills National Forest have adopted the modified Robel Pole method to measure residual herbaceous height and biomass. This is a quantifiable, non-subjective method that is repeatable and measurable. SDGFP recommends using Robel pole measurements and estimation of herbaceous biomass (Robel et al. 1970, Benkobi et al. 2000). For the Black Hills of South Dakota, the Robel Pole has been calibrated for various ecological conditions and biomass estimates are built into the model (Uresk and Benzon 2007, Uresk et al. 2009a, 2009b) thus eliminating the need for clipping, drying and weighing herbaceous vegetation which most land managers do not have the staffs or budgets to conduct. The number of cages required across a unit of land to achieve statistically valid utilization data is generally not feasible.

The second type of USFS monitoring is long-term, or effectiveness, monitoring. Effectiveness monitoring evaluates how successful management actions are at moving the vegetation and other factors toward desired conditions as established in the Forest Plan and Allotment Management Plans. Uplands and riparian areas are the focus of effectiveness monitoring which is primarily the responsibility of the USFS with an invitation to livestock permittees to participate. Trends (up, down, or stable) for a variety of rangeland resource parameters may be monitored in riparian areas and uplands at benchmark areas on each allotment. Examples of long-term, effectiveness monitoring include, but are not limited to:

- Cover-frequency index (also known as Daubenmire) is a permanent transect for repeated, quantitative vegetation monitoring. Understory canopy cover and frequency (percent) by plant species and ground cover (litter, bare, rocks) are recorded (USDA 1996). Changes in plant species or ground cover offer trend data to indicate how the vegetation is responding to environmental factors, including herbivory by wild and domestic ungulates.
- Photographs and photo-points are easily repeated to document visual changes on the landscape over time. Photos are used along monitoring plots and transects.

- Greenline/cross section methods are used in riparian areas to describe and quantify riparian areas.  Transects are perpendicular and parallel to the stream and plants are recorded at a particular intercept (USDA 1996).
- Multiple indicator method combines up to 10 metrics to capture both short-term and long-term changes in a variety of riparian conditions (vegetation, streambank stability, stubble height and many others).  These data can be used to track changes or capture site conditions (Burton et al. 2011).

Monitoring results summarized from the latest Black Hills National Forest monitoring report (USDA 2013) indicate that in general, and regardless of methodology, of those allotments monitored, upland conditions and trends were steady or upward in moving toward desired vegetation conditions as outlined in the Forest Plan.  Forage utilization throughout most of the allotments surveyed was reported to be within Black Hills National Forest Plan standards (Table 87) and allotment management objectives.  The few downward trends in upland conditions were attributed to activity on a prairie dog town, noxious weeds, an increase in an undesirable fescue species, and presence of bare ground due to weeds or heavy utilization in a particular spot.  As far as vegetation utilization (grazing by all large animals), measured forage utilization exceeded proper allowable use guidelines on a small amount of areas within certain pastures and some allotments (USDA 2013).

**Interspecific Competition**

Competition can occur in two forms; exploitative and interference.  Exploitative competition occurs when one species uses limited resources, such as forage, thus making it unavailable for another species.  Interference competition occurs when one species avoids another species, thus making habitat unavailable.

<u>White-tailed Deer and Mule Deer</u>
White-tailed deer are ubiquitous throughout South Dakota, and mule deer are typically found from the Missouri River Breaks westward to the Wyoming border (Rice 1994).  Furthermore, the northern and central Black Hills do not contain significant amounts of mule deer habitat (Griffin and Rice 1995, Griffin et al. 1999), but significant mule deer populations and suitable habitat occur in the southern Black Hills (Griffin et al. 2005).  As a result, significant interspecific competition between white-tailed deer and mule deer is unlikely to occur in the eastern prairie mixed-grass and tall-grass subunits or the northern and central regions of the Black Hills subunit.

White-tailed deer and mule deer have similar diets (Mackie 1981), but their continued coexistence in the southern Black Hills is likely due to differences in habitat use (Sieg and Severson 1996).  Mule deer tend to occupy more open habitats with rough, rocky topography (Griffin et al. 2005), while white-tailed deer are generally associated with more mesic habitat types and agricultural lands at lower elevations (e.g., river and stream riparian areas; Mackie 1981, Whitney et al. 2011).  Some studies have suggested that exploitative competition can occur between white-tailed deer and mule deer for food and space where home ranges overlap

(Kufeld and Bowden 1995); however, Whittaker and Lindzey (2001) saw little evidence of interactions between these two species, and reported that their home ranges were mostly segregated. Wood et al. (1989) found little evidence for direct competition between sympatric mule deer and white-tailed deer in eastern Montana, because mule deer and white-tailed deer maintained spatial separation. Whitney et al. (2011) similarly reported that white-tailed and mule deer in the Columbian basin of western Oregon maintained spatial separation during most seasons with spatial overlap ranging from 5%-40% seasonally with negative values for coefficients of species association, suggesting a pattern of mutual avoidance. The general pattern is for the two species to ignore each other in most encounters (Marchinton and Hirth 1984). Overall, Kramer (1973) concluded that competitive interactions between mule deer and white-tailed deer are not important because they occupy divergent ecological niches.

Geist (1990) hypothesized that hybridization between white-tailed deer and mule deer may ultimately lead to the demise of mule deer. There has been evidence that white-tailed deer and mule deer occasionally hybridize in the Black Hills (Oceanac 1977). Derr (1991) reported that hybridization was evident in 2.0% of the white-tailed deer and in 1.7% of the mule deer in sampled localities in the southwestern US, leading them to conclude that changing environmental conditions that provide a competitive advantage for one species over the other may result in ephemeral areas of hybridization. Conversely, some studies have documented significantly higher frequencies of hybridization (24%, Stubblefield et al. 1986; 13.3%, Bradley et al. 2003), indicating the potential for introgressive hybridization between the two species.

Mule Deer and Elk

The impact of elk populations on mule deer populations is of great interest to many hunters and some wildlife managers. Mule deer and elk may compete for resources where their ranges overlap, and past studies of interspecific interactions among the two species have indicated some potential for competition (Wydeven and Dahlgren 1985, Lindzey et al. 1997). For example, Frisina et al. (2008) found that the same five browse species comprised 95% and 52% of the mule deer and elk winter diets in southwest Montana, respectively, indicating a potential for exploitative competition over forage between mule deer and elk sharing winter ranges. Because elk diets were more diversified (55% browse, 32% grass, 12% forbs) than mule deer (98% browse, 2% grass, 0.5% forbs) on this winter range, they concluded that mule deer would likely be more negatively impacted than elk. However, Lindzey et al. (1997) reviewed several deer and elk competition studies and concluded past research results were equivocal due to the narrow focus and limited temporal and spatial scales of these studies, because natural landscape features may influence the seasonal distribution of these ungulates, including vegetation composition, topography and distance to water (Coe et al. 2004). Furthermore, changing landscapes from natural or human-caused disturbance can further complicate the issue, especially where habitat change favors one species over another (Keegan and Wakeling 2003).

Elk are considered diet generalists capable of digesting a wide variety of forage including low quality grasses; conversely, mule deer are considered selective concentrate feeders, requiring more digestible and higher quality forage (Dietz and Nagy 1976, Wickstrom et al. 1984).

Furthermore, tanning binding proteins in the saliva of deer allow them to consume high-tannin foods avoided by elk (Lindzey et al. 1997). In the Black Hills of South Dakota, elk mostly consume grass, followed by forbs, and occasionally winter browse such as lead plant and mountain mahogany (Sieg and Severson 1996). In summer and fall, shrubs, grasses, and forbs were determined to be the most important food sources for mule deer, while the most important winter food sources were browse, such as ponderosa pine, mountain mahogany, and common juniper (Schenck et al. 1972). Other important winter food sources were bearberry, western snowberry, Rocky Mountain juniper, forbs, and grasses (Schenck et al. 1972). In Wind Cave National Park, South Dakota, winter diets of elk primarily consisted of grasses and forbs, while mule deer diets were composed of browse species such as fragrant sumac (*Rhus aromatic*) and western snowberry, as well as moderate amounts of forbs (Wydeven and Dahlgren 1985).

Interference competition, avoidance of elk by mule deer, has been documented (Mackie 1976, Johnson et al. 2000) and can be a concern if mule deer are relegated to lower quality habitats. For example, if elk occupy aspen (*Populus tremuloides*) and mountain shrub communities, which are important mule deer fawn rearing habitats, then mule deer may be displaced to lower quality habitats and display reduced productivity and over-winter fawn survival. Wydeven and Dahlgren (1985) studied habitat relationships between elk, mule deer, and other ungulates in Wind Cave National Park, South Dakota, and found that elk and mule deer were most similar in distributional overlap in summer, occupying sites dominated by warm-season grasses; however, mule deer observations were low during summer, which may have resulted from displacement by elk causing deer to move outside of the park. Coe et al. (2004) analyzed datasets obtained from exclusion experiments at the Starkey Experimental Forest and Range in eastern Oregon, and they noted that female mule deer selected habitat attributes that were opposite from those selected by female elk, so much so that maps of resource selection functions for each species were nearly mirror images.

Although elk and mule deer may use similar forage species or occupy the same areas at specific times of the year, this does not necessarily mean they are competing. Mule deer have a higher metabolic rate than elk and their internal system is smaller and less efficient, and as a result mule deer require higher quality forage than elk during critical periods (MDWG 2015b). For example, elk can subsist on cured grasses, whereas mule deer generally cannot. The two species may also avoid direct competition through ecological mechanisms such as spatial or behavioral separation, or they may simply select different plants or plant parts (MDWG 2015b). For example, in spring elk migrate to higher elevations sooner than mule deer and they can successfully forage in deeper snow. The actual degree of dietary overlap between mule deer and elk is generally thought to be limited; however, some researchers believe competition for food can have significant impacts in specific situations (MDWG 2015b).

<u>White-Tailed Deer and Elk</u>
White-tailed deer are sympatric with elk everywhere that elk occur in the state of South Dakota. Overlapping food habits are not normally considered important when assessing interactions between elk and white-tailed deer, because elk are normally considered grazers,

feeding primarily on grasses while deer consume forbs and shrubs (Nelson 1982). However, elk grazing can interfere with key elements of white-tailed deer habitat. For example, elk browsing can limit aspen regeneration (Olmstead 1979). In northwestern Montana, Baty (1995) observed a high degree of spatial separation and a little dietary overlap between white-tailed deer and elk: white-tailed deer had smaller home ranges with abundant over story canopy and primarily foraged for browse species, while elk used larger areas with sparse overhead canopy and foraged for grasses. However, Nelson (1982) cautioned that if overpopulation of either species occurs or if both species rely on the same forage group (e.g., shrubs on winter range), serious competition can occur and elk will likely dominate. Such competition could develop on common winter ranges between these two species in the northern and northeastern Black Hills (Sieg and Severson 1996). In the central Black Hills, Hippensteel (2000) reported 40-50% dietary overlap between white-tailed deer and elk during both summer and winter, but she noted that higher levels of conifer use by white-tailed deer indicated that nutritious food items were restricted and some interspecific competition had likely occurred.

**Shed Antler Hunting**

Antlers are naturally shed annually by both white-tailed deer and mule deer as testosterone levels decrease and fat reserves are depleted during late winter months. Antlers are usually shed on wintering ranges. Wintering ranges can be critical to over-winter survival of deer. These wintering ranges typically offer sources of food and thermal cover during a time of decreased body condition, susceptibility to malnutrition and often extreme winter weather. Increased disturbance, including from shed hunting activities, during a time when deer are most physiologically stressed and are on a sub-optimal diet, can contribute to additional losses of fat reserves and potentially increased mortality (MDWG 2013b).

Shed antler hunting is becoming an increasingly popular outdoor activity across South Dakota (SDGFP conservation officers, personal communication) and also a highly competitive business enterprise in many parts of the western US. Shed antler hunting regulations are often controversial, difficult to enforce, and ineffective (MDWG 2013b). In order to protect wintering herds, some western states (e.g., Wyoming, Montana, and Colorado) have established season dates for collecting shed antlers in certain areas. Utah does not restrict shed antler hunting but does require people to take an online ethics course before shed antler hunting.
Currently, shed antler collecting for personal or commercial use is legal in South Dakota. Historically, shed antler hunting on lands owned by SDGFP has been prohibited, but the SDGFP Commission approved an amendment to ARSD § 41:03:01:05 in 2016 to allow the removal of antlers from lands owned or leased by the department.

Rule and regulations pertaining to shed antler hunting vary on other public lands in South Dakota. The USFS does not prohibit removal of antler sheds year-round from lands they own and manage. However, the USFS, including national forests and national grasslands, does close many of its interior roads to motor vehicles from approximately December 15 - May 15 every year in part to reduce disturbance on wintering wildlife (36 CFR 212.56 and 36 CFR 261.13). It is recommended that the local BHNF office be contacted for seasonal road closure information and commercial uses. The BLM also does not prohibit removal of antler sheds in South Dakota; however, they do not allow off-road travel for the purpose of shed hunting (43 CFR 8341.1c). The SDSPL currently does not have any regulations on shed hunting (M. Cornelison, personal communication).

The USFWS does not allow unauthorized removal of any natural object on or from national wildlife refuge system lands (50 CFR 27.61). The National Parks Service also does not allow for taking or removing any animals parts, including shed antlers on their properties (36 CFR 2.1(a)(1)(i)).

Shed antler hunting on public land in South Dakota has recently become a topic of discussion among SDGFP and the public. Whether collecting antlers for personal collections or for the economic incentive in today's antler market, shed antler hunting is an important recreational activity for SDGFP to monitor and consider when managing potential disturbances to wildlife and habitat resources. SDGFP encourages responsible shed antler hunting on both private and public lands where it is legal, and agrees with the following recommendations (with minor modifications) provided by the Western States Mule Deer Working Group:

- Do not chase or harass deer or other wildlife. Winter is the most critical time for deer survival.
- Wait until deer have left the winter range or area to collect shed antlers.
- Use vehicles, such as ORVs, responsibly and legally and only on roads or trails open to such use.

## GOALS, OBJECTIVES & STRATEGIES

### Guiding Principles

The following statements have guided the development of the white-tailed deer and mule deer management goals and objectives and reflect the collective values of South Dakota Game, Fish, and Parks (SDGFP) in relation to management of deer in South Dakota:

- that wildlife, including white-tailed deer and mule deer, contributes significantly to the quality of life in South Dakota and therefore must be sustained for future generations.
- that white-tailed deer and mule deer play an important role in forest and prairie ecosystems.
- in providing for and sustaining the diversity of our wildlife heritage for present and future generations.
- in management of white-tailed deer and mule deer in accordance with biologically sound principles while considering social tolerances.
- in providing accurate and timely information to the public concerning white-tailed deer and mule deer and associated recreational opportunities in South Dakota.
- that the future of white-tailed deer and mule deer in South Dakota depends on a public that appreciates, understands and supports deer and their habitats.

- that white-tailed deer and mule deer are an important aspect of tourism and visitor opportunities.

**Population Goals**

The SDGFP will manage white-tailed deer and mule deer populations and habitats by fostering partnerships and stewardship, and applying biological and social sciences.

Biological surveys provide substantial information about white-tailed deer and mule deer population demographics and vital rates across the state. From a statewide level, the accumulation of biological data is substantial and sufficient to estimate deer population abundance. Current statewide models estimate 2016 preseason populations of approximately 425,000 [95% Confidence Interval (CI): 320,000 – 530,000] white-tailed deer and 115,000 (95% CI: 80,000 – 150,000) mule deer. Statewide estimates are useful as a general measure of assessing management performance, but cannot be used to evaluate license allocation or harvest strategies at the Data Analysis Unit (DAU) or deer unit level. More useful from a license allocation perspective would be to establish quantifiable objectives at the DAU level (see Figure 22 in *Data Analysis Units* section). Abundance estimates at the DAU level, however, are currently lacking because of data limitations and current low harvest rates, resulting in insufficient estimates of harvest mortality. Recent efforts to increase radio-collaring sample sizes and increased doe harvest rates will yield valuable data in the near future; estimating white-tailed deer and mule deer abundance using population reconstruction techniques (see *Population Modeling* section) at the DAU level will soon be a viable option. In addition, further evaluation of fixed-wing aerial surveys east of the Missouri River will provide supplemental abundance estimates.

Because SDGFP currently conducts distance sampling road transects for white-tailed deer within the Black Hills, population estimates and objectives specific to white-tailed deer in this DAU are feasible. Within the Black Hills DAU (i.e., DAU 3), SDGFP will manage for 70,000 (65,000-75,000) white-tailed deer pre-season abundance. Consultation with the Black Hills USFS will occur regularly to ensure deer population densities are sustainable with current forage production and availability.

With limited current population estimates in other DAUs, numerical deer management unit objectives are impractical. As a result, individual white-tailed deer and mule deer management units will be managed to increase, maintain, or decrease deer populations (see Figures 3 and 5 in *Season Settings Process* section). Management unit objectives will be based on annual collection and evaluation of white-tailed deer and mule deer biological data, habitat resources, private land depredation issues, drought conditions, and substantial input from a wide variety of publics with an interest in deer management in South Dakota. SDGFP will adopt harvest strategies that will progressively allow the white-tailed deer and mule deer population to reach these population objectives. Management unit objectives for each white-tailed deer and mule deer unit will be evaluated biennially, and will be combined using a weighted average (based on 10-year harvest proportions) to develop DAU management objectives.

**Objectives and Strategies**

<u>Objective 1:</u> Maintain, manage, establish and protect white-tailed deer and mule deer habitat throughout the Black Hills and prairie deer management units of South Dakota.

Strategy 1A: By June 2018, conduct an inventory of existing land cover data and perform a thorough land cover analysis at the deer management unit level and quantify macro habitat types across South Dakota.

Strategy 1B: By June 2018, identify management units where deer habitat (e.g., woody cover, wetlands, and grasslands) are most limited.

Strategy 1C: By June 2019, identify top 10 habitat management focus areas for each deer species based on habitat needs, public land access, deer population densities, deer harvest densities and biological data (e.g., survival and recruitment).

1. Engage non-governmental organizations (NGOs), state and federal land management agencies to discuss ways to cooperatively fund and implement habitat Best Management Practices (BMP; see *Habitat Best Management Practices for Deer* section) for deer in identified priority areas.
2. Work with federal agencies to identify areas that are either National Environmental Policy Act (NEPA) cleared or require NEPA and would be available for cooperative habitat improvements.
3. By June 2023, strive to implement at least eight substantial (> 40 acres of habitat development or > 160 acres of habitat improvement) cooperative habitat BMP improvement projects in focus areas for mule deer on federally managed public lands.
4. By June 2023, strive to implement at least eight substantial (> 40 acres of habitat development or > 160 acres of habitat improvement) cooperative habitat BMP improvement projects in focus areas for white-tailed deer on federally managed public lands.

Strategy 1D: Pending available funding within the SDGFP Wildlife Partners Program, establish a minimum of 900 acres of woody cover development composed of primarily low-mid growing trees and shrubs specific to each ecoregion on private lands across South Dakota by June 2023.

1. Prioritize new woody cover plantings to areas where current thermal/escape cover is lacking, or current woody cover plantings are nearing the end of their lifespan.

Strategy 1E: Continually support woody habitat development at a level that will mitigate the substantial amount of brush and woodland winter habitats lost due to inundation of Lakes Sharpe and Oahe.

Strategy 1F: By June 2018, investigate and identify forb and browse enhancement options that are specific to each ecoregion and deer species.

1. By June 2018, initiate a project to identify and rank specific forb species to be used for deer habitat BMPs based on nutritional characteristics, palatability, seed availability, plant vigor and establishment potential, invasiveness, and other qualities.

2. By June 2019, develop and implement a financial incentives program for deer forb establishment and enhancement practices on private lands.

Strategy 1G: Promote the SDGFP riparian fencing program for private land to improve woody vegetation regeneration and stabilize stream banks while increasing forage production.

1. Work with the South Dakota Grassland Coalition and other organizations to establish field trips promoting and demonstrating successful riparian management cooperative projects.

Strategy 1H: Periodically hold coordination meetings between SDGFP habitat staffs, private land habitat biologists, cooperatively funded habitat biologists, and others as needed to discuss current and future habitat projects.

Strategy 1I: By June 2018, evaluate and identify SDGFP Game Production Areas (GPAs) that would benefit from cross fencing, improved grazing management, and deer habitat BMP projects.

Strategy 1J: Strive for at least 1 million acres of undisturbed Conservation Reserve Program (CRP) grassland habitat on private lands in South Dakota by 2020.

1. Advocate for policy in the next Farm Bill which would allow CRP acreage to reach the long term goal of 1.5 million acres in South Dakota.
2. Annually seek and provide assistance to landowners with expiring CRP contracts by providing re-enrollment options into general and continuous CRP or other programs that are available for maintaining all or a portion of this grassland habitat.

Strategy 1K. Continue to provide financial commitment to the 80,895 acres enrolled in the James River Watershed (JRW) Conservation Reserve and Enhancement Program (CREP) and utilize funding sources as they become available to enroll the project goal of 100,000 acres in the JRW CREP.

1. Identify means to re-enroll expiring JRW CREP agreements beginning in 2019.

Strategy 1L: Provide public awareness of mule deer and white-tailed deer habitat BMPs available for use and distribution.

1. Periodically publish deer habitat BMPs in the SDGFP Landowner's Matter newsletter, green sheet outdoor forum, and South Dakota Conservation Digest.
2. By June 2018, create deer habitat BMP flyer and distribute to local SDGFP, Natural Resources Conservation Service (NRCS), Farm Service Agency (FSA), and other land management agency offices across the state.

Strategy 1M: Provide review and coordination with all public land management agencies undergoing revision of resource management plans.

1. Participate and provide comments throughout the public process on the USFS Custer Gallatin Forest Plan revision. Conduct interagency discussions relevant to the habitat needs of mule deer and white-tailed deer on these public lands in South Dakota.

Strategy 1N: Utilize land acquisition according to SDGFP Land Acquisition Priorities and Guidelines to enhance or protect existing wildlife habitat in South Dakota.

Strategy 1O: Continue to support US Fish and Wildlife Service (USFWS) acquisition of Waterfowl Production Areas, wetland and grassland easements, and the efforts of the South Dakota Parks and Wildlife Foundation, Northern Prairie Lands Trust, and other conservation organizations in the preservation and protection of wildlife habitat.

Strategy 1P: By June 2018, evaluate potential additional funding sources (e.g., habitat stamp) that can be used for deer habitat development and improvement on private and public lands.

Objective 2: Monitor and assess white-tailed deer and mule deer populations by conducting scientifically based biological surveys within South Dakota.

Strategy 2A. Annually survey hunters to estimate white-tailed deer and mule deer harvest levels and distribution, sex, age (juvenile or adult) of harvested animals, number of hunters, hunter success, and hunter satisfaction.

1. Estimate and evaluate deer harvest from all deer hunting seasons.
2. Increase archery survey rates to 100% of all archery hunters for a minimum of 2 years.

Strategy 2B. Annually conduct and assess fall white-tailed deer and mule deer herd composition surveys.

Strategy 2C. Annually conduct and assess white-tailed deer and mule deer reproduction surveys.

Strategy 2D. Assess and monitor white-tailed deer population levels and trends by completing fixed-wing aerial surveys using an established sightability model in DAUs 9 and 10 (see *Data Analysis Units* section, Figure 22) at least once every six years.

Strategy 2E. Annually conduct survival studies to assess white-tailed deer and mule deer population levels and trends using population reconstruction techniques.

1. Increase white-tailed deer radio-collaring and survival monitoring efforts by adding one DAU each year (see *Survival Monitoring* section, Table 41).
2. Increase mule deer radio-collaring and survival monitoring efforts by adding one DAU each year beginning in 2019 (see *Survival Monitoring* section, Table 42).
3. Monitor survival in each DAU for approximately six years.

Strategy 2F. By June 2020, complete evaluations of recruitment estimates using herd composition surveys versus reproduction and fawn survival estimates.

Strategy 2G. Annually conduct spotlight abundance surveys for white-tailed deer in the Black Hills DAU (i.e., DAU 3).

Objective 3: Manage white-tailed deer and mule deer populations for both maximum and quality recreational hunting opportunities, considering all social and biological inputs.

Strategy 3A. Where habitat and social tolerances allow, manage deer within the Black Hills DAU for a preseason abundance of approximately 70,000 (65,000-75,000) white-tailed deer.

Strategy 3B. Biennially define management unit objectives (i.e., substantially increase, slightly increase, maintain, slightly decrease, substantially decrease) for mule deer and white-tailed deer for each firearm management unit.

1. Annually gather public input on white-tailed deer and mule deer management unit objectives as described in the *Seasons Setting Process* section.
2. Utilize necessary antlerless harvest management tools to ensure management objectives are met as outlined in the *Antlerless Harvest Strategies* section.
3. Set white-tailed deer and mule deer population goals at appropriate levels that can be sustained by available habitat on private and public lands, without causing substantial damages to public or private property.
4. Manage for lower densities of deer when multiple years of drought impact forage availability and social tolerance levels.

Strategy 3C. Conduct a scientific-based public opinion survey of landowners and hunters every four years (beginning in 2022) to assess public perceptions regarding mule deer and white-tailed deer management, better define social tolerance levels, and re-evaluate population objectives.

Strategy 3D. Manage deer in Custer State Park (CSP) primarily for quality wildlife viewing opportunities, with limited hunting opportunities provided as follows:

1. Antlerless deer hunting opportunities will be offered based primarily on an evaluation of range conditions in CSP.
2. Current antlerless deer hunting opportunities will be provided during a muzzleloader hunting season from December 1-15.
3. Current “any whitetail” and “any deer” hunting licenses will be valid from November 1-30, with only archery equipment allowed from November 1-15.
4. “Any whitetail” licenses will be set at 1% of the current CSP white-tailed deer population estimate. No more than 50 “any whitetail” licenses will be issued in any year. The CSP population estimate for white-tailed deer will be calculated by multiplying the CSP acreage by the current white-tailed deer density estimate for the Black Hills derived using spotlight distance sampling.
5. “Any deer” licenses will be set at 0 or 5 licenses contingent upon the current CSP mule deer population estimate. The CSP population estimate for mule deer will be calculated by multiplying the CSP acreage by the current mule deer density estimate for the Black Hills derived using population reconstruction techniques. If the CSP mule deer estimate is above 150 deer, 5 licenses will be issued. No licenses will be issued if the CSP deer estimate is ≤ 150 mule deer.

Strategy 3E. Manage Limited Access Units (24B, 27L, 35L; see *Quality Deer Management* section) and CSP for a quality hunting experience by using the following established thresholds:

1. Maintain a minimum 1st tag harvest success of 75% (3-year average) for licenses containing “any deer” or “any whitetail” firearm tags; or
2. Maintain firearm license densities no greater than 1.5 licenses/square mile for “any deer” licenses and no greater than 2.5 licenses/square mile for “any whitetail” licenses.

Strategy 3F. Manage for a minimum 1st tag harvest success of 70% (3-year average) for licenses containing “any deer” or “any whitetail” tags in the Black Hills firearm deer season.

Strategy 3G. Manage for a minimum 1st tag harvest success of 60% (3-year average) for licenses containing “any deer” or “any whitetail” tags in each West River firearm deer season unit.

Strategy 3H. Manage for a minimum 1st tag harvest success of 50% (3-year average) for licenses containing “any deer” or “any whitetail” tags in each East River and National Wildlife Refuge firearm deer season unit.

Strategy 3I. Manage for a minimum 1st tag harvest success of 40% (3-year average) for muzzleloader licenses containing “any deer” or “any whitetail” tags in each USFWS Refuge deer hunting unit.

1. By June 2018, meet with the USFWS to discuss potential harvest strategies needed to reach this objective strategy.

Strategy 3J. By June 2020, establish criteria to be used to determine where harvest management for mule deer will occur in deer hunting units east of the Missouri River.

Strategy 3K. By June 2020, develop antlerless harvest strategies for mule deer.

Strategy 3L. By August 2017, present to the SDGFP Commission a summary of public input received from the Deer Stakeholder Group and others regarding deer licensing and regulations.

Strategy 3M. Further evaluate Limited Access Units by all user groups by June 2020.

1. Conduct scientific survey to assess factors such as hunter density, hunter distribution, hunt dates, hunter success, and hunter satisfaction of all user groups.
2. Evaluate and implement ways to better inform archery, muzzleloader, and youth deer hunters that a free access permit must be obtained prior to hunting any Limited Access Area and Newton Hills State Park.
3. Evaluate additional areas for inclusion as Limited Access Areas.

<u>Objective 4:</u> Cooperatively work with private landowners to resolve white-tailed deer and mule deer depredation to growing crops, stored-feed supplies, trees, and private property.

Strategy 4A. Continue to respond to all white-tailed deer and mule deer depredation concerns on private land in a timely manner.

Strategy 4B. Explore new management techniques that could minimize damage to private property caused by white-tailed deer and mule deer.

Strategy 4C. Encourage the enrollment of willing landowners that are experiencing chronic deer depredation issues into Walk-In Area and Controlled Hunting Access Programs to allow public hunting access.

Strategy 4D. Utilize deer depredation pool hunts (see *Depredation Management* section) when warranted, to address white-tailed deer and mule deer depredation concerns.

Strategy 4E. Expand hunting opportunities where/when possible to address white-tailed deer and mule deer depredation on private lands.

Strategy 4F. By June 2019, develop additional depredation management strategies to increase acceptance of deer population goals.

Strategy 4G. Annually assess effectiveness of SDGFP depredation abatement management techniques and programs.

Strategy 4H. Work with agricultural and livestock producers, USDA Service Centers, and others to increase awareness of available SDGFP depredation assistance programs.

Objective 5: Monitor and evaluate risk and impact of disease in wild white-tailed deer and mule deer herds in South Dakota.

Strategy 5A. Investigate and collect biological samples from reported or observed sick and/or dead white-tailed deer and mule deer demonstrating symptoms of concern and document in the SDGFP Wildlife Disease Database.

Strategy 5B. Monitor white-tailed deer and mule deer disease by collecting and sampling voluntary hunter submissions at the discretion of SDGFP.

Strategy 5C. Work with Tribal entities and government agencies within South Dakota, and surrounding State agencies of Iowa, Minnesota, Montana, Nebraska, North Dakota, and Wyoming on disease concerns of white-tailed deer and mule deer.

Strategy 5D. Prohibit the unnatural movement of wild white-tailed deer and mule deer within the State of South Dakota.

Strategy 5E. Annually participate with the Midwest Fish and Wildlife Health Committee to discuss disease issues and management within deer populations.

Strategy 5F. Educate the public on the potential for increased disease transmission from feeding deer.

1. By June 2019, produce public outreach material.

Strategy 5G. Work with the South Dakota Animal Industry Board on chronic wasting disease (CWD), bovine tuberculosis, brucellosis, and other potential disease risks due to potential interaction between wild and captive cervids in South Dakota.

1. By June of 2019, establish a SD Animal Industry Board / SDGFP interagency working group to enhance collaborative work on disease management topics such as the following:
    - Create a defined protocol for removal of escaped captive non-domestic animals.

- Review SDGFP and SD Animal Industry Board administrative rules and state statutes to ensure regulations of both agencies are in agreement and sufficient to manage chronic wasting disease in both wild and captive cervids.
- Review and define SDGFP and SD Animal Industry Board roles in the approval process of new captive cervid facilities.

Strategy 5H. Assess rules and procedures to better limit the prevalence and spread of CWD by June 2020.

1. Evaluate methods and funding sources to assess the following:
    - Estimating CWD prevalence in areas of documented CWD.
    - Estimating CWD prevalence in areas with no documented CWD positive deer.
    - Improving monitoring and management protocol for areas with high levels (> 3%) of known CWD prevalence.
2. Evaluate regulatory needs regarding the transportation of hunter harvested cervids within South Dakota from hunting units with known CWD.
3. Evaluate regulatory needs regarding the transportation of hunter harvested cervids into South Dakota from other states that have established CWD in deer herds.

Strategy 5I. By June 2018, develop guidelines for managing leftover unsold licenses and license refunds in areas with documented deer losses to hemorrhagic disease.

Objective 6: Provide the public with access to private and public land for quality white-tailed deer and mule deer hunting opportunities.

Strategy 6A. Promote the SDGFP Walk-In Area and Controlled Hunting Access Programs with private landowners.

Strategy 6B. Provide up-to-date public land layers available for free download to be used in conjunction with compatible GPS units.

Strategy 6C. Annually promote and encourage hunters through social media platforms and news releases to respect private property boundaries and seek hunting permission well in advance of season opening dates.

Strategy 6D. Work cooperatively with USFS, BLM, and other land management agencies to address road closure and recreational access issues during hunting seasons and critical wintering months.

Strategy 6E. Identify public land areas that would benefit from signing or additional signing.

1. Continue to work on signing Missouri River GPAs.
2. Coordinate with other public land management agencies to identify boundary signing needs and potential funding/assistance.
3. Invite NGOs to assist in volunteer signage of public lands.

Strategy 6F. By June 2018, form an interagency working group between US Fish and Wildlife Service and SDGFP to develop ways to enhance deer hunting opportunities on USFWS Refuges and other properties.

Strategy 6G. Identify additional hunter access needs to public lands.

Objective 7: Evaluate white-tailed deer and mule deer research and management needs.

Strategy 7A. Annually collaborate with stakeholders to collect and assess research and management needs and ideas.

1. Meet with concerned and interested individuals, non-governmental organizations, academic institutions, surrounding state wildlife agencies, Tribal agencies, local sportsman's groups, USFS, BLM, USFWS, livestock and agriculture organizations, and private landowners to facilitate discussions about white-tailed deer and mule deer populations and management.
2. When appropriate, involve SDGFP Regional Advisory Panels and the Deer Stakeholder Group with further development of this plan and with future issues related to white-tailed deer and mule deer management.

Strategy 7B. Periodically review white-tailed deer and mule deer survey protocols and discuss changes that could improve data collection efficiency and accuracy.

Strategy 7C. Formally evaluate the white-tailed deer and mule deer Management Plan at least every six years. Plan updates and changes, however, may occur more frequently as needed.

Strategy 7D. Meet and discuss deer management issues and strategies with other mid-western and western states' biologists by attending the biennial Western States Deer and Elk Workshop, the annual Midwest Deer and Wild Turkey Study Group meeting, and the Mule Deer Working Group.

Objective 8: Promote public, landowner, and conservation agency awareness of white-tailed deer and mule deer management needs and challenges.

Strategy 8A. Periodically include articles about white-tailed deer and mule deer and associated habitats in the South Dakota Conservation Digest and other popular magazines, journals, and media outlets.

Strategy 8B. Educate sportsmen and sportswomen on laws and regulations regarding the use of nutritional supplements/attractants in South Dakota.

1. By June 2019, work with local South Dakota retail companies in order to better inform customers of the laws and regulations pertaining to deer hunting in South Dakota and the associated permitted use of certain items sold in retail stores.

Strategy 8C. By August of 2017, make available paper and electronic copies of "White-tailed Deer and Mule Deer Management Plan for South Dakota, 2017-2023" to all interested conservation partners, the public, and private landowners.

Objective 9: Cooperatively work with municipalities and other agencies in South Dakota to manage urban deer and deer vehicle collisions.

Strategy 9A. Meet with interested municipalities to discuss urban deer management and related issues.

Strategy 9B. Provide technical advice regarding deer-human conflicts and cooperatively work with municipalities to develop/review urban deer management plans.

Strategy 9C. Promote hunting around and within city limits to manage urban deer populations when possible.

Strategy 9D. Work with municipalities to issue kill permits to manage urban deer when warranted.

Strategy 9E. Work with the SD Department of Transportation (SDDOT) and SD Department of Public Safety to identify and mark critical areas where high numbers of deer-vehicle collisions occur.

Strategy 9F. Consider cooperative and new management techniques and strategies that can minimize deer-vehicle collisions at appropriate locations.

Strategy 9G. Provide cooperative funding to SDDOT to maintain carcass collections from deer-vehicle collisions on appropriate state highways and interstates.

Strategy 9H. Periodically meet with SDDOT to discuss upcoming road projects, deer-vehicle collisions, and potential mitigation strategies.

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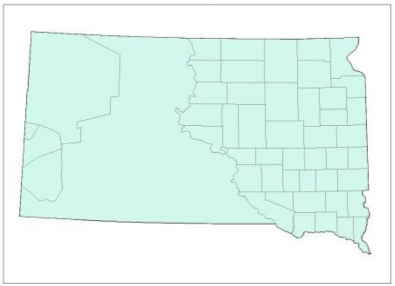
## APPENDIX

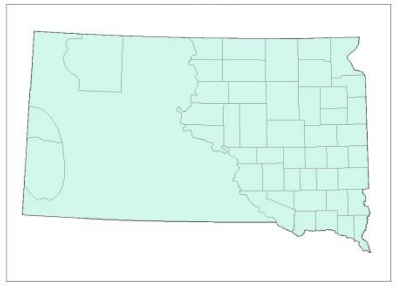
### Appendix A. Harvest Season Maps.

Firearm deer hunting unit maps, 1950-2016.

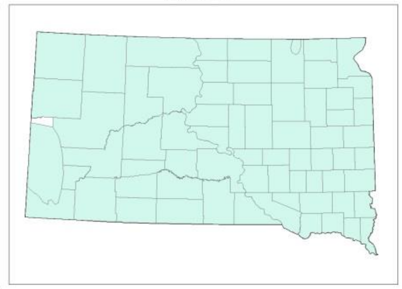
Firearm 1962



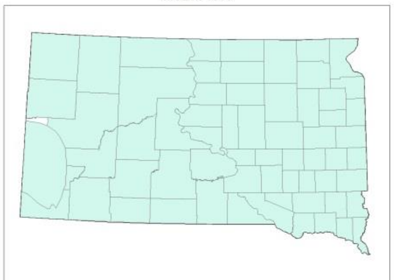
Firearm 1963



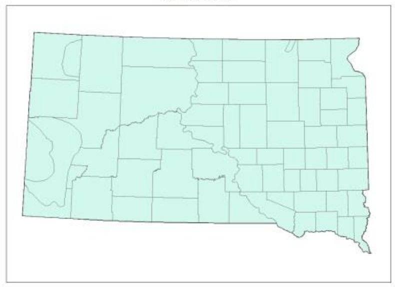
Firearm 1964



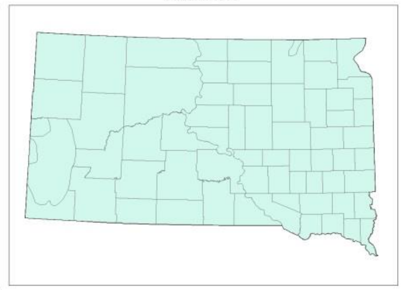
Firearm 1965



Firearm 1967



Firearm 1968



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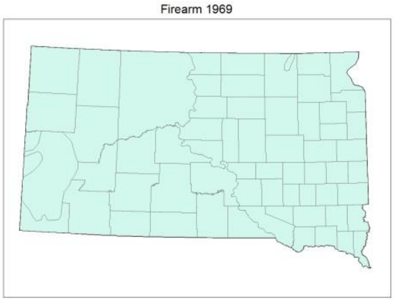
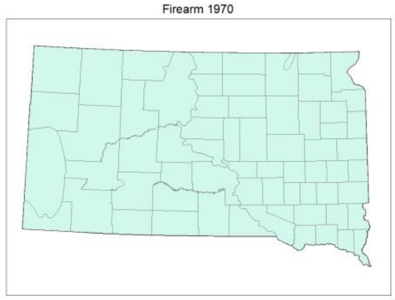


Firearm 1970



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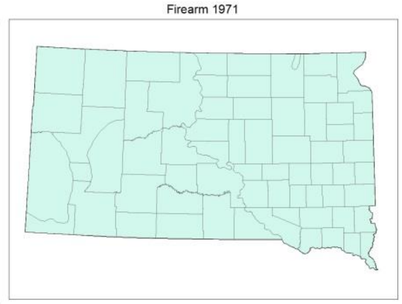
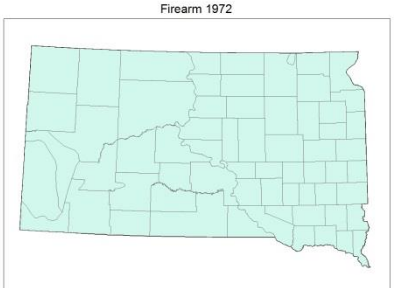
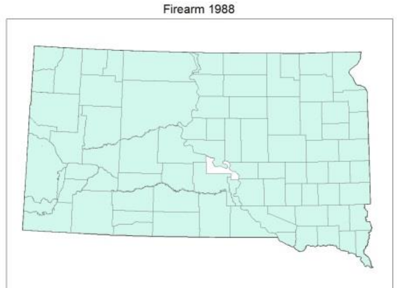


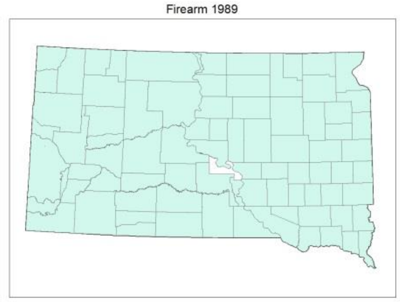
Firearm 1972



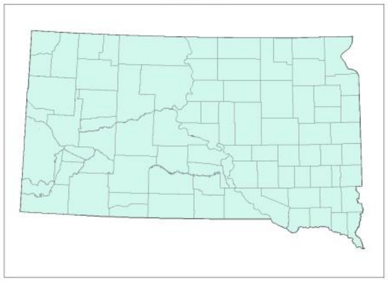
Firearm 1988



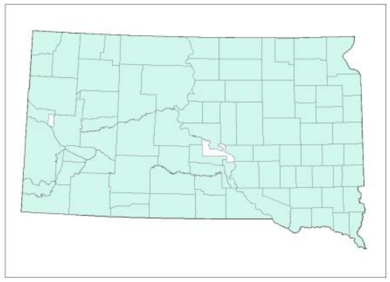
Firearm 1989



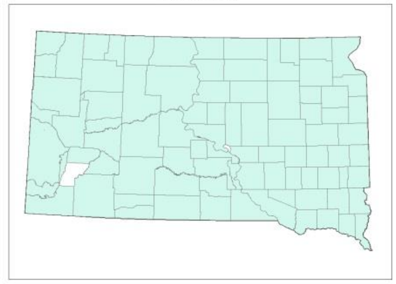
Firearm 1991



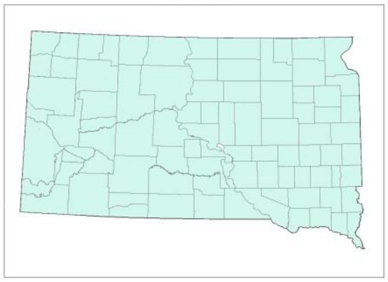
Firearm 1992



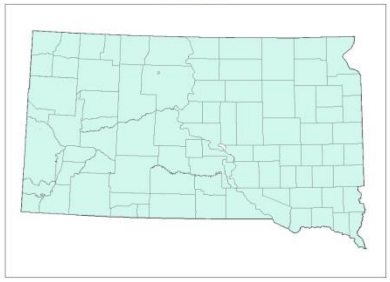
Firearm 1996



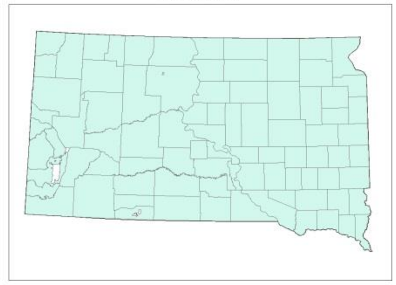
Firearm 1997



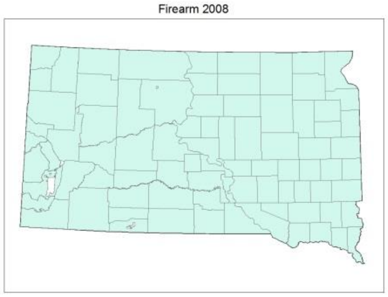
Firearm 2002



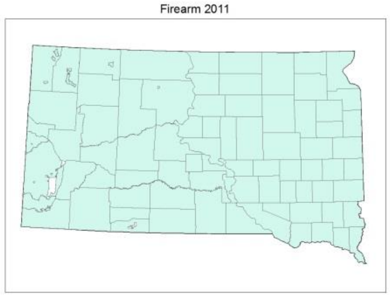
Firearm 2005



Firearm 2008

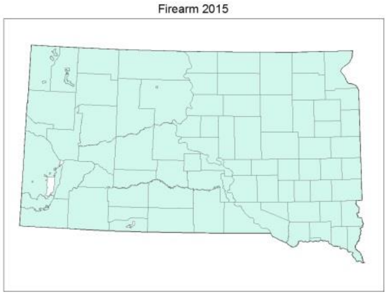


Firearm 2011

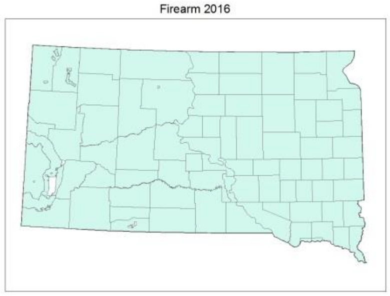


Firearm 2013

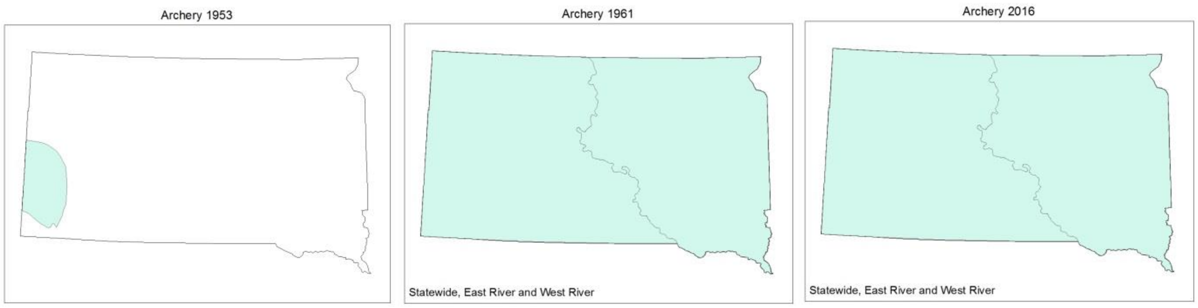
Firearm 2015



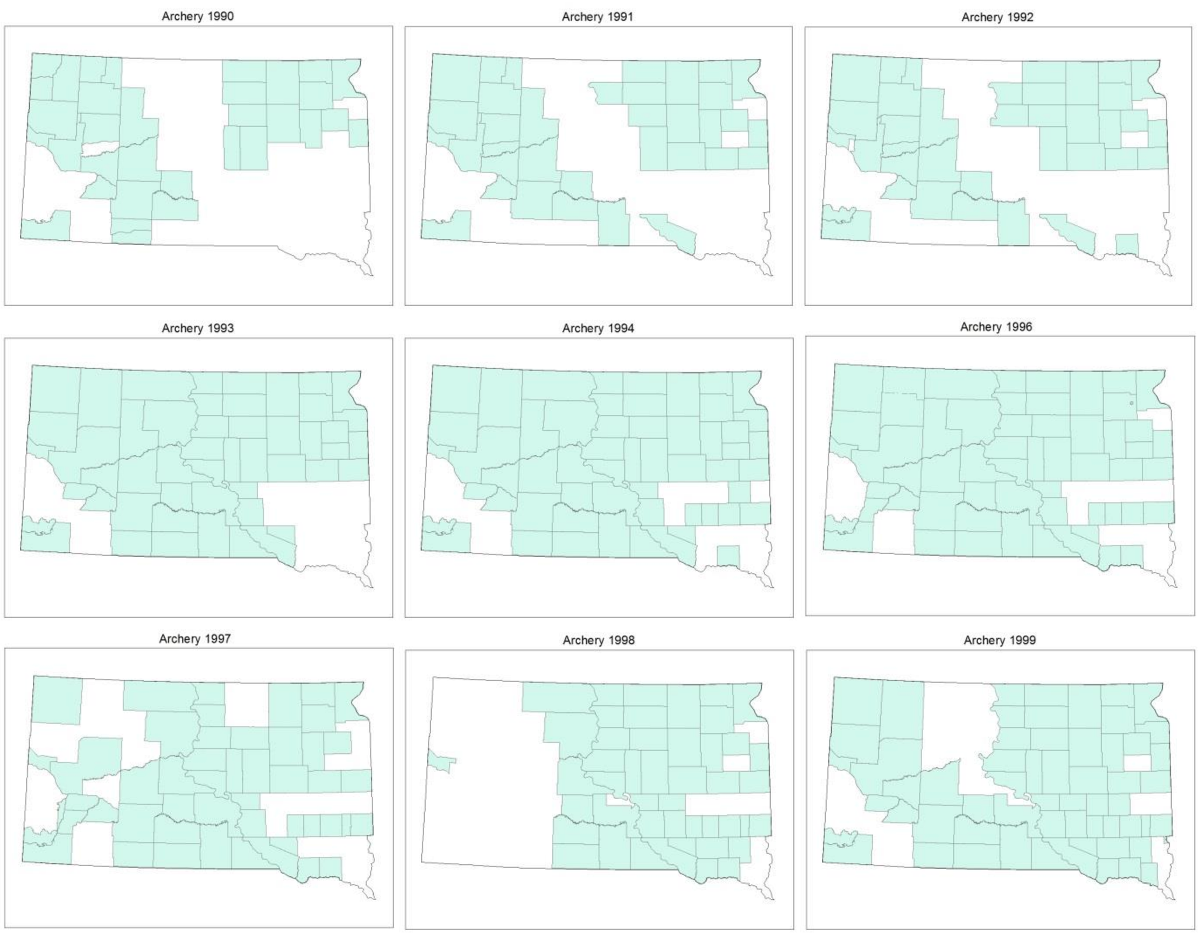
Firearm 2016



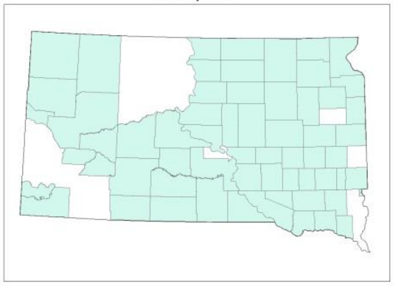
Archery hunting unit maps ("any deer" seasons), 1953-2016.



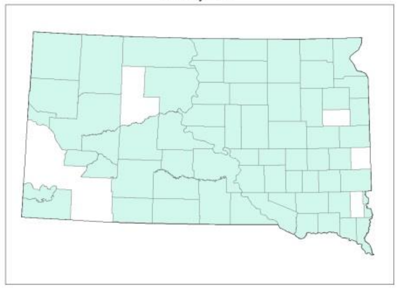

Archery hunting unit maps (antlerless deer seasons), 1990-2016.



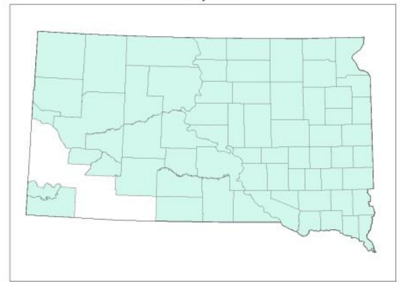
Archery 2000



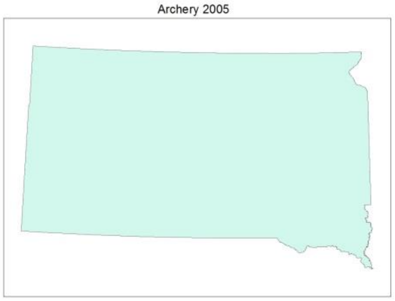
Archery 2001



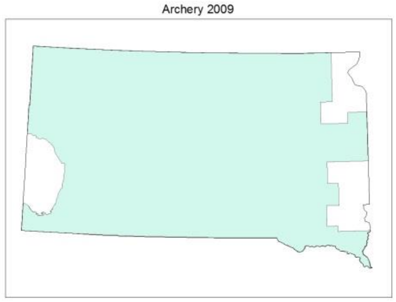
Archery 2003



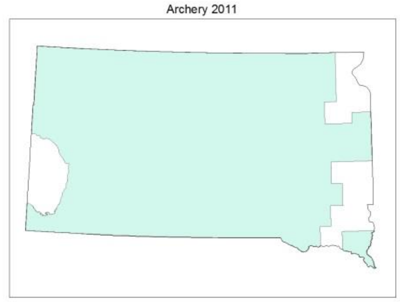
Archery 2005



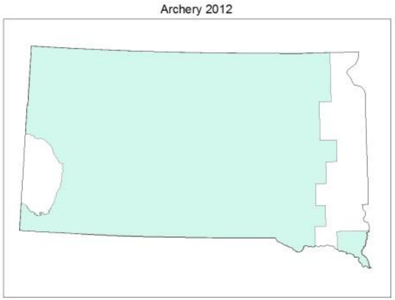
Archery 2009



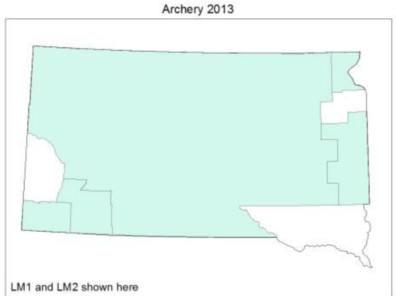
Archery 2011



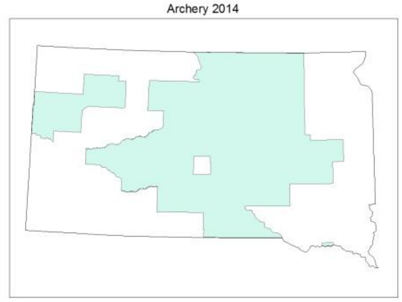
Archery 2012



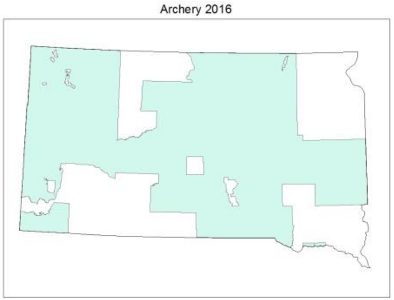
Archery 2013



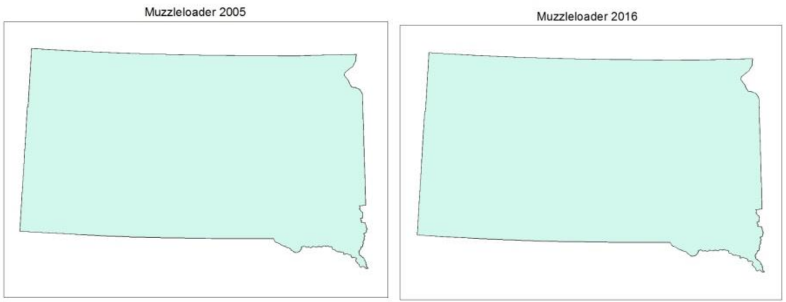

Archery 2014



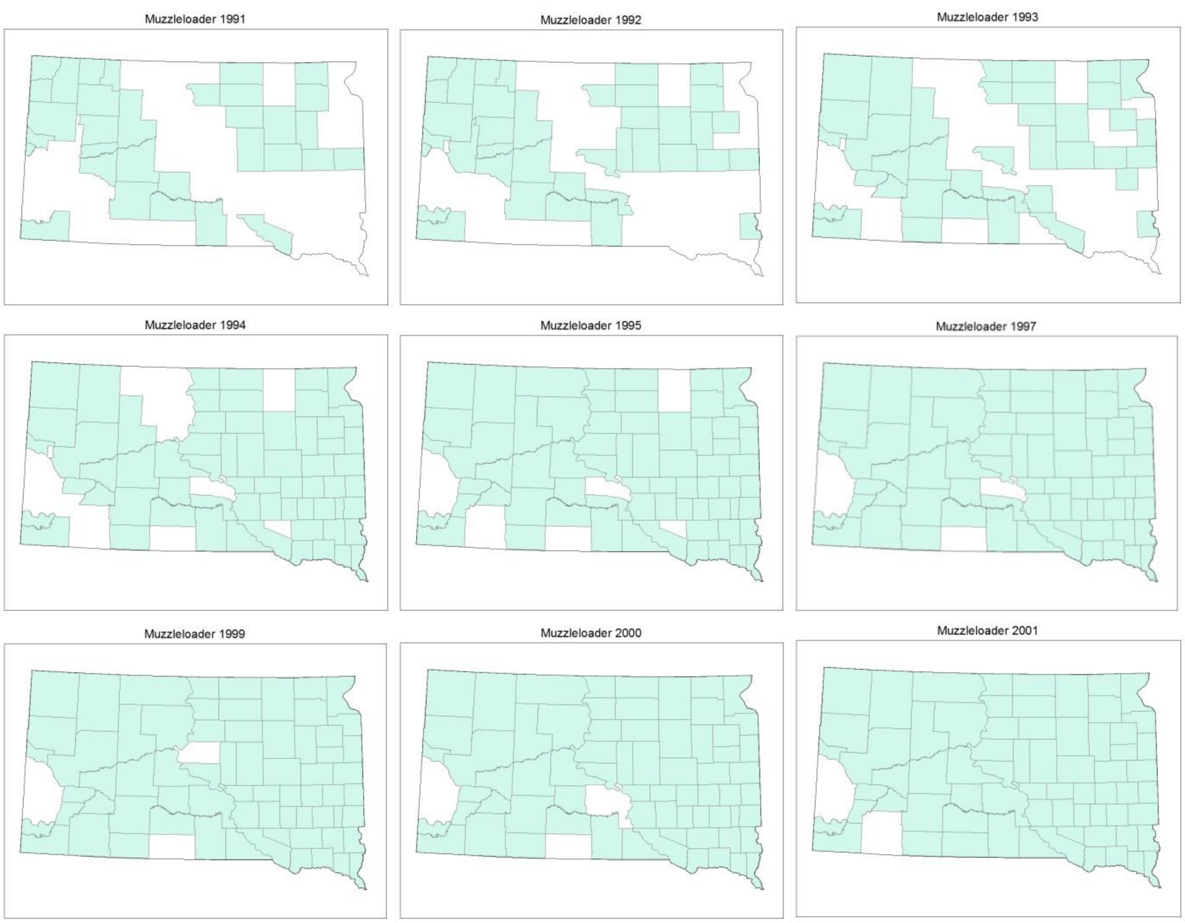
Archery 2016



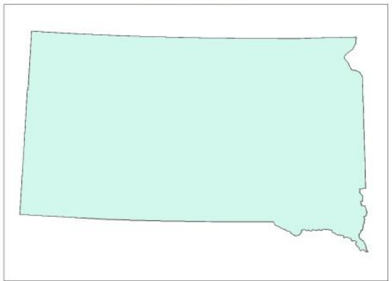
Muzzleloader hunting unit maps ("any deer" seasons), 2005-2016.



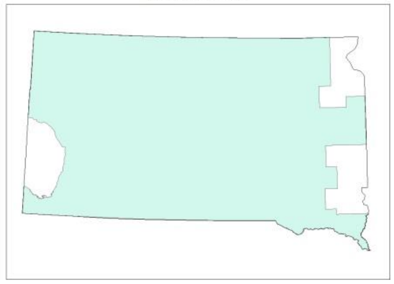

Muzzleloader hunting unit maps (antlerless deer seasons), 1991-2016.



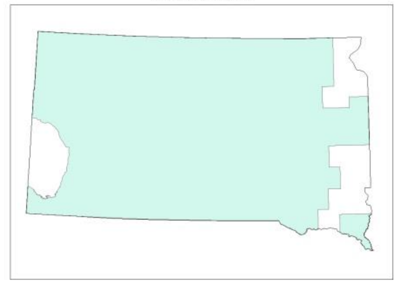
Muzzleloader 2005



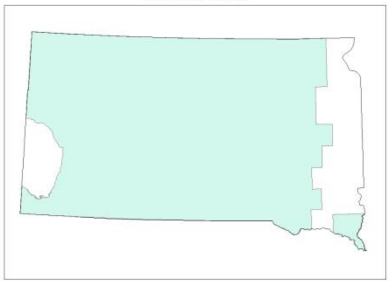
Muzzleloader 2009



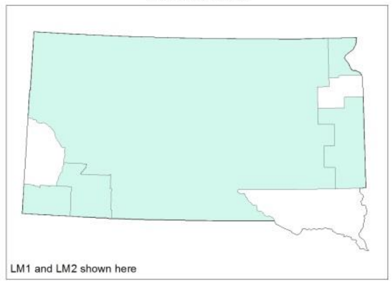
Muzzleloader 2011



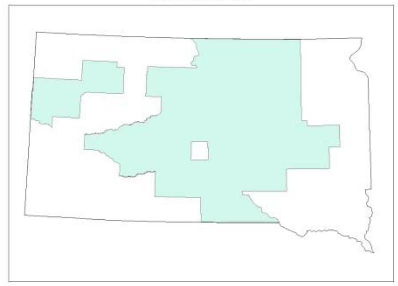
Muzzleloader 2012



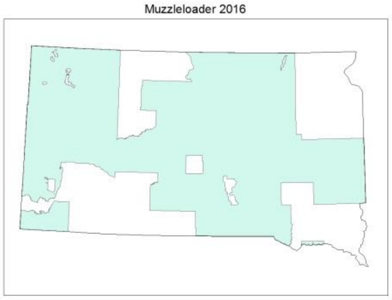
Muzzleloader 2013



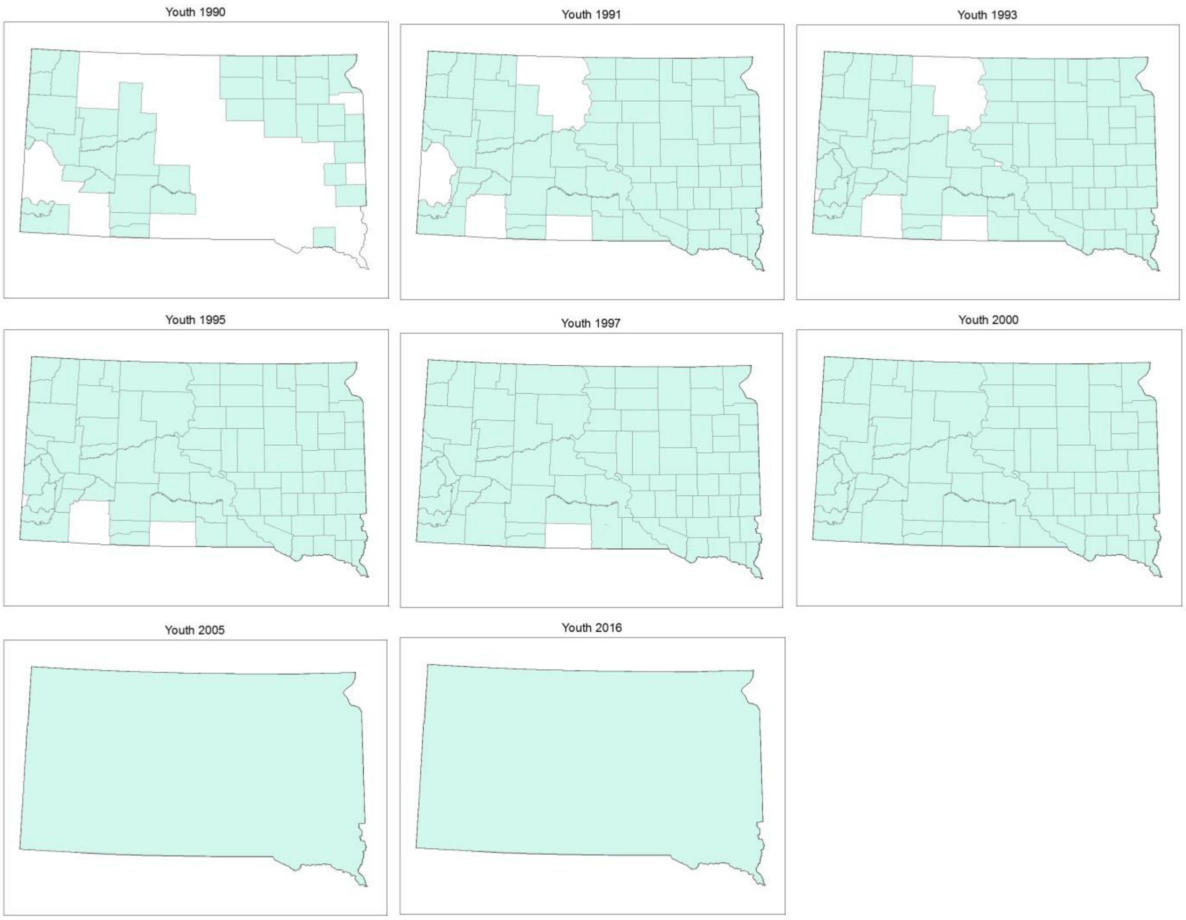

Muzzleloader 2014



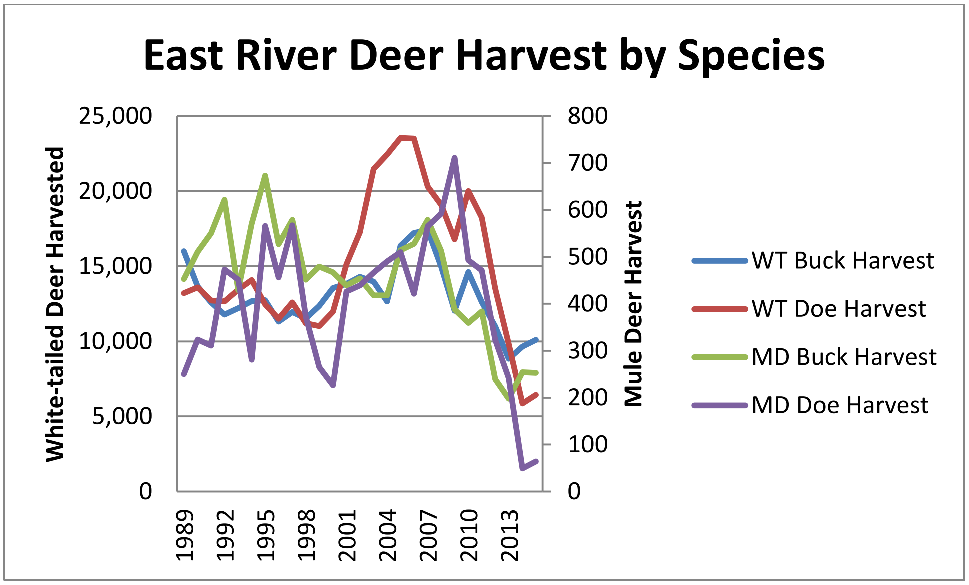
Muzzleloader 2016

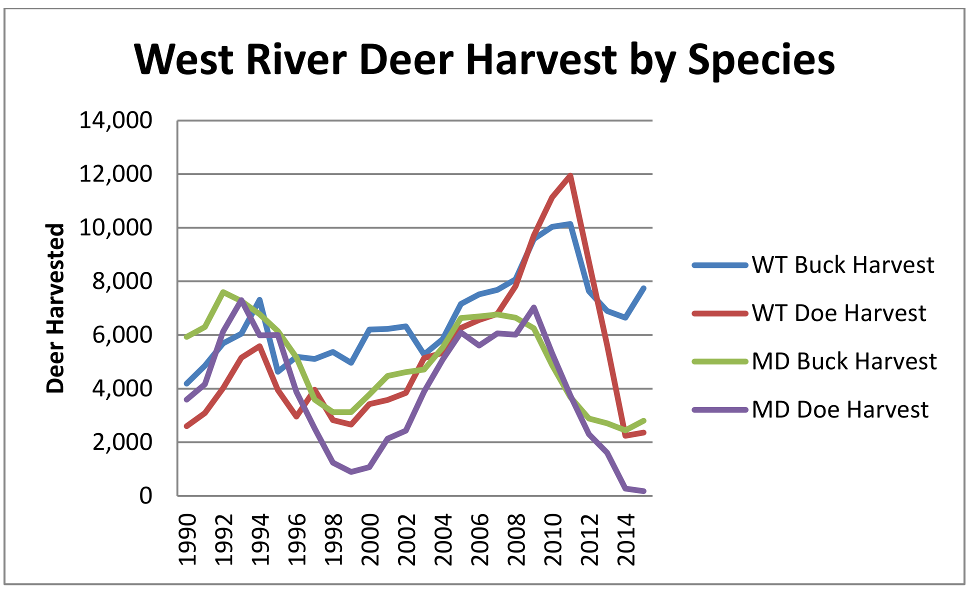


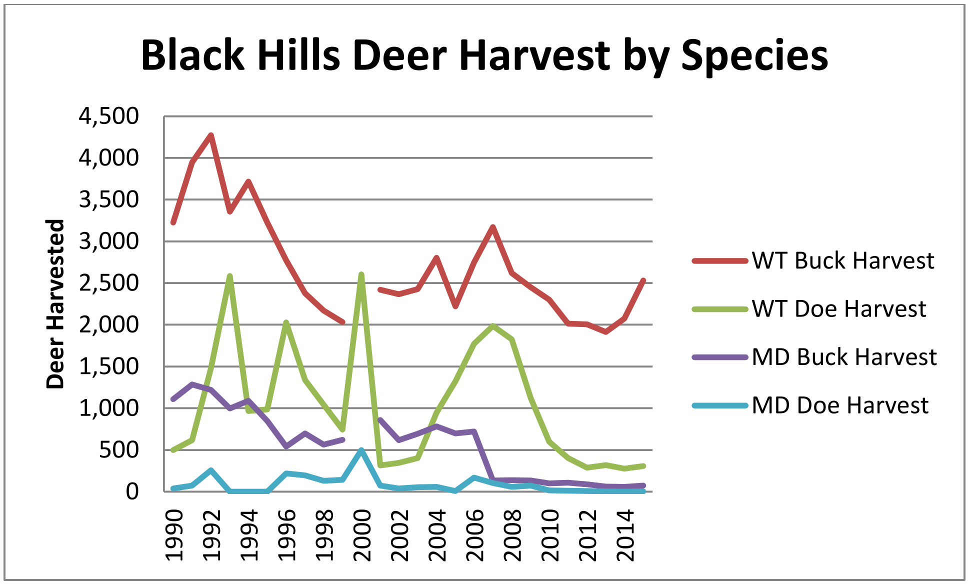
Youth Deer (antlerless deer seasons) hunting unit maps, 1990-2016.



**Appendix B. Harvest by species for East River, West River and Black Hills firearm seasons.**




Black Hills Deer Harvest by Species
Deer Harvested
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
WT Buck Harvest
WT Doe Harvest
MD Buck Harvest
MD Doe Harvest

**Appendix C. Deer Management Stakeholder Group Charter.**

**Purpose** – The SD Game, Fish and Parks (GFP) "Deer Management Stakeholder Group" is a diverse group of citizen stakeholders who have been asked to assist Department of Game, Fish and Parks Staffs and the Game, Fish and Parks Commission in conducting a review of the broad range of issues affecting deer management in South Dakota. The Deer Management Stakeholder Group will assist GFP Staffs and the GFP Commission by offering insight, ideas, and alternatives that could be considered in regard to the Department and Commission positions on various deer management goals, strategies, challenges and related recreational opportunities.

**Objectives** – The basic objectives of the Deer Management Stakeholder Group are to:

- Provide an additional link between the GFP Staffs and the GFP Commission and the citizens we serve;
- Identify challenges and opportunities and develop ideas and suggestions regarding the range of issues affecting the management of deer and associated recreation in South Dakota; and
- Promote communication, increased awareness and mutual understanding between and among the Stakeholder Group members regarding the diversity of deer management challenges.

**Scope of Authority** – The Stakeholder Group will function in an advisory capacity only and will provide a discussion forum for members to share their personal perspective and the perspective of the group or organization they may represent on a diversity of issues related to deer management. Members who serve on the Stakeholder Group do so solely in a volunteer capacity. The Stakeholder Group is granted no authority over rule-making or rule enforcement on public or private land, has no budgetary authority or authority over personnel management, nor is it granted any authority over any state or federal agency or non-governmental organization. The Stakeholder Group was assembled as an additional citizen participation opportunity but is not designed to supplant or curtail any other type of citizen participation or public involvement opportunities that may be further utilized by GFP.

**Organizational Structure and Stakeholder Group Membership** - The Stakeholder Group is comprised of a diverse group of citizen stakeholders who may represent a broad range of public interests in the management of deer in South Dakota. Participants will attend 3 to 5 structured meetings to hear GFP Staffs presentations and offer their ideas and perspectives on deer management. The Stakeholder Group meetings will be facilitated by GFP staffs or a third party facilitator hired by GFP.

**Stakeholder Group Member Roles and Responsibilities** – Working Group members will:

- Make a commitment to attend the scheduled Stakeholder Group meetings;
- Offer their thoughts and ideas and communicate with others in a respectful manner while maintaining an open mind with regard to the views and perspectives of other Working Group members, and;

- Serve as a sounding board and provide feedback and ideas to GFP Staffs and the GFP Commission.

**GFP Staffs Roles and Responsibilities** – GFP Staffs will:

- Provide a diversity of information regarding deer management to the Stakeholder Group;
- Serve the role of facilitator for the meetings, including keeping order, achieving the meeting agenda and providing a comfortable working atmosphere for Working Group members to share ideas and opinions;
- Schedule and arrange meeting room facilities, including providing all necessary communication related to the meetings;
- Listen attentively and respectfully to all viewpoints; and
- Gather meeting notes and make them available to the public via the GFP website.

**Meeting Guidelines and Communication** – The purpose of the Deer Management Stakeholder Group is to provide a forum to promote understanding of deer management issues and challenges from diverse perspectives, therefore voting or other similar methods will not be used to formulate final group consensus on issues discussed.

- Additional Open House meetings, citizen surveys or other public involvement techniques may be used as a means to share information and gather additional public input on any proposed changes in deer management.
- Stakeholder Group members are encouraged to discuss and communicate with others about specific Deer management issues discussed at the Stakeholder Group meetings.

**Travel Expenditures** – Travel expenses (lodging, per diem and vehicle mileage) for Stakeholder Group members will be reimbursed in accordance with State Reimbursement Rules for those members who are not reimbursed by another organization or agency.

**Appendix D. Herd composition survey results for white-tailed deer for the Black Hills, West River, and East River geographic regions in South Dakota, 1972-2016.**

| | **Black Hills** | | | **East River** | | | **West River** | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | N | F:100D | B:100D | N | F:100D | B:100D | N | F:100D | B:100D |
| 1972 | 2,246 | 33.1 | 15.5 | | | | | | |
| 1973 | | | | | | | | | |
| 1974 | | | | | | | | | |
| 1975 | | | | | | | | | |
| 1976 | | | | | | | | | |
| 1977 | 2,135 | 43.8 | | | | | | | |
| 1978 | 2,072 | 51.0 | | | | | | | |
| 1979 | | | | | | | | | |
| 1980 | | | | | | | | | |
| 1981 | | | | | | | | | |
| 1982 | 764 | 141.9 | 20.6 | 1,581 | 145.5 | 37.8 | 869 | 128.1 | 32.0 |
| 1983 | 636 | 150.7 | 27.1 | 2,177 | 145.1 | 36.2 | 1,439 | 122.4 | 33.2 |
| 1984 | 862 | 111.3 | 26.8 | 2,100 | 139.0 | 35.6 | 1,895 | 132.5 | 27.1 |
| 1985 | 853 | 122.7 | 16.2 | 1,466 | 134.8 | 40.8 | 1,503 | 106.7 | 22.4 |
| 1986 | 703 | 79.1 | 14.0 | 1,331 | 147.1 | 39.1 | 1,560 | 118.8 | 23.1 |
| 1987 | 858 | 120.9 | 14.8 | 1,674 | 70.3 | 29.2 | 1,439 | 152.7 | 33.4 |
| 1988 | 907 | 103.3 | 11.6 | 2,421 | 75.9 | 33.4 | 1,547 | 136.8 | 33.2 |
| 1989 | 937 | 86.1 | 14.1 | 2,752 | 78.9 | 30.5 | 1,940 | 134.2 | 28.0 |
| 1990 | 1,098 | 109.9 | 6.7 | 2,618 | 141.5 | 39.4 | 1,727 | 145.6 | 35.7 |
| 1991 | 371 | 123.8 | 8.1 | 2,867 | 130.9 | 48.8 | 1,640 | 172.0 | 34.6 |
| 1992 | 508 | 112.7 | 10.1 | 2,391 | 129.3 | 27.3 | 1,247 | 160.4 | 37.2 |
| 1993 | 566 | 87.9 | 8.0 | 2,149 | 140.4 | 36.9 | 1,121 | 119.3 | 20.8 |
| 1994 | 705 | 102.6 | 4.1 | 1,569 | 134.5 | 31.0 | 1,766 | 129.5 | 17.2 |
| 1995 | 683 | 101.2 | 9.6 | 1,745 | 131.5 | 43.3 | 1,236 | 141.1 | 19.6 |
| 1996 | 1,222 | 85.4 | 15.3 | 1,737 | 131.4 | 38.7 | 1,571 | 119.3 | 25.7 |
| 1997 | 778 | 90.7 | | 1,396 | 129.2 | | 1,377 | 110.6 | |
| 1998 | 595 | 103.7 | 16.7 | 2,572 | 134.4 | 38.9 | 1,422 | 122.2 | 26.4 |
| 1999 | 656 | 82.3 | 18.3 | 1,545 | 144.5 | 43.2 | 1,575 | 117.3 | 19.2 |
| 2000 | 565 | 84.6 | | 2,325 | 137.7 | | 1,640 | 133.0 | |
| 2001 | 785 | 76.8 | | 2,443 | 136.5 | | 2,169 | 104.4 | |
| 2002 | 631 | 96.0 | | 3,516 | 120.4 | | 1,677 | 101.8 | |
| 2003 | 1,341 | 84.2 | | 1,971 | 152.7 | | 1,638 | 120.8 | |
| 2004 | 1,255 | 54.9 | | 2,108 | 135.5 | | 472 | 88.0 | |
| 2005 | 400 | 74.7 | | 1,713 | 138.9 | | 229 | 100.9 | |
| 2006 | 991 | 77.9 | | 1,868 | 132.9 | | 209 | 81.7 | |
| 2007 | 505 | 70.6 | | 1,472 | 122.7 | | 702 | 133.2 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2008 | 654 | 142.2 | | 2,267 | 125.8 | | 568 | 132.8 | |
| 2009 | 1,130 | 63.5 | 29.0 | 5,063 | 101.2 | 25.6 | 1,011 | 106.8 | 24.0 |
| 2010 | 1,410 | 67.4 | 25.8 | 4,381 | 104.9 | 35.0 | 1,226 | 97.0 | 22.4 |
| 2011 | 1,141 | 63.8 | 20.0 | 6,888 | 91.0 | 33.1 | 1,994 | 90.1 | 23.2 |
| 2012 | 2,362 | 73.1 | 27.2 | 5,618 | 102.7 | 31.9 | 1,620 | 83.0 | 26.8 |
| 2013 | 1,439 | 72.4 | 30.0 | 6,242 | 92.8 | 32.6 | 586 | 59.0 | 25.9 |
| 2014 | 964 | 73.9 | 25.7 | 7,942 | 95.9 | 36.8 | 2,391 | 85.8 | 22.3 |
| 2015 | 1,137 | 79.6 | 22.4 | 9,739 | 95.1 | 32.3 | 4,152 | 90.4 | 23.7 |
| 2016 | 818 | 77.4 | 26.1 | 8,266 | 89.7 | 26.1 | 3,679 | 70.7 | 23.9 |

**Appendix E. Herd composition survey results for mule deer for the Black Hills, West River, and East River geographic regions in South Dakota, 1972-2016.**

| | **Black Hills** | | | **East River** | | | **West River** | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | N | F:100D | B:100D | N | F:100D | B:100D | N | F:100D | B:100D |
| 1972 | 453 | 37.3 | 31.7 | | | | | | |
| 1973 | | | | | | | | | |
| 1974 | | | | | | | | | |
| 1975 | | | | | | | | | |
| 1976 | | | | | | | | | |
| 1977 | 198 | 54.7 | | | | | | | |
| 1978 | 302 | 102.7 | | | | | | | |
| 1979 | | | | | | | | | |
| 1980 | | | | | | | | | |
| 1981 | | | | | | | | | |
| 1982 | 97.6 | 98.4 | 54.4 | | | | 1,636 | 109.3 | 28.8 |
| 1983 | 166 | 142.4 | 39.0 | | | | 1,176 | 64.6 | 30.1 |
| 1984 | 207 | 124.4 | 41.0 | | | | 2,224 | 106.8 | 23.9 |
| 1985 | 131 | 103.3 | 15.0 | | | | 1,486 | 77.2 | 28.4 |
| 1986 | 139 | 89.4 | 21.2 | | | | 879 | 100.3 | 25.1 |
| 1987 | 153 | 129.3 | 34.5 | | | | 1,588 | 133.7 | 28.8 |
| 1988 | 61 | 92.9 | 25.0 | | | | 1,699 | 119.7 | 45.4 |
| 1989 | 101 | 102.1 | 12.8 | | | | 2,319 | 120.7 | 36.4 |
| 1990 | 135 | 122.2 | 27.8 | | | | 2,397 | 146.3 | 40.7 |
| 1991 | 89 | 113.2 | 21.1 | | | | 1,862 | 175.9 | 30.8 |
| 1992 | 41 | 100.0 | 15.8 | | | | 1,367 | 143.9 | 45.8 |
| 1993 | 129 | 64.0 | 8.0 | | | | 1,021 | 135.6 | 29.6 |
| 1994 | 102 | 97.8 | 28.9 | | | | 1,903 | 145.4 | 17.4 |
| 1995 | 80 | 65.1 | 20.9 | | | | 1,533 | 168.8 | 50.6 |
| 1996 | 103 | 111.9 | 33.3 | 295 | 157.1 | 67.0 | 1,884 | 130.8 | 43.9 |
| 1997 | 109 | 91.2 | | | | | 1,248 | 115.9 | |
| 1998 | 102 | 93.3 | 33.3 | 269 | 184.8 | 55.7 | 1,029 | 147.9 | 35.5 |
| 1999 | 217 | 62.5 | 46.2 | | | | 1,396 | 112.7 | 23.1 |
| 2000 | 112 | 72.3 | | | | | 1,850 | 122.4 | |
| 2001 | 136 | 70.0 | | 244 | 151.5 | | 2,394 | 99.0 | |
| 2002 | 118 | 96.7 | | 305 | 113.3 | | 1,912 | 82.1 | |
| 2003 | 188 | 66.4 | | 199 | 93.2 | | 2,256 | 102.0 | |
| 2004 | 173 | 80.2 | | 22 | 57.1 | | 1,347 | 95.2 | |
| 2005 | 75 | 56.3 | | 22 | 57.1 | | 304 | 97.4 | |
| 2006 | 130 | 64.6 | | 153 | 121.7 | | 479 | 72.3 | |
| 2007 | 288 | 71.4 | | 185 | 107.9 | | 693 | 105.0 | |
| 2008 | 178 | 78.0 | | 215 | 147.1 | | 735 | 124.1 | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 2009 | 119 | 66.7 | 116.7 | 180 | 66.7 | 47.6 | 875 | 91.0 | 48.8 |
| 2010 | 90 | 78.0 | 41.5 | 131 | 80.3 | 34.4 | 1,045 | 77.5 | 39.7 |
| 2011 | 87 | 67.4 | 34.9 | 298 | 66.7 | 54.1 | 1,412 | 66.6 | 36.5 |
| 2012 | 105 | 70.5 | 68.2 | 419 | 61.9 | 45.5 | 1,106 | 65.8 | 42.1 |
| 2013 | 172 | 61.4 | 45.8 | 340 | 42.4 | 35.6 | 824 | 60.5 | 27.6 |
| 2014 | 127 | 64.8 | 70.4 | 775 | 56.3 | 43.9 | 2,472 | 72.7 | 34.6 |
| 2015 | 235 | 67.0 | 48.6 | 421 | 61.4 | 27.4 | 4,299 | 83.8 | 37.8 |
| 2016 | 142 | 54.8 | 39.7 | 705 | 72.6 | 41.6 | 4,188 | 64.6 | 40.1 |

**Appendix F. The number of fawns per 100 does for white-tailed deer (WT) and mule deer (MD) based on daylight and nocturnal spotlight counts, determined for the Black Hills, West River, and East River regions of South Dakota, 1977-2014. In some instances values were divided according to daylight and spotlight counts.**

| | Pre-season Fall Classification Count (fawns/100 does) | | | | | | |
|---|---|---|---|---|---|---|---|
| | Black Hills | | West River | | East River | | |
| Year | WT | MD | WT | MD | WT | MD | Reference |
| 1977 | 110.20 (daylight) 68.78 (spotlight) | - | 163.56 (daylight) 128.87 (spotlight) | 107.40 (daylight) 82.12 (spotlight) | 144.03 (daylight) 147.79 (spotlight) | - | Rice 1984 |
| 1978 | 91.74 (daylight) 100.75 (spotlight) | 85.46 (daylight) 83.33 (spotlight) | 148.21 (daylight) 149.24 (spotlight) | 120.69 (daylight) 107.91 (spotlight) | 110.67 (daylight) 143.62 (spotlight) | - | Rice 1984 |
| 1979 | 131.73 (daylight) 117.08 (spotlight) | 88.46 (daylight) 126.92 (spotlight) | 151.95 (daylight) 155.14 (spotlight) | 118.71 (daylight) 116.04 (spotlight) | 158.43 (daylight) 155.41 (spotlight) | - | Rice 1984 |
| 1980 | 140.79 (daylight) 117.14 (spotlight) | 240.00 (daylight) 129.17 (spotlight) | 148.00 (daylight) 140.34 (spotlight) | 112.88 (daylight) 114.75 (spotlight) | 157.71 (daylight) 172.04 (spotlight) | - | Rice 1984 |
| 1981 | 138.53 (daylight) 126.18 (spotlight) | 143.59 (daylight) 111.90 (spotlight) | 160.12 (daylight) 132.76 (spotlight) | 135.00 (daylight) 177.78 (spotlight) | 162.56 (daylight) 154.78 (spotlight) | - | Rice 1984 |
| 1977 - 1981 ave | 121.04 (daylight) 106.05 (spotlight) | 110.40 (daylight) 95.03 (spotlight) | 153.95 (daylight) 140.75 (spotlight) | 118.90 (daylight) 112.26 (spotlight) | 148.21 (daylight) 154.43 (spotlight) | - | Rice 1984 |
| 1982 | 149.3 (daylight) 129.9 (spotlight) | 83.3 (daylight) 115.4 (spotlight) | 132.1 (daylight) 116.4 (spotlight) | 111.5 (daylight) 105.9 (spotlight) | 142.0 (daylight) 152.4 (spotlight) | - | Wallin & Rice 1987c |
| 1983 | 161 (daylight) 136 (spotlight) | 132 (daylight) 159 (spotlight) | 116 (daylight) 133 (spotlight) | 113 (daylight) 117 (spotlight) | 140 (daylight) 153 (spotlight) | - | Wallin & Rice 1987d |
| 1984 | 111 | 124 | 132 | 107 | 139 | - | Wallin & Nash 1987 |
| 1985 | 123 | 103 | 107 | 77 | 135 | - | Hauk & Nash 1987 |
| 1986 | 79 | 89 | 119 | 100 | 147 | - | Hauk 1987 |
| 1987 | 109 | 117 | 153 | 150 | 142 | - | Hauk 1989 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1988 | 103 | 93 | 137 | 120 | 132 | - | McPhillips 1989 |
| 1989 | 86 | 102 | 134 | 121 | 127 | - | McPhillips 1990 |
| 1990 | 110 | 122 | 146 | 146 | 142 | - | McPhillips & Rice 1991a |
| 1991 | 124 | 113 | 175 | 176 | 131 | - | McPhillips & Rice 1991b |
| 1992 | 113 | 100 | 160 | 144 | 129 | - | McPhillips & Rice 1992 |
| 1993 | 88 | 64 | 119 | 136 | 140 | - | McPhillips & Rice 1993 |
| 1994 | 103 | 98 | 129 | 145 | 135 | | McPhillips & Rice 1995 |
| 1995 | 101 | 65 | 141 | 169 | 132 | | McPhillips & Rice 1996 |
| 1996 | 85 | 112 | 119 | 131 | 131 | 157 | McPhillips et al. 1997 |
| 1997 | 91 | 91 | 111 | 116 | 129 | | Schlueter et al. 1998 |
| 1998 | 104 | 93 | 122 | 148 | 134 | 185 | Schlueter 1999 |
| 1999 | 107 | 81 | 117 | 150 | 145 | - | Schlueter 2000 |
| 2000 | 85 | 72 | 133 | 122 | 138 | 152 | Smith 2001a |
| 2001 | 77 | 70 | 104 | 99 | 136 | 113 | Smith 2002b |
| 2002 | 96 | 97 | 100 | 82 | 120 | 93 | Huxoll 2003 |
| 2003 | 84 | 67 | 121 | 102 | 153 | 58 | Huxoll 2004 |
| 2004 | 55 | 80 | 88 | 95 | 135 | 58 | Huxoll 2005 |
| 2005 | 75 | 56 | 101 | 97 | 139 | - | Huxoll 2006 |
| 2006 | 78 | 65 | 82 | 73 | 133 | 122 | Huxoll. 2007 |
| 2007 | 71 | 71 | 133 | 105 | 123 | 108 | Huxoll 2008 |
| 2008 | 71 | 78 | 133 | 124 | 126 | 147 | Huxoll 2009 |
| 2009 | 64 | 67 | 109 | 89 | 101 | 67 | Huxoll 2010 |
| 2010 | 67 | 78 | 97 | 78 | 105 | 80 | Huxoll 2011 |
| 2011* | 64 | 67 | 90 | 67 | 91 | 67 | Huxoll 2012 |
| 2012* | 73 | 70 | 83 | 66 | 103 | 62 | Huxoll 2013a |
| 2013 | 72 | 61 | 59 | 61 | 93 | - | Huxoll 2014 |
| 2014 | 74 | 70 | 86 | 73 | 96 | - | Huxoll 2015 |

*State-wide values for white-tailed deer, mule deer, and all deer provided in 2011 were 87, 67, and 84 fawns/100 does and in 2012 91, 65, and 87 fawns/100 does, respectively.

**Appendix G. The number of bucks per 100 does for white-tailed deer (WT) and mule deer (MD) based on daylight and nocturnal spotlight counts, determined for the Black Hills, West River, and East River regions of South Dakota, 1977-1999, 2010-2012. In some instances values were divided according to daylight and spotlight counts.**

| | Pre-season Fall Classification Count Bucks/100 does | | | | | | |
|---|---|---|---|---|---|---|---|
| | Black Hills | | West River | | East River | | |
| Year | WT | MD | WT | MD | WT | MD | Reference |
| 1977 | 10.88 (daylight) 17.35 (spotlight) | - | 21.13 (daylight) 44.25 (spotlight) | 27.25 (daylight) 29.55 (spotlight) | 40.00 (daylight) 38.28 (spotlight) | | Rice 1984 |
| 1978 | 4.80 (daylight) 17.20 (spotlight) | 15.38 (daylight) 40.71 (spotlight) | 19.40 (daylight) 28.03 (spotlight) | 23.45 (daylight) 29.40 (spotlight) | 37.65 (daylight) 47.06 (spotlight) | | Rice 1984 |
| 1979 | 9.79 (daylight) 21.33 (spotlight) | 23.33 (daylight) 23.33 (spotlight) | 22.83 (daylight) 42.19 (spotlight) | 29.72 (daylight) 35.66 (spotlight) | 31.94 (daylight) 41.77 (spotlight) | | Rice 1984 |
| 1980 | 6.58 (daylight) 20.29 (spotlight) | 28.57 (daylight) 53.13 (spotlight) | 30.80 (daylight) 24.83 (spotlight) | 28.18 (daylight) 30.52 (spotlight) | 24.38 (daylight) 47.42 (spotlight) | | Rice 1984 |
| 1981 | 10.43 (daylight) 18.97 (spotlight) | 36.54 (daylight) 25.00 (spotlight) | 24.77 (daylight) 23.42 (spotlight) | 14.37 (daylight) 35.09 (spotlight) | 25.22 (daylight) 37.85 (spotlight) | | Rice 1984 |
| 1977-1981 ave | 8.14 (daylight) 19.37 (spotlight) | 24.68 (daylight) 34.43 (spotlight) | 24.68 (daylight) 32.51 (spotlight) | 24.36 (daylight) 31.71 (spotlight) | 31.89 (daylight) 41.68 (spotlight) | | Rice 1984 |
| 1982 | 16.3 (daylight) 13.0 (spotlight) | 46.4 (daylight) 32.0 (spotlight) | 35.3 (daylight) 26.4 (spotlight) | 29.7 (daylight) 29.0 (spotlight) | 37.1 (daylight) 39.2 (spotlight) | - | Wallin & Rice 1987c |
| 1983 | 17 (daylight) 24 (spotlight) | 24 (daylight) 37 (spotlight) | 27 (daylight) 43 (spotlight) | 27 (daylight) 37 (spotlight) | 36 (daylight) 36 (spotlight) | - | Wallin & Rice 1987d |
| 1984 | 21 | 33 | 20 | 24 | 36 | - | Wallin & Nash 1987 |
| 1985 | 28 | 12 | 22 | 28 | 41 | - | Hauk & Nash 1987 |
| 1986 | 12 | 18 | 23 | 25 | 39 | - | Hauk 1987 |
| 1987 | 13 | 31 | 27 | 23 | 42 | - | Hauk 1989 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1988 | 10 | 23 | 27 | 36 | 44 | - | McPhillips 1989 |
| 1989 | 12 | 11 | 22 | 29 | 39 | - | McPhillips 1990 |
| 1990 | 5 | 22 | 27 | 31 | 39 | - | McPhillips & Rice 1991a |
| 1991 | 7 | 13 | 26 | 23 | 49 | - | McPhillips & Rice 1991b |
| 1992 | 7 | 11 | 27 | 33 | 27 | - | McPhillips & Rice 1992 |
| 1993 | 7 | 7 | 21 | 25 | 26 | - | McPhillips & Rice 1993 |
| 1994 | 3 | 25 | 17 | 14 | 31 | - | McPhillips & Rice 1995 |
| 1995 | 8 | 17 | 20 | 39 | 43 | - | McPhillips & Rice 1996 |
| 1996 | 13 | 28 | 26 | 35 | 39 | 54 | McPhillips et al. 1997 |
| 1997 | - | - | - | - | 39 | - | Schlueter et al. 1998 |
| 1998 | 13 | 27 | 26 | 25 | 87 | 90 | Schlueter 1999 |
| 1999 | 18 | 46 | 19 | 23 | 43 | - | Schlueter 2000 |
| No data in deer management reports from 2000-2010. | | | | | | | |
| 2011* | 20 | 35 | 23 | 37 | 33 | 54 | Huxoll 2012 |
| 2012* | 27 | 68 | 27 | 42 | 32 | 46 | Huxoll 2013a |

*State-wide values provided in 2011 include 29, 39, and 31 bucks/100 does for white-tailed deer, mule deer, and all deer; while in 2012 values were 30, 44, and 32 bucks/100 does.