SOUTH DAKOTA
PRONGHORN MANAGEMENT PLAN
2019 – 2029

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

WILDLIFE DIVISION REPORT 2019-05

July 2019

This document is for general, strategic guidance for the Division of Wildlife and serves to identify what we strive to accomplish related to **Pronghorn Management**. This process will emphasize working cooperatively with interested publics in both the planning process and the regular program activities related to pronghorn management.

This plan will be utilized by Department staff on an annual basis and will be formally evaluated at least every 10 years. Plan updates and changes, however, may occur more frequently as needed.

ACKNOWLEDGEMENTS

This plan is a product of substantial discussion, debate, and input from many wildlife professionals. In addition, those comments and suggestions received from private landowners, hunters, and those who recognized the value of pronghorn and their associated habitats were also considered.

Management Plan Coordinator – Andy Lindbloom, South Dakota Department of Game, Fish, and Parks (SDGFP).

SDGFP Pronghorn Management Plan Team that assisted with plan writing, data review and analyses, critical reviews and/or edits to the South Dakota Pronghorn Management Plan, 2019 - 2029 – Nathan Baker, Chalis Bird, Paul Coughlin, Josh Delger, Jacquie Ermer, Steve Griffin, Trenton Haffley, Corey Huxoll, John Kanta, Keith Fisk, Tom Kirschenmann, Chad Lehman, Cindy Longmire, Stan Michals, Mark Norton, Tim Olson, Chad Switzer, and Lauren Wiechmann. Cover art was provided by Adam Oswald.

All text and data contained within this document are subject to revision for corrections, updates, and data analyses.

Recommended Citation:

South Dakota Department of Game, Fish and Parks. 2019. South Dakota Pronghorn Management Plan, 2019 – 2029. Completion Report 2019-05. South Dakota Department of Game, Fish and Parks, Pierre, South Dakota, USA.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

APHIS	Animal and Plant Health Inspection Service
Apps	Applications
ARSD	Administrative Rules of South Dakota
ATV	All-Terrain Vehicles
BFM	South Dakota Bureau of Finance and Management
BHNF	Black Hills National Forest
BLM	Bureau of Land Management
BMP	Best Management Practices
BNP	Badlands National Park
CHAP	Controlled Hunting Access Program
CI	Confidence Interval
CRD	Commission Recommendation and Development
CRP	Conservation Reserve Program
CSP	Custer State Park
DAU	Data Analysis Unit
DOE	Department of Energy
EIA	Energy Information Administration
FPNG	Fort Pierre National Grasslands
GPA	Game Production Areas
GPS	Global Positioning System
Intamap	Program R statistical package
IRRC	Interim Rules Review Committee
LRC	Legislative Research Council
MC	Monte Carlo
MOU	Memorandum of Understandings
NGO	Non-governmental Organizations
NPS	National Park Service
NRCS	USDA Natural Resources Conservation Service
NUGMP	Badlands National Park North Unit General Management Plan
OSPRA	Oglala Sioux Parks and Recreation Authority
OST	Oglala Sioux Tribe
PR	Pittman-Robertson Act
R Core Team 2015	Program R Statistical Software
SD RMP	South Dakota Approved Resource Management Plan
SDCL	South Dakota Codified Law
SDDOT	South Dakota Department of Transportation
SDFO	South Dakota Field Office
SDGFP	South Dakota Game, Fish and Parks
SDSPL	South Dakota School and Public Land
SUGMP	Badlands National Park South Unit General Management Plan
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service

WFF	Wildlife Friendly Fence
WIA	Walk-In Area
WICA	Wind Cave National Park
WPP	Wildlife Partners Program
WSI	Winter Severity Index

EXECUTIVE SUMMARY

South Dakota's diverse landscapes of grassland, rangeland, and cropland areas are home to pronghorn (*Antilocapra americana*) across areas primarily adjacent to and west of the Missouri River. Pronghorn 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 pronghorn populations to recover from historic lows. Pronghorn hunting seasons have occurred regularly since the 1940s, with pronghorn hunters harvesting approximately 18,000 pronghorn during the recent record year of 2008.

Pronghorn hunting is a popular and much awaited outdoor activity for many sportsmen and women in South Dakota. Within South Dakota, approximately 5,800 residents and 700 non-residents hunted pronghorn in 2017, with a recent peak pronghorn hunter participation occurring in 2008 when approximately 13,000 residents and non-residents pursued pronghorn. Hunting remains the number one tool for managing pronghorn 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 pronghorn 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 pronghorn management. Current pronghorn 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 10 years but should be considered a working document that will be amended as new biological and social data provide opportunities to improve management of pronghorn resources in South Dakota. Furthermore, this plan will aid in the decision-making process of the 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 2018 preseason pronghorn populations of approximately 45,900 [95% confidence interval (CI): 36,000 – 55,800]. Based on habitat and social tolerances, pronghorn management units will be managed to increase, maintain, or decrease populations. The overall statewide pronghorn objective, a summation of unit objectives, is 69,000 (95% CI, 59,000-80,000). All management unit objectives are based on annual collection and evaluation of pronghorn biological data, habitat resources, weather data, private land depredation issues, and substantial input from a wide variety of publics with an interest in pronghorn management in South Dakota. The SDGFP will adopt harvest strategies that will progressively allow the pronghorn population to reach these unit objectives.

Many complex issues arise during the management of pronghorn, their habitats, depredation to private property, and hunting opportunities. While not an exclusive list, the following challenges and opportunities are covered in this management plan: 1) habitat loss, conversion, and fragmentation; 2) hunter access; 3) hunting regulations; 4) harvest strategies; 5) hunting season setting process; 6) lead bullet fragmentation; 7) predation management; 8) social tolerance, and 9) winter severity and drought. These challenges and opportunities serve as the foundation for many of the objectives and strategies outlined in the plan and will be addressed to ensure this plan is successfully implemented.

The SDGFP will manage pronghorn 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) enhance the conditions and capacities to help preserve, protect, enhance, and manage pronghorn habitat; 2) monitor and assess pronghorn populations by conducting scientifically based biological surveys; 3) manage pronghorn populations for both maximum and quality recreational hunting opportunities, considering all social and biological inputs; 4) cooperatively work with private landowners, organizations, and other agencies to resolve pronghorn depredation to agricultural crops and other conflict issues; 5) monitor and evaluate risk and impact of disease in pronghorn herds in South Dakota; 6) provide the public with access to private and public land for quality pronghorn hunting opportunities; 7) evaluate pronghorn research and management needs; and 8) promote public, landowner, and conservation agency awareness of pronghorn management needs and challenges. 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 Pronghorn Management Plan, 2019-2029" was an important component of the revision process. Multiple avenues for public involvement and outreach were used to engage the public at various stages of plan development and to ensure opportunities for participation were accessible to all citizens. In 2012, the SDGFP conducted a public opinion survey of landowners and hunters to collect and evaluate opinions on numerous topics related to pronghorn and other species' management (Longmire 2014). In the fall of 2017, the SDGFP sent out a press release to solicit comments from the public on the current pronghorn management plan. In May of 2019, SDGFP made a draft of the plan revision available to the public for 30-day review and comment. A limited number of opinions and suggestions from the public were received related to pronghorn management in South Dakota. These comments were carefully considered by the SDGFP planning team and SDGFP commission during development of the revised management plan.

The "*South Dakota Pronghorn Management Plan, 2019-2029*" will serve as the guiding document for decision making and implementation of actions to ensure pronghorn populations and their habitats are managed appropriately, addressing both biological and social tolerances, while considering the needs of all stakeholders. The 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 pronghorn in South Dakota.

INTRODUCTION

The pronghorn (*Antilocapra americana*) is the only member of the family Antilocapridae and is native only to North America. In the 1804 journals of the Lewis and Clark expedition, it was noted that pronghorn occurred in vast numbers over most of the Dakota Territory (Miller and Kellogg 1955). In 1841 Maximillean recorded pronghorn as wintering west of the Missouri River along the Cheyenne River and during the spring they would swim the river to summer in the Coteau des Prairie. In the 1879 Yankton Daily Press, pronghorn were reported as abundant on the prairies east of the James River (SDGFP 1965). It has been estimated that over 700,000 pronghorn ranged in South Dakota prior to 1800 (Bever undated).

Today pronghorn populations in South Dakota persist at substantially lower numbers than were historically present. Pronghorn densities are greatest in the western rangelands of the state, but herds exist in most counties west of the Missouri river and some counties directly east of the river. Public demand for hunting opportunities is strong, with approximately 13,000 rifle hunters and 2,000 archery hunters purchasing licenses at recent peak population levels in 2008. Current populations are affected by weather extremes of drought and severe winters, harvest, decreasing available habitats due to conversion to agriculture, predation, and landowner tolerance.

The South Dakota Department of Game, Fish and Parks (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 wildlife 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 management. Current 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, and aid in the decision-making process of the SDGFP and SDGFP Commission. It also serves to inform and educate the sportsmen and women, landowners, and other publics of South Dakota to whom it will ultimately benefit.

HISTORICAL BACKGROUND

Historically, pronghorn ranged west of the Mississippi River from southern Canada south through Mexico as far as present-day Mexico City. Some wildlife historians estimated pronghorn numbers to be equal to or exceed those of the American bison (*Bison bison*). By the early 1900s it was estimated that numbers in the central range had diminished greatly and the northern and southern ranges were nearly void of any pronghorn with a decline by more than 99% due to fencing, habitat loss, and unregulated hunting (O'Gara and Yoakum 2004). It has also been reported that the mobility of pronghorn was partially dependent upon the snow trampling of bison which provided lanes of travel and food during severe winter storms. Thus, the near extermination of bison has also been suggested as partially responsible for the rapid decline of pronghorn. In 1873, a fatal epizootic

outbreak that reportedly killed 75 to 90 percent of pronghorn between the Yellowstone and Missouri rivers may have also contributed to the decline of pronghorn (SDGFP 1965).

Pronghorn hunting throughout the United States was unregulated and included subsistence harvest, market hunting, and recreational hunting ultimately causing the population to decline and become extirpated from several portions of their historical range (Rossi and Hunt 1971). The passage of the Homestead Act in 1862 increased the number of settlers in South Dakota, ultimately increasing the amount of unregulated hunting pressure of many game species. Pronghorn populations in South Dakota showed similar declines as much of western North America and were considered extirpated east of the Missouri River by 1909, with a small population holding on west of the Missouri River. The passage of the Lacey Act on May 25, 1900 protected wildlife populations by making the interstate transport of game killed in violation of state laws a federal offence. This ultimately diminished the market hunting impacts on pronghorn nationally. The era of the 1900's also included enhancements in rangeland protection and preservation initiated by Theodore Roosevelt. Alarmed by the decline in pronghorn populations, the South Dakota House passed Bill No. 7 on January 7, 1911, making it unlawful to kill pronghorn in South Dakota. The hunting season on pronghorn remained closed until 1936 (Popowski 1959). The introduction of the North American Model of Wildlife Conservation initiated by Aldo Leopold in 1918, outlined management of game populations through habitat management, and the use of the surplus animals produced above the sustainable population level through harvest without endangering the future population (Leopold 1918). These ideals were implemented during a time of exodus of homesteaders from the prairies due to the droughts and dust storms of the 1930s, ultimately leading to an increase in the pronghorn population in South Dakota.

During the next 50 years, several attempts to reintroduce pronghorn to the landscape occurred. The first record of restocking in South Dakota took place in 1914 when the Boone and Crockett Club purchased 13 pronghorn in Alberta and released them in Wind Cave National Park (WICA) (USDA 1925). In 1950, 30 pronghorn were released in Weta Basin of Jackson County and 24 in Tripp County. In 1952, 16 pronghorn were released in the Pronghorn Reserve in Harding County, 13 were released west of Buffalo in Harding County, 8 were released in Custer State Park (CSP), and 30 southeast of Kadoka in Jackson County (Berner 1952a). Brief memos and notes in Department files mention that in 1961 approximately 40 pronghorn were released in Mellette County, 40 northeast of Hamill (Tripp County), and approximately 20 at the Badlands Bombing Range near Scenic (Oglala Lakota County). In 1962, sixty-two animals were released in Grant and McPherson counties. Additional pronghorn were put in McPherson County in 1964, in addition to a new transplant site near Lake City in Marshall County. The last transplant occurred in South Dakota in 1985 when 104 pronghorn trapped in Wyoming were transplanted to the Crow Creek Indian Reservation in Buffalo County.

Prior to transplanting animals SDGFP staff evaluated numerous factors to determine the suitability of proposed areas to sustain pronghorn populations. Factors evaluated included 1) distribution of cultivated lands, 2) winter range, 3) amount and distribution of woven wire fence, 4) predation, 5) land ownership, and 6) class of livestock (Bever undated). A SDGFP report shows support for

transplanting pronghorn into Tripp County (Bever 1949), presenting "almost 100% of farmers and ranchers living within or near the areas inspected have signed a petition requesting the introduction of pronghorn". A similar unpublished report of landowners surveyed in Haakon County stated that 100% of landowners contacted were in favor of releasing pronghorn, even after being informed of potential crop damage issues.

Although available literature does not pinpoint the person or parties responsible for the conception of the Pronghorn Reserve in Harding County, Peter Norbeck (as governor of the State and later Senator in Washington) was chiefly responsible for the establishment of the Pronghorn Reserve in the Slim Buttes area on Jan. 3, 1921 (USDA 1925). The original reserve was justified primarily to save pronghorn from extinction, secondarily to act as a refuge for deer and game birds, and also as a planting site for bison and elk (*Cervus elaphus*). The original reserve included 20,800 acres but was later reduced to an area of about 8-10,000 acres. Because the original plan for the reserve called for fencing of US Forest Service (USFS) lands, special legislation was needed. Senator Norbeck introduced an enabling act in the 68th Congress which authorized the withdrawal of public domain for the protection of pronghorn and other game animals and birds. This act passed in 1924, and in 1925 President Coolidge signed a proclamation completing the withdrawal on the Pronghorn Reserve. It appears only 360 acres are included under this protection. In 1924, SDGFP also purchased 1,120 acres of private lands within the reserve.

The Pronghorn Reserve originally contained approximately 50 animals, but a few additional pronghorn moved in from adjacent herds as the fence was being constructed (Popowski 1959). The winter of 1936-37 nearly decimated the herd, and after a storm in 1949 it was reported that only 7 pronghorn were left in the Reserve. The fence later deteriorated allowing unimpeded animal movement in and out of the Reserve (Popowski 1959). There are no indications that the Pronghorn Reserve was responsible for the increase of pronghorn in western South Dakota, rather it seems range expansion from Montana and herd growth of existing local herds likely occurred.

An estimate made by the Bureau of Biological Survey in 1924 placed the pronghorn population at 680 animals in eleven bands within twelve counties in South Dakota. During 1941, a census estimated 11,000 pronghorn mostly located in Harding and Butte counties, and in 1942 SDGFP issued 500 permits for the first regulated pronghorn season (SDGFP 1965). License sales and harvest records have been collected and monitored since the first pronghorn season (Appendix A). Annual pronghorn seasons have continued to present day, with the exception in 1945 and 1949 being closed.

Pronghorn populations naturally fluctuate based on extreme winters, drought, and predator population fluctuations. Hipschman (1959) described the post-World War II era in South Dakota as a time of resurgence in game species due to land use changes and ideal weather patterns. Statewide populations have reached nearly 67,000 in 1983, 54,000 in 1995, and 81,000 as recently as 2008 (Figure 1). Following these population spikes, SDGFP responded with increased licenses, offering double or triple tags and providing more liberal seasons. Several major population declines

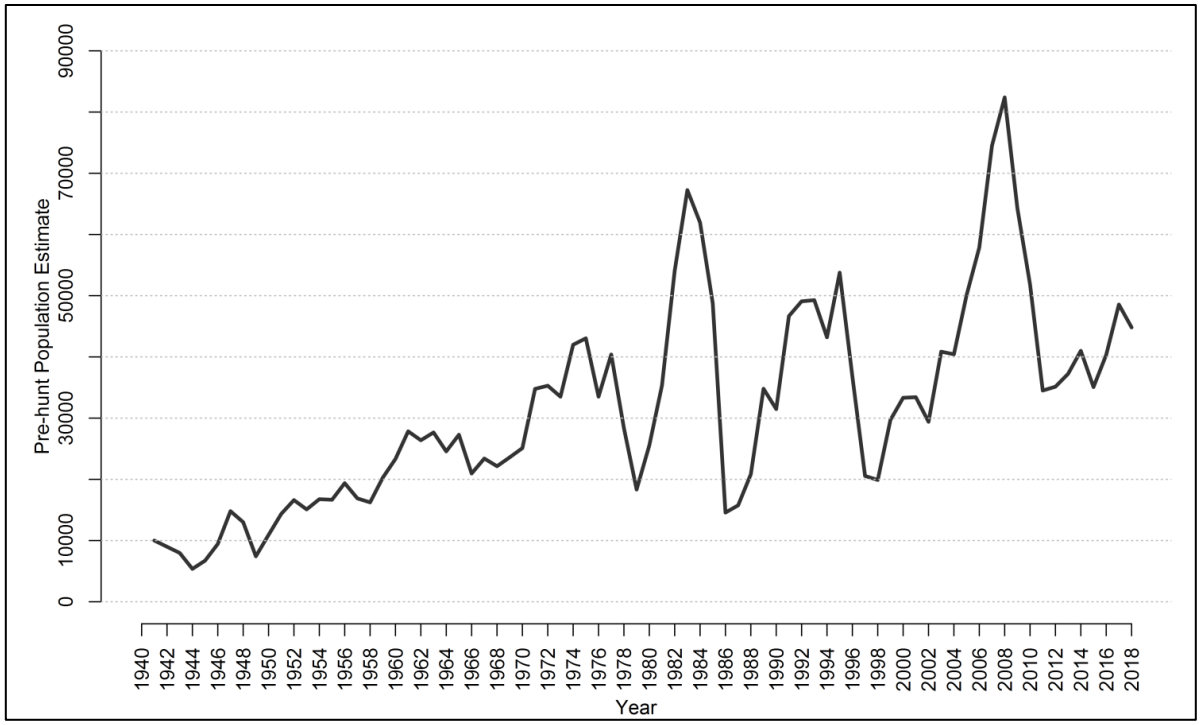


Figure 1. South Dakota pronghorn pre-hunt population estimates, 1941-2018.

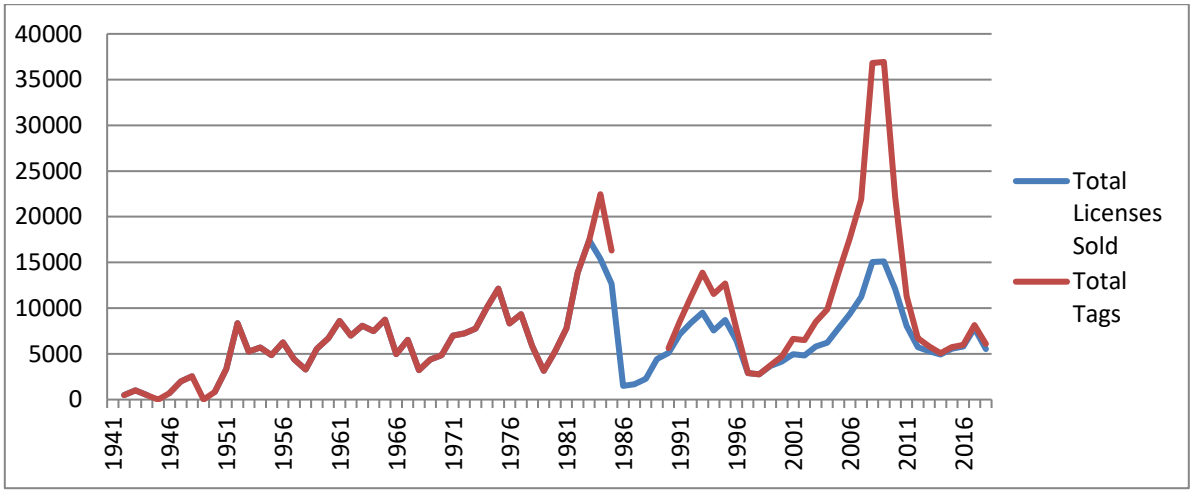


Figure 2. Pronghorn license and tag distribution, 1941-2017.

occurred in 1977 to 1979, 1984 to 1986, 1995 to 1998, and 2008 to 2011. During years of low population numbers, SDGFP decreased license/tag sales substantially (Figure 2).

During 2007 and 2008 pronghorn populations in most hunting units were above objectives and population growth rates were challenging to control exclusively through hunter harvest. Record

harvest levels during this time, combined with the impacts of the 3 consecutive severe winters (2008-2009, 2009-2010, and 2010-2011) reduced pronghorn populations below management objectives in most management units. In addition to direct winter mortality and reduced recruitment, abundance of pronghorn populations in hunting management units may also be influenced by movements of wintering herds as they migrate or disperse to avoid deep snow. This migration presumably occurred during the 2008-2009, 2009-2010, and 2010-2011 winters, which caused populations of some units in the northern range to decrease, while some populations in the southern range were stable or increased due to the influx of migrating pronghorn.

SEASON SETTING PROCESS

Managing wildlife populations within various social tolerances, hunter desires, and expectations of the general public is a challenging task. Pronghorn hunting is a popular and much awaited outdoor activity for many sportsmen and women in South Dakota. The high demand for pronghorn hunting opportunities amongst the numerous pronghorn 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 pronghorn 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 pronghorn. 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 pronghorn 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 pronghorn seasons are currently considered by the SDGFP Commission on a two-year cycle. Currently, all hunting season dates are proposed in January and finalized in March, with all other pronghorn season rules proposed in June and finalized in July.

The pronghorn 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 pronghorn hunting season recommendations by SDGFP staff. From a workload perspective, SDGFP staff spend a considerable amount of time on pronghorn management and pronghorn hunting seasons largely due to the high demand by both resident and nonresident hunters, and the challenges of finding that balance between biological and social carrying capacities. The process for the development of pronghorn hunting recommendations by SDGFP staff includes the evaluation of three groups of information: biological data, harvest data, and social data (Figure 3).

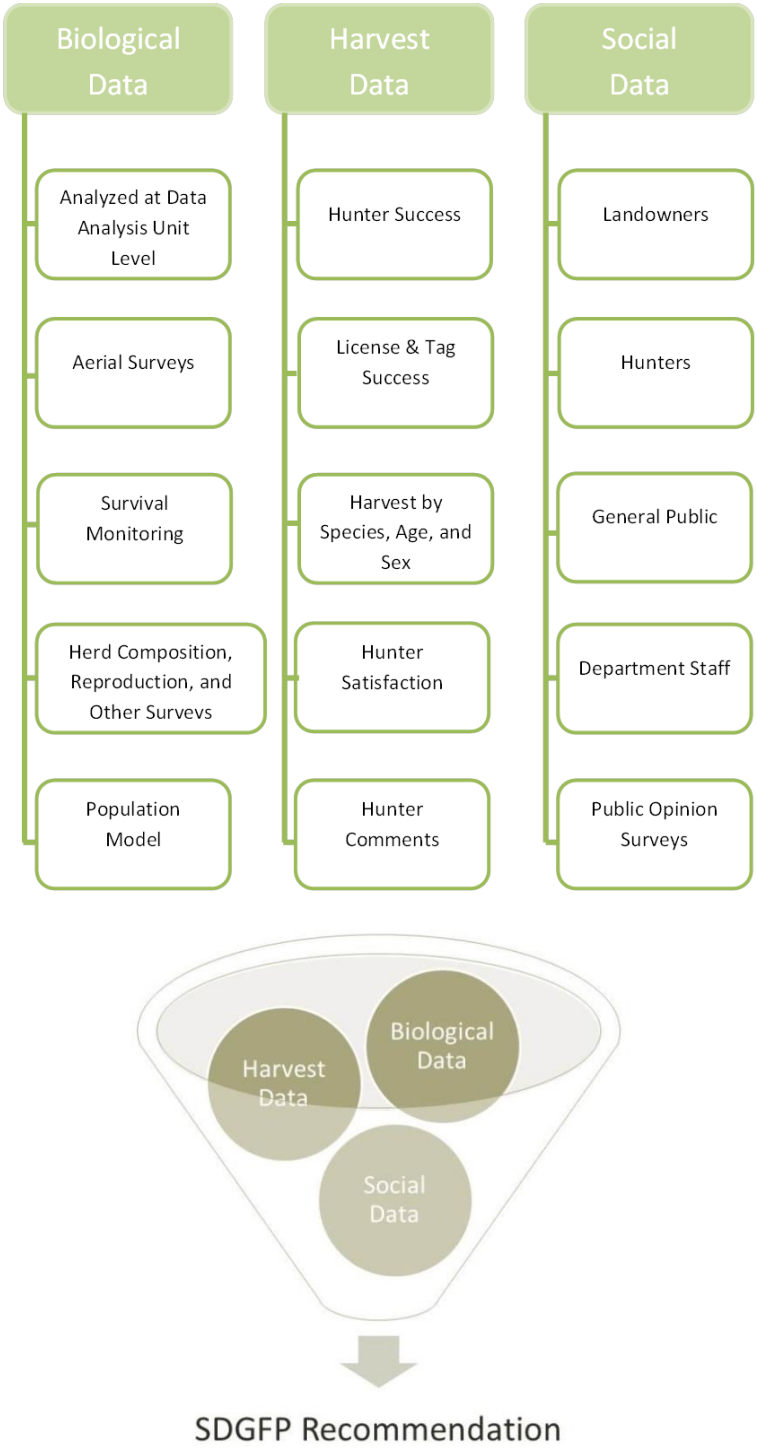


Figure 3. Simplistic model describing the process for the development of SDGFP pronghorn hunting recommendations.

As described in the *Pronghorn Population Surveys* section of this plan, pronghorn biological data are collected from aerial surveys, herd composition surveys, and survival monitoring. These data are used in a population model to assist SDGFP in determining current population abundance and trends for pronghorn across their range in South Dakota (Appendix A, Figure 4). Depending on the objectives of each biological survey, data are analyzed at the hunting unit, 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).

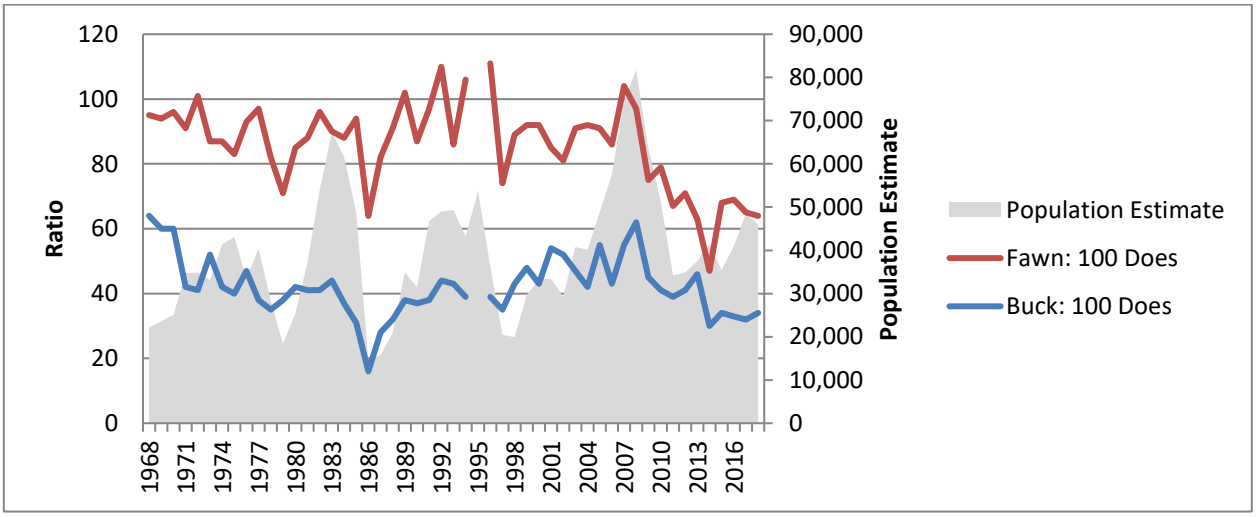


Figure 4. Pronghorn population and fawn:doe and buck:doe ratios, 1986-2018.

Harvest data, also described in the *Pronghorn 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 pronghorn seasons. Trends in hunter/tag success rates are used as a qualitative way to assess pronghorn population trends. However, success can be affected by many factors other than pronghorn 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 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 staff for review. If hunters request a follow up on a question or desire an opportunity to discuss a topic with SDGFP staff, every effort is made to follow up with these requests.

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) are used

by SDGFP to determine pronghorn population objectives. This input constructs a list of discussion topics for consideration in hunting season structures.

One of the first and most important steps in the pronghorn license recommendation process is to define a numeric population objective for each firearm hunting management unit (Appendix C). Determination of population objectives involves SDGFP staff obtaining stakeholder's opinions regarding the status of pronghorn populations within individual firearm pronghorn 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, 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 pronghorn population abundance levels, pronghorn depredation issues, landowner tolerance, hunter comments, and harvest results from the previous season. The end result is a defined quantitative management objective for each firearm management unit; staff then evaluate current pronghorn abundance estimates and define a qualitative management objective direction (i.e., substantially decrease, slightly decrease, maintain current level, slightly increase, substantially increase). The development of objective directions is important in better defining management intentions with the public and provides more transparency (Figure 5).

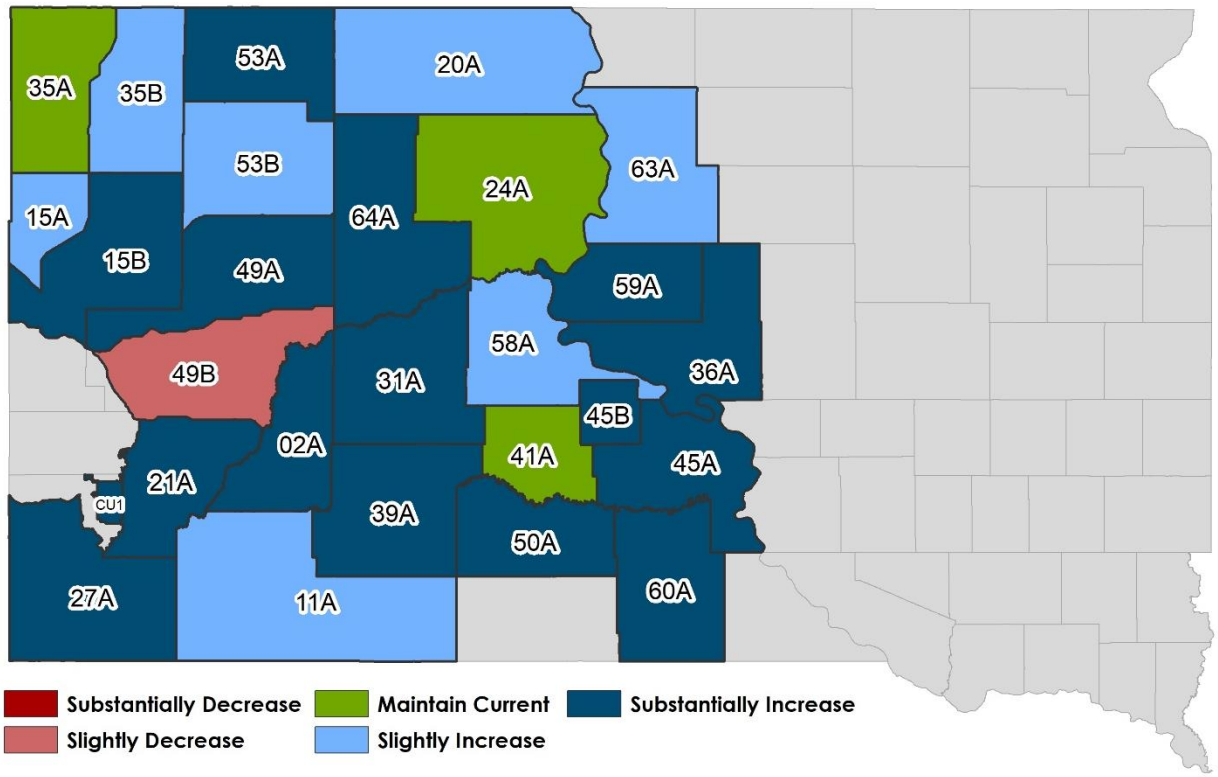


Figure 5. South Dakota pronghorn hunting unit population objectives, 2019-20.

Data Analysis Units (DAU) are described in more detail in *Pronghorn Population Surveys* section. Numeric objectives for firearm units within each DAU are summed to develop DAU objectives. Once the DAU objective is defined, Accounting-type population models are used to generate population projections for each DAU (lambda and abundance estimates) based on modeling inputs (e.g., adult female survival, aerial survey estimates, herd composition ratios). The projected (model generated) and objective lambdas are then compared, and future doe/kid harvest strategies are manipulated to achieve the desired DAU management objective. Harvest is assumed to be additive, and the number of doe/kid pronghorn added or removed from the population is calculated at the DAU level, then distributed to the unit level in accordance with the defined unit objective. Five-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 doe/kid harvest recommendations are selected for future harvest season license recommendations. This process is repeated for all pronghorn firearm management units across the state.

Each of the four SDGFP Wildlife Division administrative regions work closely with big game program staff, human dimension specialists, harvest survey coordinator, and GIS staff to assemble and present available information to regional biologists and wildlife managers, local conservation officers, wildlife damage specialists, and other staff. Each administrative region then submits a "regional recommendation" to the SDGFP Commission Recommendation and Development (CRD) group, which corresponds with appropriate harvest strategies to meet pronghorn population objectives. Comprised of regional terrestrial resources supervisors, senior biologists, and administrators, the CRD group meets 2-3 weeks before each SDGFP 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 department recommendation and presented to the SDGFP Commission in the form of an action sheet for consideration by the SDGFP 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 staff.

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 SDGFP 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.

Biennially at each SDGFP Commission meeting in June, SDGFP presents department recommendations for adoption as an official proposed rule for all pronghorn hunting seasons, except for hunting season dates which are proposed at the January SDGFP Commission meeting. The SDGFP Commission has the flexibility to change the department recommendation in any fashion they determine appropriate or to simply take no action, which results in no change to current administrative rule.

Once the SDGFP Commission adopts a formal proposal, the proposal is then open for public comment for one month or until the next SDGFP Commission meeting. SDGFP Commission proposals available for public comment can be found online at https://gfp.sd.gov/commission/information/. It is during this time that the public can review all proposals and provide comments at https://gfp.sd.gov/forms/positions/. 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 SDGFP 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 SDGFP Commission meeting following the public comment period. In addition, the Public Hearing portion of the SDGFP 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 SDGFP 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 SDGFP Commission formally adopts changes to administrative rule.

Post-SDGFP Commission Action

The final rules adopted by the SDGFP Commission are again reviewed by LRC. Final rules and minutes of the public hearing are sent to the Interim Rules Review 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 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).

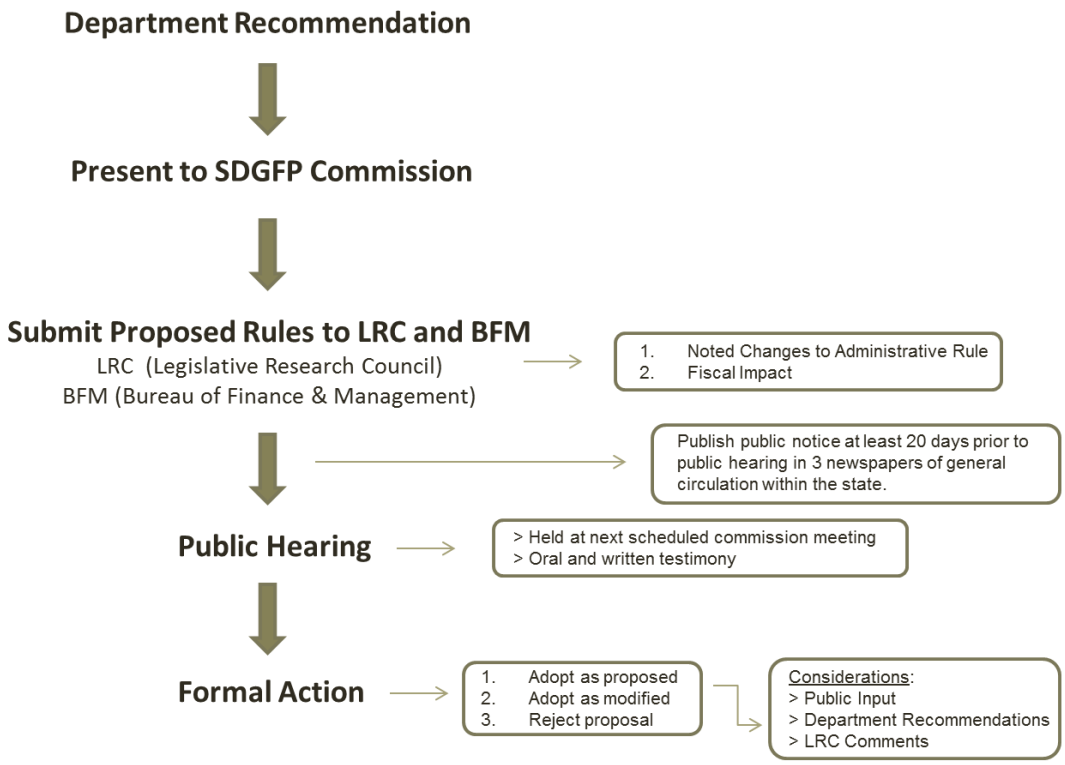


Figure 6. SDGFP Commission process for establishing hunting season regulations.

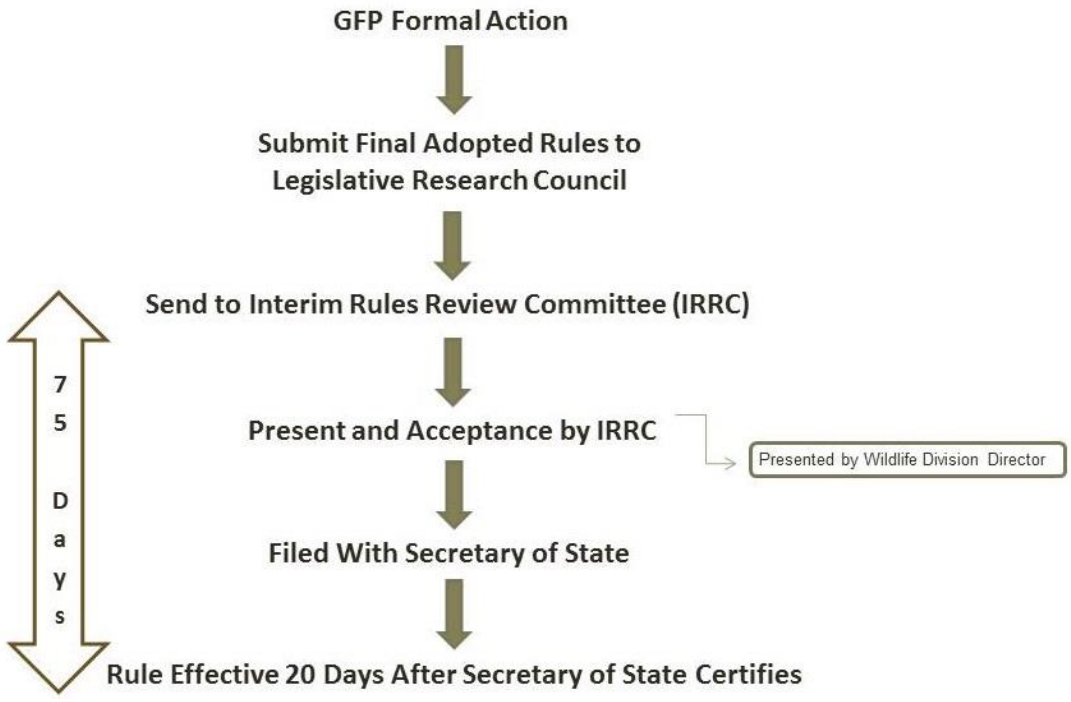


Figure 7. Post-SDGFP Commission administrative rule promulgation process

The season setting process is a very diverse process involving multiple steps from start to end. Once the formal procedure is complete, SDGFP staff 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 apply for limited-draw licenses in attempts to obtain their desired pronghorn license(s) for the upcoming fall hunting season.

PRONGHORN HUNTING

Historical Harvest

Historically, harvest on pronghorn in South Dakota is similar to many Western states. Increased homesteaders in the late 1800's led to increased hunting pressure and land use conversion. Ultimately, pronghorn populations declined drastically into the early 1900s. The ideals of Aldo Leopold's North American Model of Wildlife Conservation written in 1918, demonstrated a management method for game populations to provide a sustainable yield by hunters. Increased regulation and legislation allowed managers to gain more control over the number of pronghorn harvested each year. Pronghorn seasons were closed from 1911 to 1942 to protect the small remaining population in the state. License sales and harvest records have been collected and monitored since 1942 (Appendix A). Annual pronghorn seasons have continued to present day, with the exception in 1945 and 1949 being closed.

Hunting Seasons

The 2017 archery season for antelope was open August 19-October 31, except when the firearm antelope season is open. There were unlimited statewide "any antelope" licenses available to resident and non-resident hunters, with 2,090 sold in 2017. The 2017 firearm season was open September 30-October 15 and a total of 5,083 licenses (of which: 2% were available to non-residents) were available. The CSP antelope season was closed in 2017. Unit distribution and identification is provided in Appendix D.

Firearm hunter success has gradually declined from historic levels. Small declines in success are sometimes observed after a high pronghorn population year, when increased numbers of licenses and tags are available (sometimes including double and triple doe tags issued for one license; Figure 8). Increased harvest, along with major winter weather events, often brings the population nearer objective levels. From 2009 to 2017, firearm hunter success has increased from a historic low of 44% to 64%. Further information on harvest and license sales can be found in the *Harvest Survey* section.

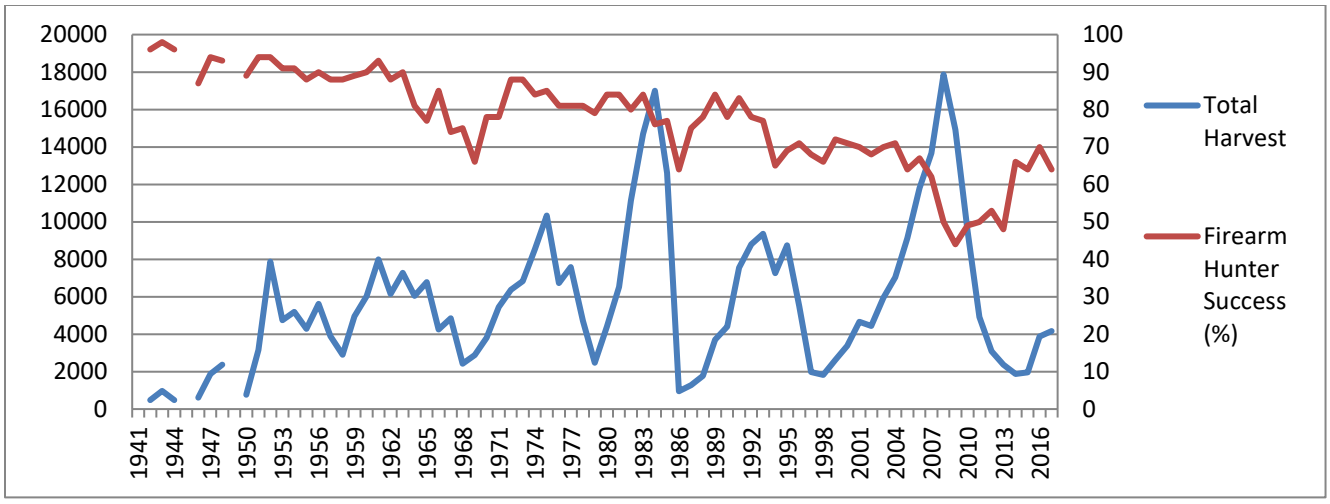


Figure 8. Pronghorn firearm season harvest and hunter success, 1941-2017.

Landowner Licenses and Preference System

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

Landowner-own-land License

Resident landowners/operators, including any immediate family living at home, who have not already been issued a pronghorn license that allows the harvest of a buck, may purchase a reduced-price license to hunt on their own land. 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 landowner-own-land licenses can be found in Table 1.

> ***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 1. Harvest statistics for landowner-own-land licenses, 2008-2017.

Year	Licenses Sold	Tags Sold	Adult Bucks	Adult Does	Buck Fawns	Doe Fawns	Total Pronghorn	Hunter Success	Tag Success
2008	301	462	179	74	4	14	271	70%	59%
2009	309	468	152	58	8	7	224	56%	48%
2010	299	479	121	66	6	3	196	54%	41%
2011	276	423	83	47	7	4	141	42%	33%
2012	233	354	98	42	5	6	150	55%	42%
2013	234	365	60	30	9	0	99	31%	27%
2014	268	392	136	37	7	2	183	56%	47%
2015	302	466	126	57	4	9	197	52%	42%
2016	314	493	139	76	9	8	232	56%	47%
2017	350	536	158	68	5	9	240	55%	45%

*One hunter can have multiple tags valid for one license.

Landowner Preference

Since 1975, up to 50% of all allocated licenses in each pronghorn hunting unit during the first lottery drawing for the pronghorn firearm season are made available to qualifying landowners 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 2009-2017, the fewest amount of “any antelope” licenses (license type that allows the harvest of a buck) issued to those meeting landowner preference was 5.1% in 2008, with the greatest percent of 15.5% in 2015 (Table 2).

> ***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.*

In summary, there is one license type (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 firearm pronghorn season, is also available to qualifying landowner/tenants and provides an advantage to these applicants against those with the general public. Table 3 illustrates the differences between these various options for landowner/tenants and the respective restrictions or conditions.

Table 2. Resident “any antelope” licenses and landowner preference statistics, 2008-2017.

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
# of Issued Resident “any antelope” Licenses	8,709	6,006	4,141	2,996	2,982	2,703	2,960	2,951	3,868	3,869
# Issued to Landowner Preference	446	410	399	393	395	337	360	458	242	433
Percentage Issued to Landowner Preference	5.1%	6.8%	9.6%	13.1%	13.2%	12.5%	12.2%	15.5%	11.0%	11.2%

Table 3. Pronghorn license options available to qualifying landowners.

License Comparison	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.
Landowner Eligibility Requirements	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	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; 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 an “any antelope” or a double tag license valid for one “any antelope” and one “any antlerless antelope”. *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 antelope hunting season.
License Fee	50% of regular license fee	Regular license fee

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

Pronghorn Hunter Profile

Since 2010, pronghorn hunter satisfaction ratings have ranged from slightly satisfied to moderately satisfied and has remained fairly consistent. Satisfaction is measured on a 7-point Likert Scale where: 1 is Very Dissatisfied; 2 is Moderately Dissatisfied; 3 is Slightly Dissatisfied; 4 is Neither Dissatisfied nor Satisfied; 5 is Slightly Satisfied; 6 is Moderately Satisfied; and 7 is Very Satisfied. The category breakdown for interpreting the mean satisfaction score is: 1.00 to 1.86 is Very Dissatisfied; 1.87 to 2.73 is Moderately Dissatisfied; 2.74 to 3.60 is Slightly Dissatisfied; 3.61 to 4.47 is Neither Dissatisfied nor Satisfied; 4.48 to 5.34 is Slightly Satisfied; 5.35 to 6.21 is Moderately Satisfied; and 6.22 to 7.0 is Very Satisfied.

The average satisfaction rating for archery pronghorn hunters has slowly increased since 2010. The average satisfaction rating ranged from 4.63 in 2010 to 5.33 in 2016 indicating archery hunters were slightly satisfied with their overall hunting experience. In 2017, archery pronghorn hunters' overall satisfaction rating (5.44) increased on average to moderately satisfied (Huxoll 2018). Firearm pronghorn hunters' overall satisfaction has remained consistent over recent years. The average satisfaction rating ranged from 4.69 in 2010 to 5.26 in 2017. Across the past 8 years, firearm hunters have indicated they were slightly satisfied with their overall pronghorn hunting experience, with the exception of 2017 when the average satisfaction (5.42) was moderately satisfied (Huxoll 2018).

Similar to hunters' satisfaction ratings, the archery and firearm hunter effort indices have remained fairly consistent since 2010. During this time, average days hunted has fluctuated from a low of 3.77 to a high of 4.18. In 2017, archery pronghorn hunters' averaged 4.0 days hunted (Huxoll 2018). Firearm pronghorn hunters averaged half as many days hunting during this same time period. Over the past 8 years, firearm pronghorn hunters averaged 2 days hunted, with days hunted ranging from 1.76 to 2.49. In 2017, firearm hunters averaged 2.22 days hunted (Huxoll 2018).

HUNTER ACCESS

In 2018, over 4.75 million acres were open to public hunting access, which accounted for 10% of South Dakota. The majority of this publicly accessible land (over 2 million acres) is managed by the U.S. Forest Service, of which approximately 917,000 acres contain pronghorn habitat in the form of national grassland designation. Other public lands included portions managed by the U.S. Bureau of Land Management (BLM; 274,000 acres), U.S. Fish and Wildlife Service (USFWS; 150,000 acres), SD Office of School & Public Lands (SDSPL; 750,000 acres), and SDGFP (281,000 acres; Figure 9). A large portion (over 1.2 million acres) of publicly accessible land was leased by SDGFP in 2018 from private landowners through the Walk-In Area (WIA) program (Figure 10); of which approximately 990,000 acres were in the pronghorn range west of the Missouri River. Land leased as WIA received up to $13/acre in 2018, depending on where it was located in the state, the amount of hunting opportunity provided, and the quality of habitat. For example, most WIAs in the western part of the state are rangeland and received ≤$1/acre, while many WIAs in central and eastern South Dakota,

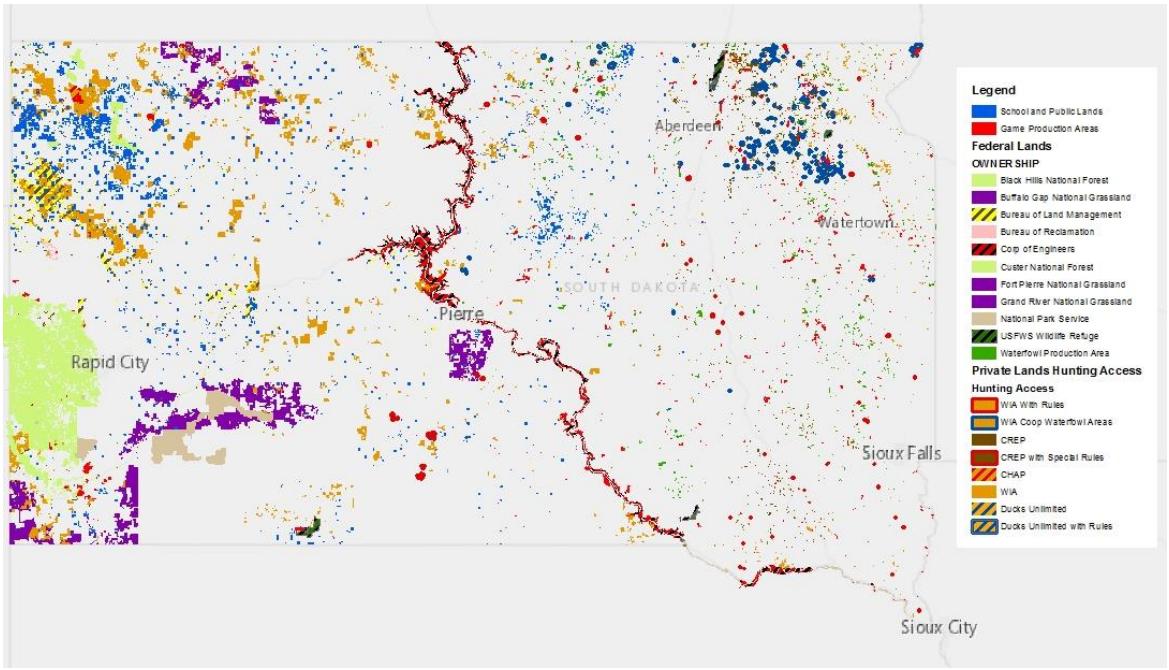


Figure 9. Hunter access land ownership distribution, 2018.

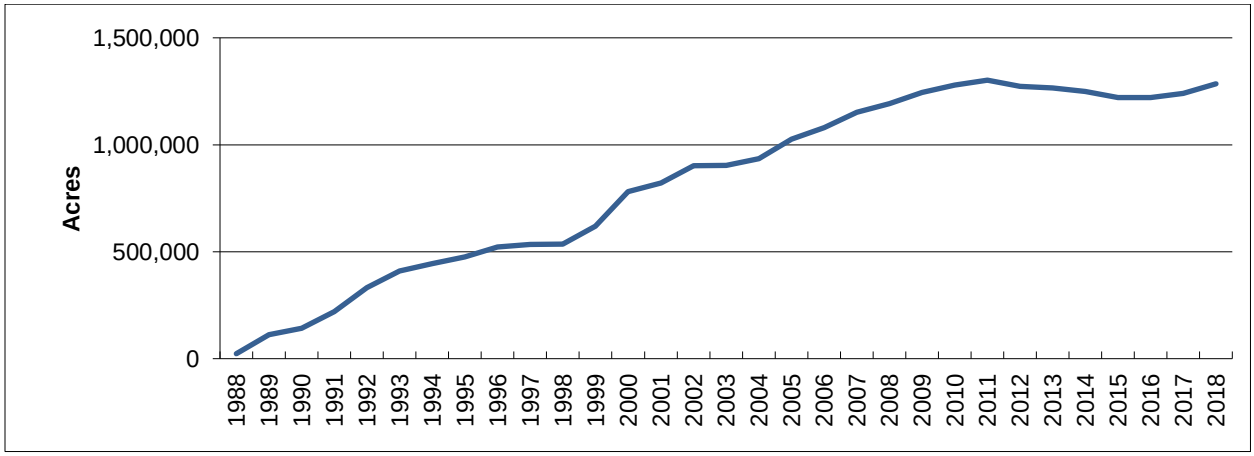


Figure 10. Number of Walk-In Area public hunting access program acres enrolled, 1988-2018.

primarily enrolled in Conservation Reserve Program (CRP), received $6/acre. All types of hunting during legal hunting seasons are allowed on the majority of WIA lands.

SDGFP also leased land for pronghorn and other game hunting opportunities through the Controlled Hunting Access Program (CHAP). In 2018, CHAP program consisted of 23,000 acres and paid between $6 and $10/hunter day. If the private landowner provided access to >1,000 acres of land, an additional $250 payment was made. The range in pay/hunter day was dependent on how many

restrictions were placed on the CHAP area. If a CHAP was open to all hunting it received 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 Global Positioning System (GPS) units, and on maps within the SDGFP Android and Apple smartphone applications. Lands owned and leased by SDGFP for public hunting access are also posted with appropriate signs.

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 was largely due to the sale of hunting licenses, habitat stamps, and similar permit types purchased by hunters. In 1937, the Federal Aid in Wildlife Restoration Act, also known as the Pittman-Robertson Act (PR), became law. The revenue generated through PR comes from an excise tax on the sale of firearms, ammunition and other hunting related items. This revenue is apportioned to state wildlife agencies by the USFWS for conservation efforts, hunter education and shooting programs. State wildlife agencies like SDGFP, can use 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 funded by SDGFP through the sale of license fees collected from hunters. Without this federal excise tax state wildlife agencies would be very financially limited.

Many local businesses such as gas stations, restaurants, motels, and sporting goods stores substantially rely on economic benefits from outdoor recreationists such as pronghorn 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 pronghorn hunters and other outdoor recreationists.

Since 1955, the U.S. Department of the Interior and the U.S. Department of Commerce has 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 pronghorn hunting, only results from the 2006, 2011 and 2016 national surveys are reported herein (USFWS 2006, 2011, 2016). Survey results reported average dollars spent per big game hunter, combined for both resident and

nonresident pronghorn hunters. Categorical expenditures for big game hunting included: food and lodging, transportation, other trip costs, and equipment. Average expenditure per big game hunter in 2006, 2011 and 2016 were $412, $464 and $675, respectively. A 3% annual inflation rate was used as an adjustment factor between survey years. Ideally, a report of expenditures separated by residents and nonresidents would be desired; thus, the estimated expenditures in Table 4 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 not specific to big game or pronghorn hunting. Pronghorn hunting does leave an economic footprint in South Dakota, with expenditures of resident and nonresidents in 2017 estimated at $4 million and $0.5 million, respectively. Estimated pronghorn hunting economics are reported in Table 4.

Estimated expenditures of pronghorn hunters while hunting in South Dakota were obtained from the US Fish and Wildlife Service National Survey of Fishing, Hunting and Wildlife-Associated Recreation-South Dakota (USFWS 2006, 2011, 2016) and adjusted for an annual inflation rate of 3%.

While national surveys of economic impacts of fishing, hunting and wildlife-associated recreation have comprehensive and long-term datasets, response rates and sample sizes are often limited and results may have large uncertainty. In addition, some of the information is not specific enough to make inferences for state wildlife agencies.

Table 4. Number of unique resident and nonresident pronghorn hunters and estimated expenditures while pronghorn hunting in South Dakota, 2008-2017.

Year	Number of Unique Hunters			Estimated Dollars Spent by Unique Hunters		
	Resident	Nonresident	Total	Resident	Nonresident	Total
2008	10,117	1,554	11,671	$4,422,048	$679,239	$5,101,287
2009	11,104	1,945	13,049	$4,999,060	$875,646	$5,874,706
2010	8,973	1,424	10,397	$4,160,867	$660,323	$4,821,189
2011*	6,285	761	7,046	$2,916,240	$353,104	$3,269,344
2012	4,645	255	4,900	$2,219,938	$121,870	$2,341,808
2013	5,147	280	5,427	$2,533,650	$137,832	$2,671,482
2014	3,642	415	4,057	$1,846,586	$210,416	$2,057,002
2015	4,045	432	4,477	$2,112,445	$225,606	$2,338,051
2016*	4,183	460	4,643	$2,823,525	$310,500	$3,134,025
2017	5,765	656	6,421	$4,008,116	$456,084	$4,464,200

*Indicates year with new survey data reported by the USFWS. Years in between surveys adjusted for an annual inflation rate of 3 percent.

Non-Consumptive Use

A significant amount of time is dedicated to the design and implementation of pronghorn management and harvest seasons, but many residents and visitors also enjoy viewing pronghorn 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% of the U.S. population ≥16 years of age (72 million people) 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 enjoyed observing, feeding or photographing wildlife. Wildlife watching has a significant impact on the nation's economy and generated approximately $54.9 billion in 2011. Most of the money generated from non-consumptive users was related to wildlife equipment and trips related to wildlife and wildlife viewing. Participants bought equipment such as binoculars, cameras, trail cameras, wildlife food, camping equipment, off-road vehicles, and wildlife organization memberships 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 the residents (49%) reported they have taken trips sometime in their lifetime for which fish and wildlife viewing was the primary purpose. 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 (83%) of residents who reported taking a trip primarily for wildlife viewing 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 indicated that South Dakota citizens place a relatively high value on having healthy populations of fish and wildlife. About 80% of the citizens felt that fish and wildlife were 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 have recently increased. There are many website 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.

PRONGHORN POPULATION SURVEYS

South Dakota has the 5th largest pronghorn population in North America with an estimated 47,700 animals in 2017 (Schroeder 2018). Growth rates of pronghorn populations are highly influenced by annual survival of adult does and fawn recruitment rates, which can fluctuate substantially from year to year and area to area. Therefore, annual management surveys are critical to properly assess abundance and trends of populations and ultimately drive management decisions to reach population objectives. Numerous surveys are completed by SDGFP to manage this important resource for both consumptive and non-consumptive users.

Pronghorn surveys in South Dakota include hunter harvest surveys, spring aerial surveys, fall herd composition surveys, and survival monitoring for 27 pronghorn game management units within seven DAUs that comprise the state's pronghorn range (Appendix A, Appendix B; Figure 11). Survey data are annually compiled and analyzed in a population model to estimate pre-season population abundance for each hunting management unit.

Data Analysis Units

South Dakota Game, Fish and Parks recently completed a cooperative project with the University of Montana resulting in development of Data Analysis Units (DAUs) for deer management in South Dakota. The results of this project are applicable to pronghorn and provide a solid foundation for robust future pronghorn data analyses. A DAU is defined as an aggregate of management units large enough to account for auto-correlated (i.e., spatial and temporal serial correlation) 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 potentially large amounts of heterogeneity may exist in animal abundance within a DAU because of factors that can be controlled by fine scale (i.e., game management unit) 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, pronghorn vital rate estimates and their variation over time would be used to assign management units to a DAU, 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. The process described here was used to develop DAUs for deer management, but because population dynamics of deer and pronghorn populations are likely influenced by similar biotic and abiotic factors, the resulting DAUs are used for pronghorn management as well. A hierarchical cluster analysis technique was used to find similarity among units. This technique identified 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 evaluated for

each analysis based on abiotic and biotic factors potentially impacting pronghorn ecology across South Dakota. The hypothesis chosen included factors aimed at describing the general biological potential of an area. Covariates included (Nowak and Lukacs, unpublished):

- Fall snow- which serves as a surrogate to the end of the growing season and may affect pronghorn overwinter survival.
- Spring snow- has a similar effect on overwinter survival as Fall snow, but acts more directly as a mortality factor by increasing feeding energy required for already weakened pronghorn with minimal reserve fat stores.
- Precipitation- plays a role in the productivity of the vegetative communities.
- Temperature- also included because of its role in controlling vegetative communities and the productivity of those communities.
- Net Primary Productivity- measure of the actual productivity of vegetative communities in each management unit.
- Agriculture- course scale measure of agriculture to account for human altered landscapes.
- Vegetative layer- a measure of the vegetative communities available.
- Canopy Cover- a measure of the over story canopy affecting the availability of forage.

As emphasized in the DAU definition, 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 input from expert opinion. The final product of the cluster analysis and expert opinion resulted in 7 pronghorn DAUs (Figure 11).

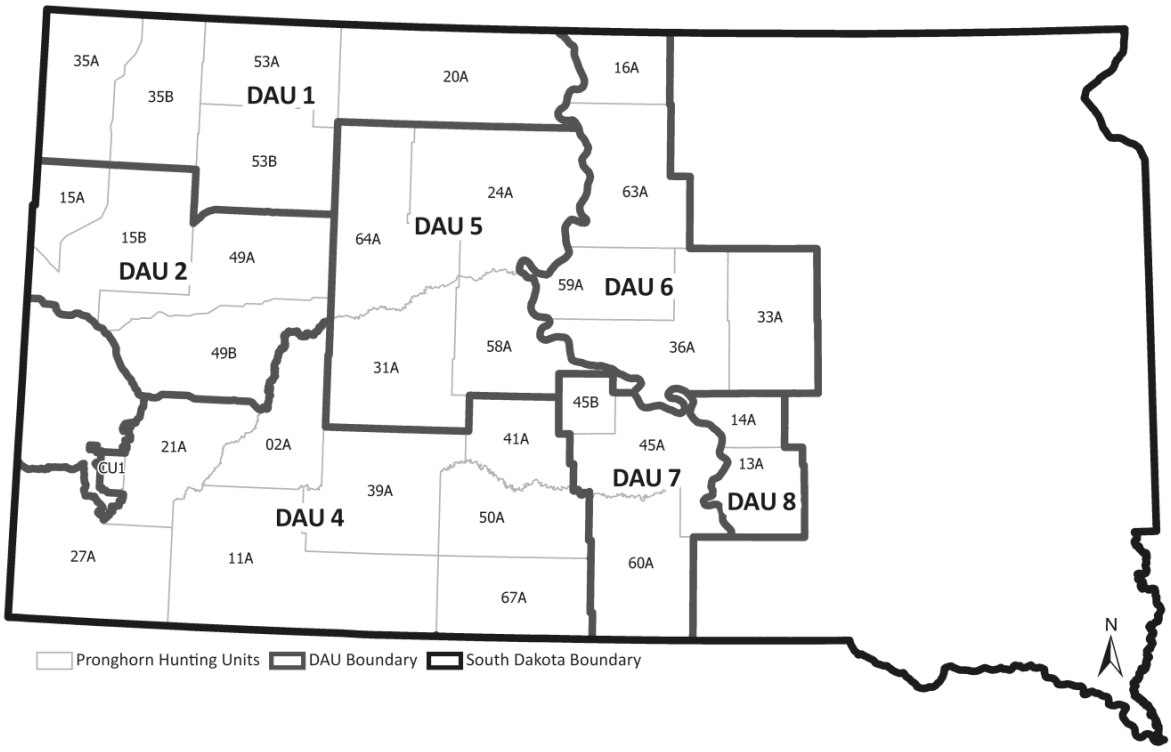


Figure 11. Data Analysis Units (DAUs) for pronghorn management in South Dakota, 2018.

Harvest Surveys

Hunting is the primary tool used for maintaining population densities at acceptable social carrying capacities. The SDGFP has developed several regulated hunting seasons in South Dakota to provide recreational opportunities to harvest pronghorn and to ensure adequate and appropriate harvest levels to meet established population objectives.

The pronghorn hunter harvest survey is conducted annually via mailed report cards (Appendix E) and emailed surveys. Currently, hunters are surveyed for each pronghorn season available; firearm, archery, landowner, mentored youth, and CSP. Hunter survey cards are mailed to a statistically representative sample of license holders to estimate hunter success, pronghorn harvest and related information for each season (Appendix A). Sampling intensity is dependent on hunting season, number of licenses sold, and license types available. Randomly selected hunters receive a survey card or email at the end of the season. Non-respondents receive up to 3 subsequent mailings/emails at 12-14 day intervals to maximize response rates and precision, in addition to limiting non-response bias. The minimum response rate target has been established as 85%, providing harvest estimates ±15% of the mean.

<u>Firearm Pronghorn</u>

During the 2017 Firearm pronghorn hunting season 4,965 resident licenses were available by lottery application. Licenses which permitted landowners to hunt only land they owned or leased were unlimited. A total of 5,286 licenses were sold (Table 5; Figure 12), representing a total of 5,933 tags.

The 2017 season was open 16 days from September 30-October 15. A random sample of 3,655 hunters was taken from total license sales, and 2,879 surveys were returned for a 79% response rate. Approximately 69% of email surveyed hunters responded. Respondents reported hunting an average of 2.22 days each. Of those responding, 6.6% reported they did not hunt at all in 2017. Average hunter satisfaction was 5.26, based on a numerical scale from 1 (very dissatisfied) to 7 (very satisfied), 4 being neutral. Harvest projections are derived by statistically applying the responses returned from the surveys delivered to a sample of the hunting population and extrapolating it to the entire population of hunters for each hunting unit.

Projected harvest for the 2017 season was 2,531 adult bucks, 963 adult does, 161 buck fawns, and 130 doe fawns for a total of 3,785 pronghorn (Table 5; Figure 12). Projected overall success for the season was 64%. Harvest and success have increased above levels in 2013 (Figure 12). Harvest densities were greatest in the northwest and southwest units of the state (Figure 13).

Table 5. Firearm pronghorn harvest summaries, 2010-2017.

Year	License Sold		Harvest			Success	Avg. Days Hunted	Avg. Satisfaction
	Resident	Nonres	Males	Females	Total			
2010	8,806	969	3,932	5,017	8,949	49%	2.49	4.69
2011	5,752	457	2,523	1,971	4,493	50%	2.18	4.54
2012	3,965	0	1,695	942	2,637	53%	2.05	4.79
2013	3,467	0	1,454	480	1,935	48%	1.76	4.72
2014	2,991	61	1,770	314	2,083	66%	1.99	5.12
2015	3,260	62	1,910	314	2,224	64%	2.08	5.23
2016	3,266	62	2,112	350	2,461	70%	2.04	5.42
2017	5,286	146	2,692	1,093	3,785	64%	2.22	5.26

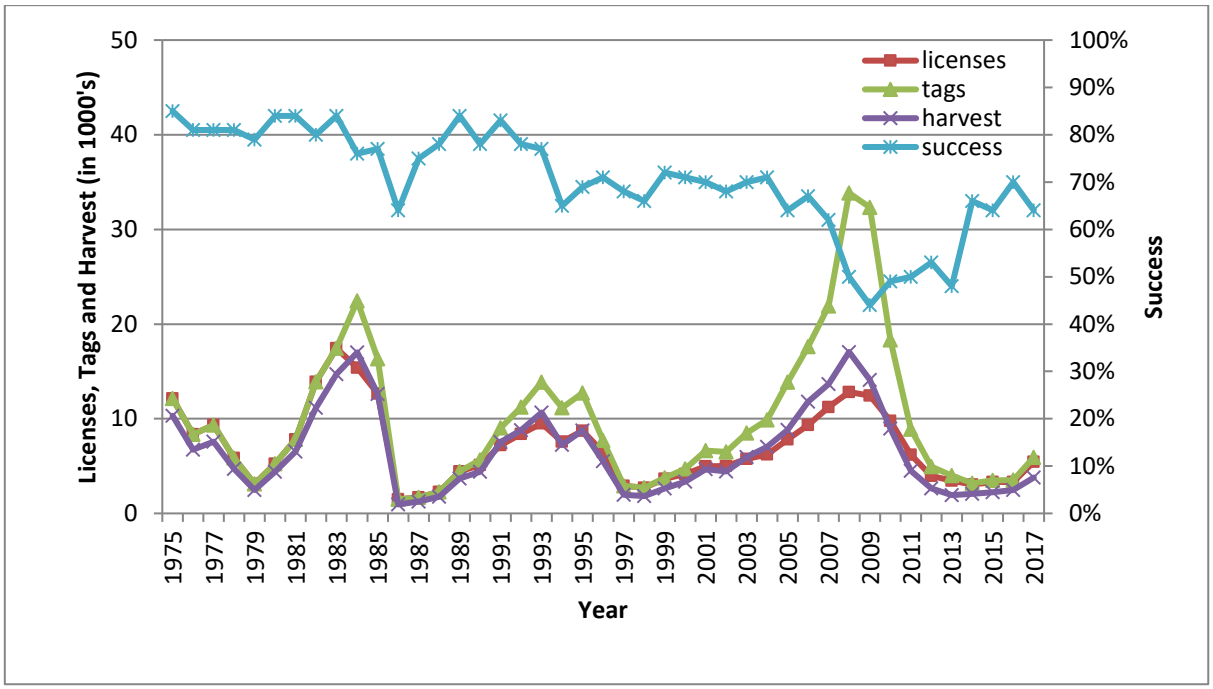


Figure 12. Firearm pronghorn harvest survey results, 1976-2017.

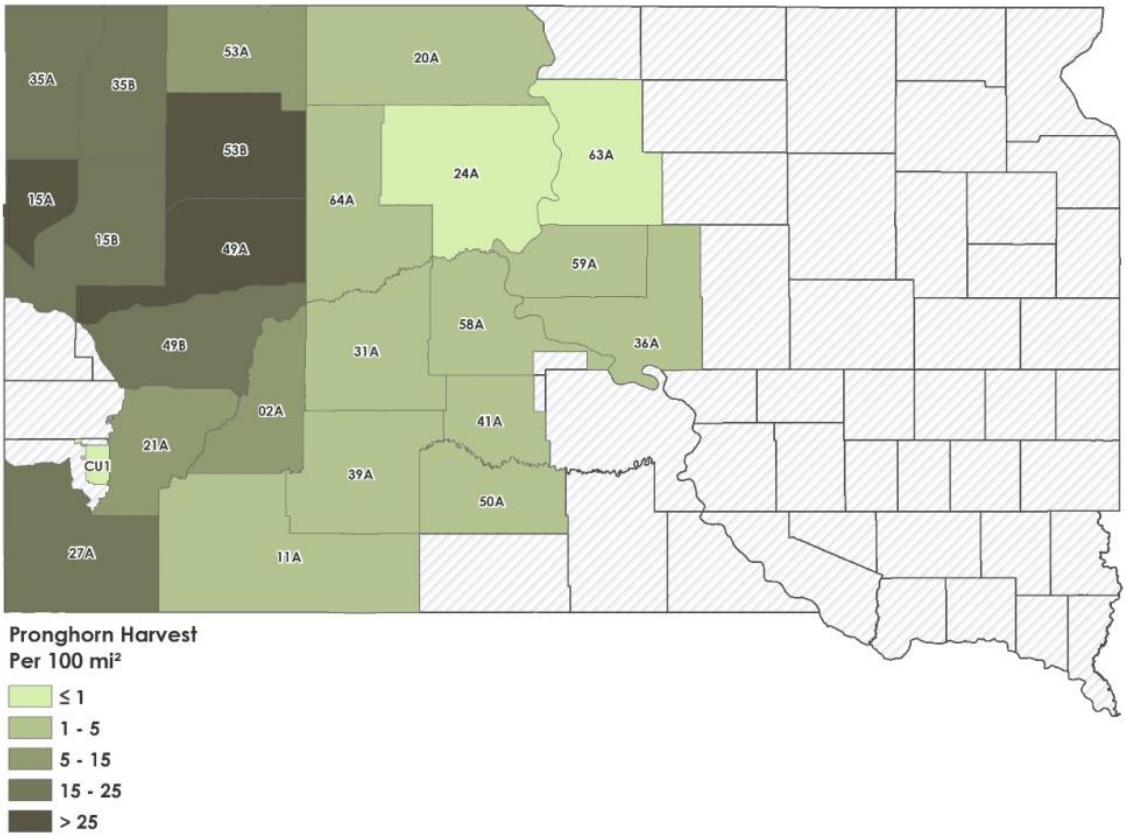


Figure 13. Distribution of pronghorn harvest during the 2017 firearm season for each game management unit in South Dakota.

Custer State Park Pronghorn

The 2016 CSP pronghorn harvest season was open October 11-19. One-thousand two-hundred and twenty-three applications were received for the 3 available licenses. Each license holder received either an electronic or paper harvest survey and all 3 responded, each harvesting a mature buck and averaging 1.3 days of hunting. Hunter satisfaction was based on a numerical scale from 1 (very dissatisfied) to 7 (very satisfied) and averaged 7.00 for the season. The season was closed in 2017 (Table 6).

Archery Pronghorn

In 2017, 2,090 single-tag archery pronghorn licenses were issued (1,569 resident and 521 nonresident; Table 7). All license holders were sampled for the harvest survey, and the response rate was 73%, with a 71% email response rate.

Overall success rate for the archery season was estimated at 28%, with 508 bucks, 46 does, 21 buck fawns, and 6 doe fawns harvested. Archery harvest peaked in 2008, decreased for several years, and is beginning to return to near peak levels (Figure 14). The archery season was open August 19 to October 31, except when and where a state firearm pronghorn season was open (September 30

to October 15). Of the 23 management units where pronghorn harvests were reported, the Harding and Butte units accounted for just over 53% of all harvest (Figure 15).

Average hunter satisfaction was 5.44 and was based on a numerical scale from 1 (very dissatisfied) to 7 (very satisfied), 4 being neutral.

Table 6. Custer State Park harvest summaries, 2011-2017.

Year	Apps	Licenses	Harvest			Success	Avg. Days Hunted	Avg. Satisfaction
			Bucks	Does	Total			
2011	1,170	3	3	0	3	100%	1.3	NA
2012	916	3	3	0	3	100%	1.3	NA
2013	995	3	3	0	3	100%	1	NA
2014	1,086	3	3	0	3	100%	2	6
2015	1,223	3	3	0	3	100%	1.7	6.67
2016	1,243	3	3	0	3	100%	1.3	7
2017		Season Closed			0			

Table 7. Archery pronghorn harvest summaries, 2008-2017.

	Licenses Sold		Harvest		Success	Avg. Days Hunted	Avg. Satisfaction
Year	Resident	Nonresident	Bucks	Does			
2008	1,599	614	657	157	27%	4.42	5.48
2009	1,713	686	516	189	16%	4.47	4.75
2010	1,490	503	363	87	13%	4.13	4.63
2011	1,246	309	281	56	16%	4.18	4.48
2012	1,212	255	297	22	22%	3.8	4.74
2013	1,164	280	292	38	23%	3.77	4.97
2014	1,165	354	356	28	25%	3.94	5.19
2015	1,372	372	411	52	27%	4.07	5.26
2016	1,523	400	466	42	26%	3.8	5.33
2017	1,569	521	529	52	28%	4	5.44

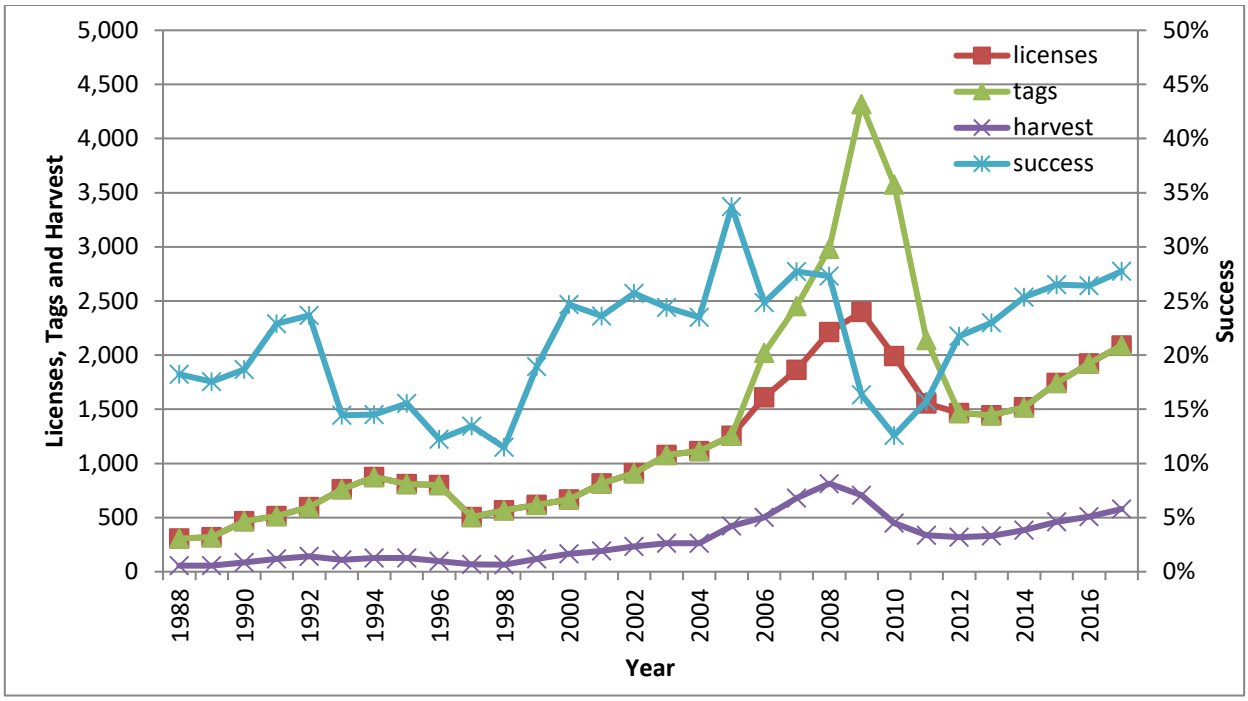


Figure 14. Archery pronghorn harvest survey results, 1988-2017.

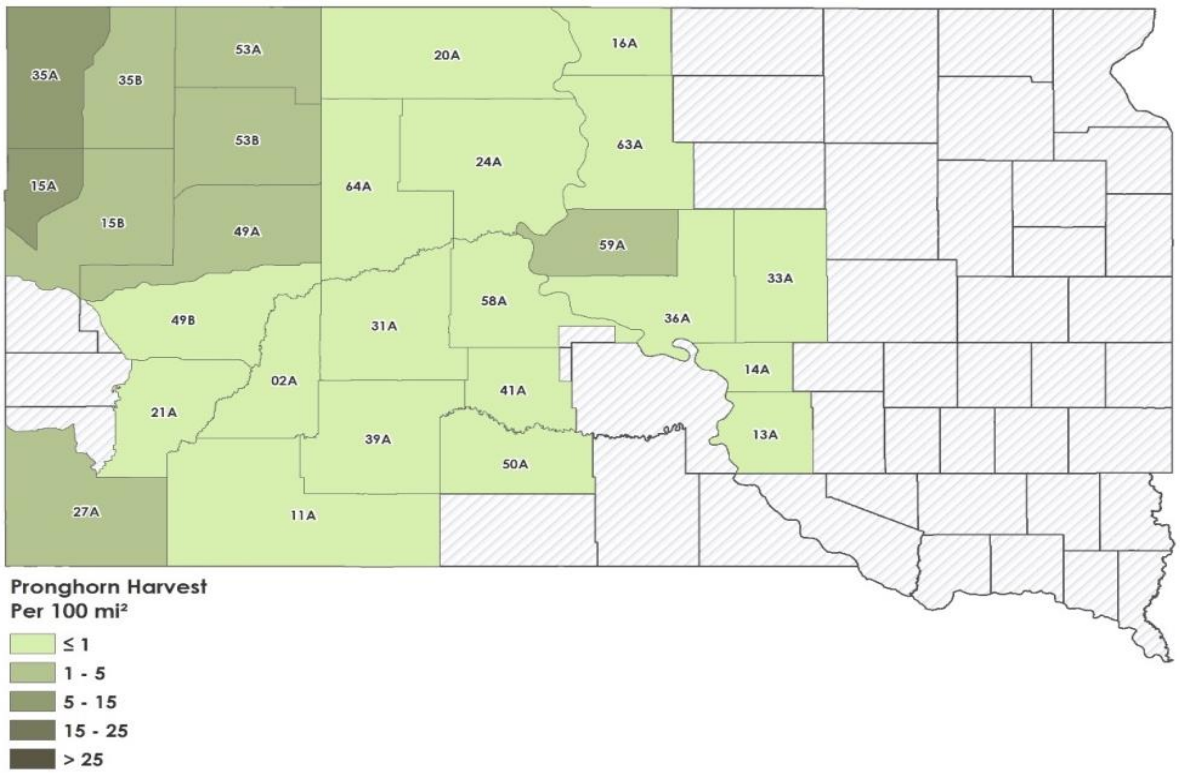


Figure 15. Distribution of pronghorn harvest during the 2017 archery season for each game management unit in South Dakota.

Mentored Youth Pronghorn

The 2017 Mentored Youth pronghorn hunting season had 629 resident single-tag doe/kid licenses issued for the 2017 Mentored Youth pronghorn hunting season (Table 8). All mentors/hunters were sampled and 441 responses (70%) were received from a combination of email and paper surveys.

The Mentored Youth licenses were valid during the Archery and Firearm Pronghorn seasons. The Archery season was open from August 19 to October 31, except when and where a state firearm pronghorn season was open. The Firearm Pronghorn season was open 16 days from September 30 to October 15. Respondents reported hunting an average of 1.79 days each.

Hunter survey projections for the season estimated a total of 36 buck fawns, 244 doe adults and 26 doe fawns were harvested. Estimated total harvest for the Mentored Youth pronghorn season was 305, and the overall success rate was 49%. The four units with the highest reported harvest were Butte/Lawrence (15B), Harding W (35A), Perkins S (53B), and F River/Custer SW (27A). The average satisfaction rating for those responding (1 being very dissatisfied and 7 very satisfied) was 5.64.

Table 8. Mentored Youth pronghorn harvest summaries, 2008-2017.

YEAR	Licenses Sold	Harvest				Success	Avg. Days Hunted	Avg. Satisfaction
		Buck fawns	Doe					
			Adults	fawns	Total			
2008	172	10	68	6	84	49%	1.96	5.87
2009	280	12	82	14	107	38%	1.85	4.96
2010	319	16	91	14	121	38%	1.88	5.15
2011	273	17	67	3	87	32%	1.5	5.31
2012	316	15	101	11	128	40%	1.61	5.66
2013	350	14	80	14	108	31%	1.32	5.35
2014	361	16	126	22	163	45%	1.58	5.58
2015	493	32	165	32	230	47%	1.71	5.72
2016	538	28	225	14	267	50%	1.83	5.72
2017	629	36	244	26	305	49%	1.79	5.64

Aerial Surveys

A fixed-wing aircraft inventory of South Dakota's pronghorn population was first initiated in 1941. A review of this aerial survey method in 1951 suggested a sample of one-third of the unit (where pronghorn density was about 1/mile^2), with observers counting pronghorn up to one-quarter mile perpendicular to each side of the aircraft, usually produced population estimates with an error ≤10% (Bever 1951). A subsequent report (Robbins 1964) similarly suggested that one-third of the units should be sampled when pronghorn densities are ≥1/mile^2, and further recommended half of

the unit should be flown when densities are between 0.30 to 0.99/mile^2, and the entire unit if densities are <0.3/mile^2.

Spring adult pronghorn estimates are generated biennially through aerial surveying procedures. The survey is conducted from May to mid-June, during spring vegetative green-up. A fixed–winged aircraft is flown at speeds <100 mph, and altitudes between 100 to 200 feet above ground level. In units west of the Missouri River, aerial strip transects are flown 1.5 miles apart, with transect widths of 0.5 miles. Two observers (one being the pilot) record and classify all adult pronghorn (neonates are not counted) observed ≤0.25 miles of each side of the aircraft. Results from sampled areas (an approximate systematic third of each unit) are used to estimate pronghorn densities in un-sampled areas (Figure 16). In units east of the Missouri River, the entire area is surveyed, but transect widths are increased to 1 mile. No sightability correction factor is used to account for potential pronghorn missed during the survey, resulting in an assumption of 100% detection probability. If detection probability is less than 100%, total population estimates will be biased low.

A ratio estimator was used to estimate the total population $(\hat{\tau})$ and variance $\left(\widehat{var}(\hat{\tau})\right)$ for each hunting unit (Caughley 1977, Thompson 2002):

$$\hat{\tau} = \frac{\sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} M_i} M;$$

$$\widehat{var}(\hat{\tau}) = \left(\frac{nM}{N\sum_{j=1}^{n} M_i}\right)\frac{N(N-n)}{n(n-1)}\sum_{j=1}^{n}\left(y_j - \frac{\sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} M_i} M_j\right)^2$$

Where:
n = total transects within unit;
y_i = total pronghorn observed per transect;
M_i = transect unit area;
M = total unit area;
N = total transects available in unit.

To account for sampling variation in hunting units and DAUs west of the Missouri River, 95% confidence intervals $\left(CI_{0.95,\hat{\tau}}\right)$, assuming a normal distribution, were estimated using:

$$CI_{0.95,\hat{\tau}} = \hat{\tau} \pm 1.96 * \sqrt{\widehat{var}(\hat{\tau})}.$$

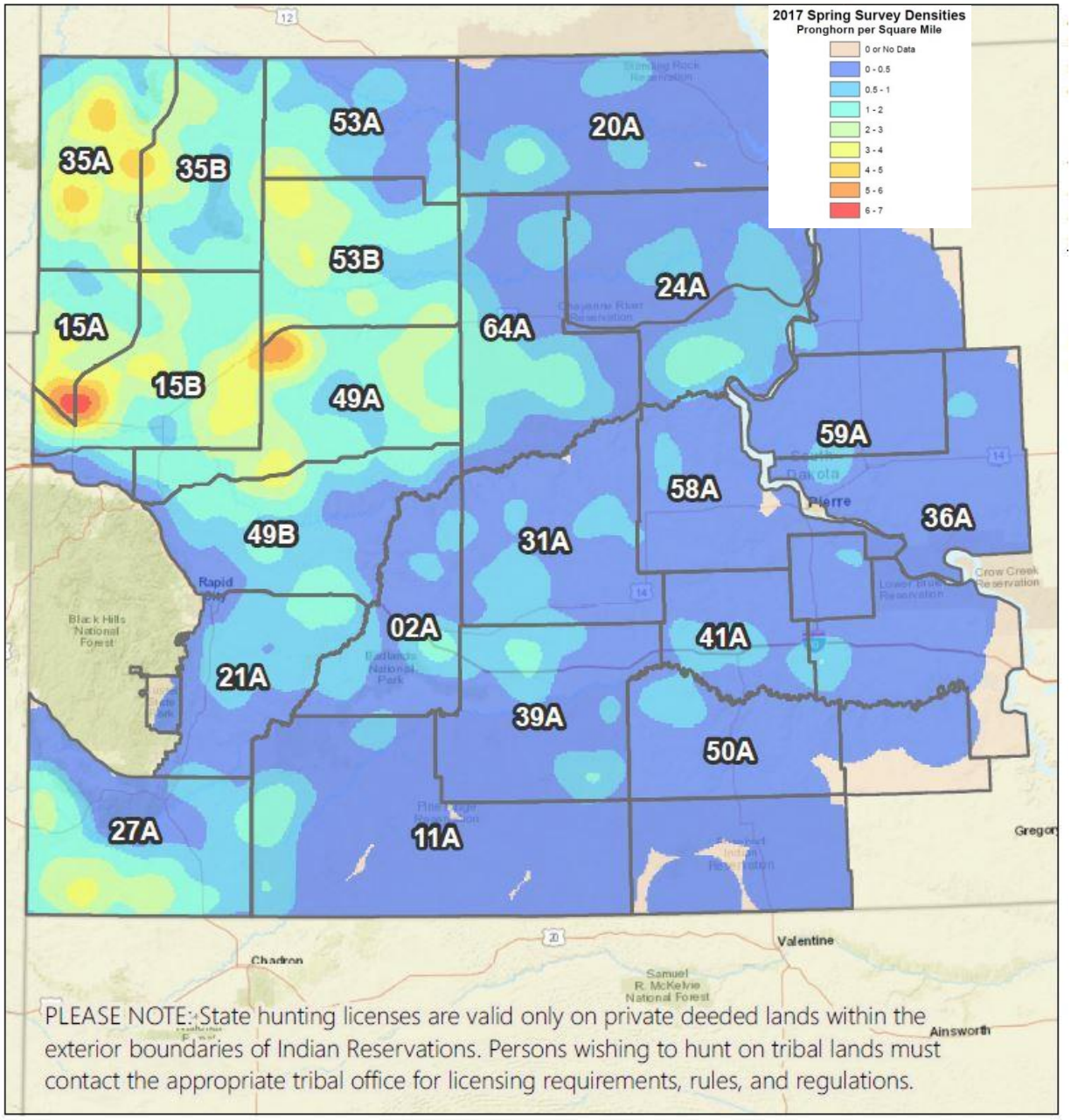


Figure 16. Adult pronghorn density estimates derived from spring aerial surveys in South Dakota, 2017.

Because detection probability is assumed 100% and all sampling units in the sampling frame are surveyed, no variance or confidence intervals were estimated for units east of the Missouri River. Assuming independence among hunting units, the total statewide and DAU spring population estimates were calculated by summing total population and variance across hunting units (Thompson 2002). The statewide spring estimate in 2017 was 32,813 (95% CI = 26,569 – 39,057).

Herd Composition Surveys

Since 1968, pronghorn herd composition data have been collected via opportunistic ground counts across the entire pronghorn range in South Dakota (Appendix B). Traditionally, surveys were completed from August 1 through September 30, with minimum sample size goals set at 10% of the estimated doe population in each hunting unit. Following the completion of a thorough evaluation of herd composition survey methods, the survey period was modified in 2017 to September 1-30 to reduce the monthly variability in age and sex ratio data (Cudmore 2017). The sample size was also changed to a minimum of 200 unique groups per DAU, with counts distributed across the entire DAU as much as feasible. These modifications will result in a precise and more reliable estimate of pronghorn herd composition ratios.

SDGFP survey personnel classified over 7,800 fawns, does, and bucks in September of 2018 to estimate sex and age ratios. Age ratios are calculated as fawns per 100 does and represent fall recruitment into the population. Recruitment estimates are weighted based on the population density within each hunting unit to derive a weighted estimate for each DAU. DAU estimates of fawn:doe ratios in 2018 (Table 9) ranged from a low of 46:100 in DAU 7 (*n* = 160 does) to a high of 67:100 in DAU 1 (*n* = 1117 does). The statewide 2018 fawn:doe ratio of 58 (95% CI: 55-61) fawns per 100 does is currently below the 20-year average of 77 fawns per 100 does (Figure 17) and is the lowest recorded statewide average to date. It's possible the changes in survey protocol may have introduced some negative bias in results when compared with previous data, but future trend data will be improved by better consistencies in survey methods. The statewide 2018 buck:doe sex ratio of 42 is above the average of 35 bucks per 100 does (Figure 18).

Table 9. Herd Composition survey results, 2018.

DAU	# Fawns	# Does	# Bucks	Total	F:100D	B:100D
DAU 1	747	1117	450	2314	67	40
DAU 2	479	764	332	1575	63	43
DAU 4	476	941	332	1749	51	35
DAU 5	337	589	272	1198	57	46
DAU 6	153	327	174	654	47	53
DAU 7	73	160	93	326	46	58
STATEWIDE	2,265	3,898	1,653	7,816	58	42

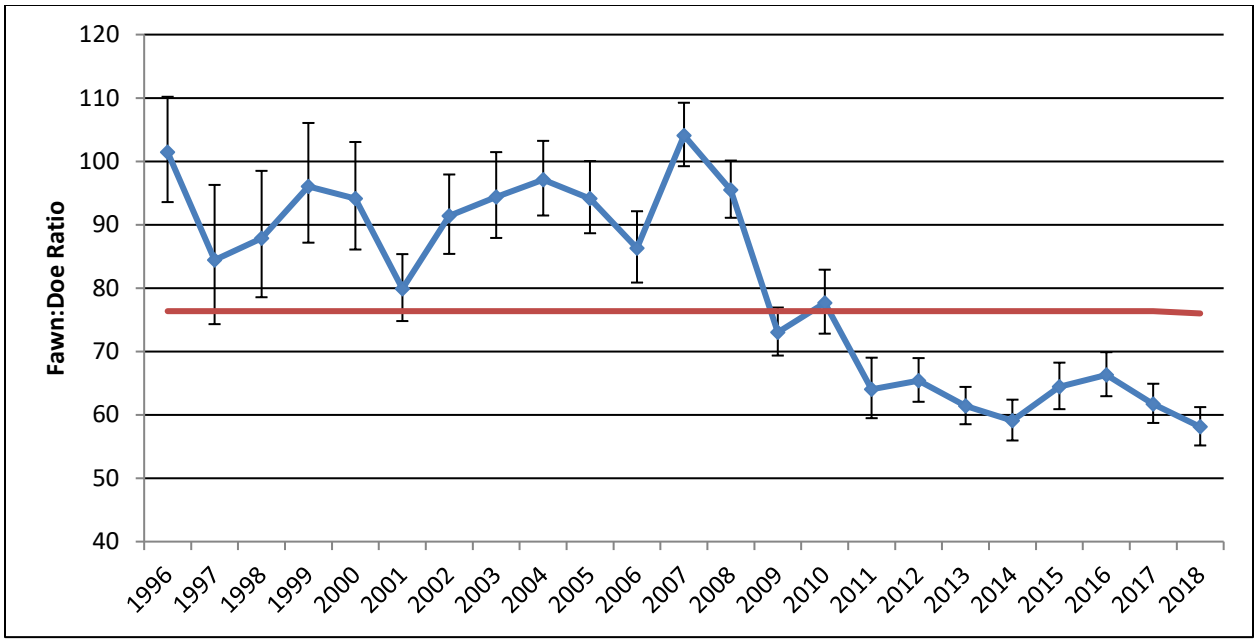


Figure 17. Statewide fawn:100 doe estimates and average trend line depicting 77 fawns:100 does, 1996-2018.

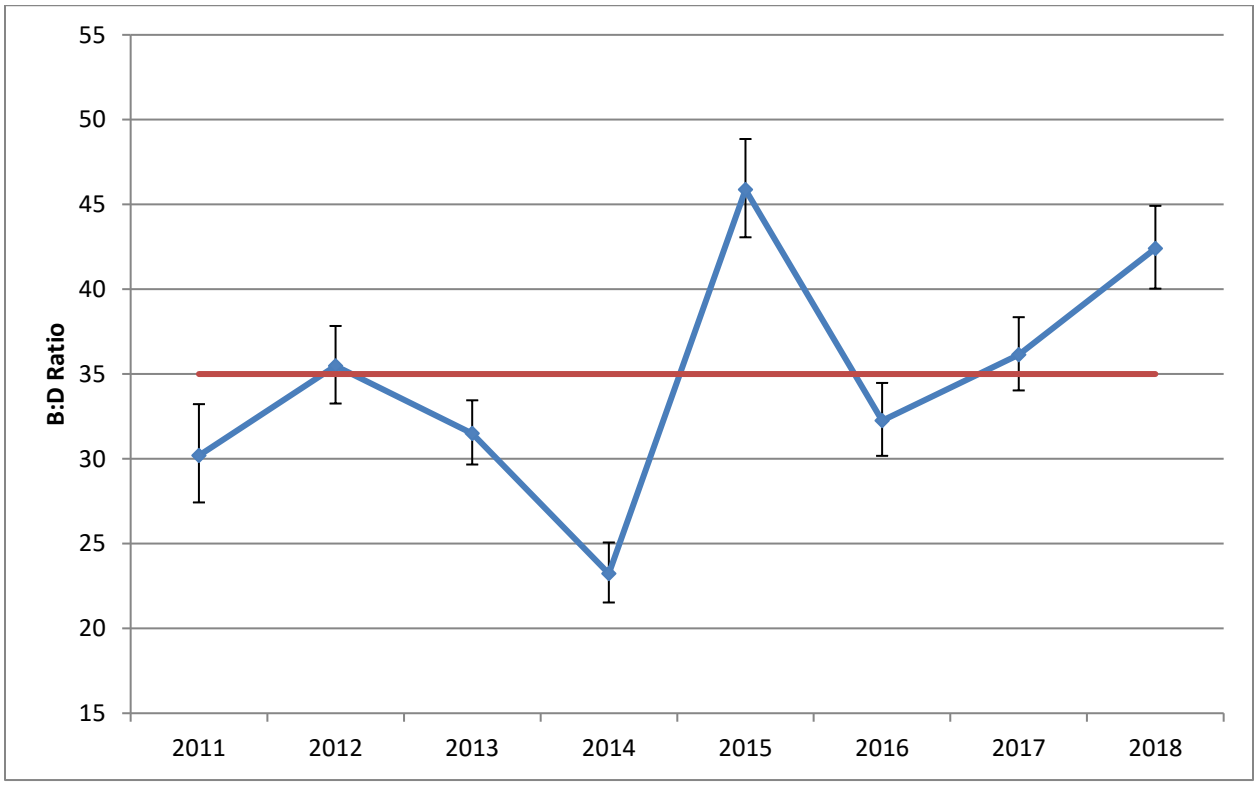


Figure 18. Statewide buck:100 doe estimates and average trend line depicting 35 bucks:100 does, 2011-2018.

Survival Monitoring

Understanding population dynamics of pronghorn and determining annual rates of population change (λ) requires knowledge of juvenile and adult survival rates. Annual rates of change within a pronghorn population are influenced primarily by adult survival and the number of fawns that reach one year of age. Pronghorn survival was first estimated within South Dakota in 2002 (Sievers 2004). Survival estimates dating back to 2002 can be found in Table 10.

Table 10. Pronghorn survival estimates from multiple research projects conducted in South Dakota, 2002-2018.

Year	DAU	Survival	SE	n	Time Frame
Adult Female Pronghorn Annual Survival					
2002a	Wind Cave	0.88	0.21	8	Nov-Oct
2003a	Wind Cave	0.86	0.26	7	Nov-Oct
2002b	DAU 1	0.89	0.09	45	Nov-Oct
2003b	DAU 1	0.87	0.09	52	Nov-Oct
2004b	DAU 1	0.83	0.10	41	Nov-Oct
2003b	DAU 4	0.89	0.09	37	Nov-Oct
2004b	DAU 4	0.82	0.12	36	Nov-Oct
2015c	DAU 2	0.85	0.06	48	April-March
2016c	DAU 2	0.89	0.04	61	April-March
2017d	DAU 4	0.76	0.04	123	Oct-Sept
2018d	DAU 2	0.68	0.07	63	Oct-Sept
2018d	DAU 4	0.74	0.04	125	Oct-Sept
Yearling Pronghorn Survival					
2002b	DAU 1	0.95	0.09	22	Nov-April
2003b	DAU 4	0.92	0.14	13	Nov-April
2015c	DAU 2	0.76	0.15	10	6-18 month post capture
2016c	DAU 2	0.81	0.09	24	6-18 month post capture
Fawn Pronghorn Survival					
2002a	Wind Cave	0.22	0.22	9	45 day post capture
2003a	Wind Cave	0.42	0.22	9	45 day post capture
2002b	DAU 1	0.92	0.10	26	12 week post capture
2004b	DAU 1	0.92	0.10	26	12 week post capture
2003b	DAU 4	0.63	0.14	27	12 week post capture
2005b	DAU 4	0.63	0.14	30	12 week post capture
2015c	DAU 2	0.58	0.08	40	6 month post capture
2016c	DAU 2	0.71	0.06	52	6 month post capture

(a=Sievers 2004, b=Jacques et al. 2007b, c=Kauth 2017, d=SDGFP research)

Increased efforts to obtain statistically and biologically meaningful survival estimates (sample sizes >100 individuals) within a defined DAU have been occurring since 2017. Currently, SDGFP is monitoring adult females in DAU 4. Monitoring efforts on adult female pronghorn previously occurred in DAU 2 as well. Within the active monitoring areas, adult females (≥17 months) are captured via helicopter net gun and fitted with a very high frequency (VHF) radio-collar during the winter months. Survival rate monitoring of juveniles (5-16 months) and adult males will be evaluated in the future.

Monitoring for a live/dead status 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 1st -15th for each collared individual. 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.

All capture, monitoring, and mortality data are collected using hand held electronic devices (i.e., cell phones and tablets) and later stored in a centralized database. Annual survival rates are calculated using known fates interval-censored logistic regression models in Program R. Following the completion of a research project that begins in July of 2019, future data will be stored in a SQL server database and transferred through an application program interface connection to a web interface (PopR) created by the University of Montana. Survival rates for each sex and age category will be calculated within PopR using similar interval-censored logistic regression models. However, more objective and robust estimates will be obtained by statistically sharing data and smoothing estimates among DAUs and months using random effects.

Future capture and monitoring efforts of pronghorn will occur annually. Thirty adult females were captured in the winter of 2018/19 for the last scheduled capture event. Pronghorn will be captured in 2 different DAUs in 2019/20, with 105 adults and 110 juveniles captured in each area. Monitoring of radio-collared pronghorn will continue for approximately 6 years, or until sample sizes become insufficient.

Population Modeling

Biennial DAU pre-hunt pronghorn estimates are projected from adult spring aerial survey estimates, explained in the *Aerial Surveys* section, using fall herd composition data from the most recent 3 years available. Assuming no adult mortality from the spring survey to the hunting season, pre-hunt adult male and adult female cohorts are projected to the fall by multiplying the spring estimate by adult sex ratios, calculated from the most recent 3-year average of herd composition data. Pre-hunt fawns are estimated by multiplying pre-hunt adult females by fawns per adult female (age ratio), calculated from the most recent 3-year average of herd composition data. Male and female recruitment from birth to fall was assumed to be equal.

Because aerial surveys for pronghorn are conducted biennially, pre-hunt population abundance and trends for DAUs are projected during years without surveys using herd composition and winter severity data. Sex and age (young-of-year and >young-of-year) cohort-specific estimates of annual survival rates are predicted using a function related to a winter severity index (accumulated snow fall and minimum temperature during winter months; Baccante and Woods 2010). Cohort-specific survival rates are multiplied by cohort populations to project the adult population by sex to the next hunting season. Pre-hunt fawns are estimated by multiplying pre-hunt adult females by fawns per adult female (age ratio), calculated from the most recent 3-year average of herd composition data.

The total DAU projected pre-hunt population mean, standard deviation and 95% CIs are estimated using a parametric bootstrap with 2,000,000 simulations (random draws from all parameters based on probability distribution). Survival parameters for the bootstrap are constrained between 0 and 1 using the beta distribution with standard deviation equal to 0.05. Sex and age ratio parameters for the bootstrap are constrained between 0 and 1 and standard deviation was estimated using the multinomial distribution. Assuming independence among DAUs, the total statewide fall population projections are calculated by summing total population and variance across DAUs (Thompson 2002).

In 2017, based on aerial surveys and fall recruitment, the pronghorn preseason population was estimated at 48,553 (95% CI = 39,351 – 57,755) and the projection to the 2018 preseason population was 46,026 (95% CI = 36,016 – 56,036). These estimates are substantially lower than the record population of 82,392 in 2008 (Appendix A). Conservative harvest rates have allowed statewide pronghorn populations to slowly increase towards population objectives since 2011, but above average winters have resulted in population reductions in some years and DAUs (Figure 1; Table 11).

Table 11. Preseason population estimates of pronghorn in each DAU of South Dakota, 2008-2018.

Year	DAU 1	DAU 2	DAU 4	DAU 5	DAU 6	DAU 7
2008	35,045	25,033	11,157	8,712	859	1,586
2009	17,070	25,188	11,103	8,778	690	1,475
2010	12,982	17,976	13,794	5,448	595	1,033
2011	8,214	11,248	9,197	4,434	566	846
2012	7,249	11,186	11,625	4,142	341	592
2013	10,006	10,097	11,375	4,780	601	380
2014	11,364	11,494	12,461	4,792	627	402
2015	11,442	11,862	7,497	3,567	422	284
2016	13,812	13,954	8,258	3,687	443	292
2017	16,139	16,760	9,104	4,850	1,146	555
2018	16,284	14,873	8,560	4,667	1,142	500

Population trajectories are an important management tool that enables justification for future harvest strategies dependent upon management objectives. Understanding population rates of change allows managers to implement proactive management recommendations while practicing adaptive management techniques. Growth rates of pronghorn populations are primarily dependent on adult female survival and fawn recruitment. Estimating annual survival and fall herd composition allow managers to apply appropriate harvest rates in order to meet unit objectives (Table 12).

Table 12. Predicted pronghorn population growth rates[a] (decrease [↓], stable [●], increase [↑]) based on recruitment, survival[b], and harvest rate.

Recruitment		60 Fawns:100 Does			80 Fawns:100 Does			100 Fawns:100 Does		
Survival		Low	Ave	High	Low	Ave	High	Low	Ave	High
Doe Harvest Rates	30%	↓↓↓	↓↓↓	↓↓	↓↓↓	↓↓	↓	↓↓↓	↓	●
	20%	↓↓↓	↓↓	↓	↓↓↓	↓	●	↓↓↓	●	↑
	10%	↓↓↓	↓	●	↓↓	●	↑	↓↓	●	↑↑
	0%	↓↓	●	↑	↓	↑	↑↑	↓	↑	↑↑↑

[a] ↓↓↓: <.75 ↓↓: .75 - .84 ↓: .85 - .94 ●: .95 – 1.05 ↑: 1.06 - 1.15 ↑↑: 1.16 – 1.25 ↑↑↑: 1.25+

[b] Survival rates of adults and juvenile pronghorn (in the absence of harvest) are categorized as follows: 1) High = Does ~ 90%, Overwinter Fawns ~80%, 2) Average = Does ~ 80%, Overwinter Fawns ~70%, 3) Low = Does ~ 65%, Overwinter Fawns ~ 50%.

PRONGHORN RESEARCH IN SOUTH DAKOTA

Pronghorn are shrub-steppe and grassland obligate ungulates unique to North America (Gates et al. 2012). Western South Dakota makes up the eastern range of pronghorn distribution, with the greatest densities occurring within the eastward extension of sagebrush-steppe communities (Jacques et al. 2009). Currently, South Dakota contains the 5th highest number of pronghorn amongst all other states in the U.S. (Schroeder 2018). Population growth rates are likely most affected by weather extremes, such as drought and severe winters, harvest, predation, habitat conversion and fragmentation (Forrest et al. 2004, Gates et al. 2012, Jacques et al. 2009, Jones et al. 2018).

Movements and Home Range

Seasonal factors driving annual, long distance migration of pronghorn have been documented in Wyoming, Montana, and throughout the northern pronghorn range (Martinka 1966, Sawyer et al. 2005, Seidler et al. 2014, Suitor et al. 2008). However, research conducted in South Dakota suggests most populations are non-migratory. Jacques et al. (2009) documented seasonal movements of

pronghorn in Harding County and Fall River County and found that the majority of pronghorn studied were permanent residents or conditional migrators with no accounts of obligate migration. Similarly, Kauth (2017) found that >86% of adult pronghorn in and around Butte County were also non-migratory. Both Jacques et al. (2009) and Kauth (2017) noted, however, that the mild winters with minimal snow accumulation, which occurred during both studies, may have contributed to limited migratory behavior.

During the winter of 2015/2016, Kauth (2017) monitored movements of yearling (*n* = 33) and adult female (*n* = 67) pronghorn and found that adult winter home ranges were more than twice as large as summer home ranges (28.5 mi^2 and 11.7 mi^2, respectively). Additionally, daily distance traveled by adult females tended to be shorter in summer (May-October) than in winter (November-April). These results support other studies which found generally shorter daily movements in the summer compared to winter due to abundant, high quality forage (O'Gara and Yoakum 2004; Jacques et al. 2009). While there was no statistically significant difference between yearling winter and summer home ranges (29.3 mi^2 and 20.7 mi^2, respectively), yearling summer home ranges tended to be almost twice as large as adult summer home ranges. Daily distances traveled by yearlings were observed to be higher from April to June when some yearlings attempted to establish a home range. Dispersal probability during spring and fall was greater amongst yearling pronghorn (26.1-43.8%) compared to adults (8.0-13.9%). Of the yearlings collared as fawns, 58% were classified as dispersers from natal home ranges, while 42% were classified as residents (Kauth 2017).

Jacques (2006) classified 56% of fawns as dispersers, with most (84%) dispersers departing natal home ranges in late October, occupying winter home ranges for 102-209 days, then dispersing to permanent home ranges in April. Fawn dispersal distances from natal ranges to permanent home ranges varied from 4-171 miles, while permanent home range size was documented to range from 6-64 mi^2. Adult females were predominantly non-migratory and 10% were conditional migrators (Jacques et al. 2009). Mean distance between summer and winter range was 14 miles. In southwest North Dakota, 55% of pronghorn made seasonal movements (defined as >9 miles) for an average distance of 44 miles (Kolar et al. 2011). Mean winter and summer home ranges were 22 mi^2 and 8 mi^2 in Harding county, respectively, and 49 mi^2 and 25 mi^2 in Fall River County, respectively (Jacques et al. 2009). Winter and summer home ranges of 26 mi^2 and 21 mi^2, respectively, were documented in WICA (Sievers 2004). Kauth (2017) found that highways may be significant physical barrier to pronghorn movement and dispersal.

Seasonal Habitat & Resource Selection

Jacques (2006) studied habitat use of neonates in the northwest and southwest portions of South Dakota and found significantly greater shrub cover and density at neonate bed sites in Harding County versus Fall River County, while distance to nearest concealment cover was also lower. Overstory height was greater and distance to concealment cover was less at bed site locations than at random locations in both study areas. Jacques (2006) recommended management of rangelands that maximizes overstory height of grasses and shrubs, understory height, and distribution of clumped, vertical structure to provide neonates with adequate concealment cover for protection

from predators. In WICA, mean height of vegetation at fawn bed sites was greater (P = 0.05) than vegetation height at random locations (Jacques et al. 2007a). Research in CSP (Lehman et al. 2009) discovered that fawns during the hiding phase (1-28 days old) selected dry prairie-seminatural mixed grassland, while fawns in the group phase (29-60 days old) selected similar areas, but also prairie dog dominated grasslands. Group phase fawns also selected bed sites that had greater forb cover and overstory canopy cover of ponderosa pine (*Pinus ponderosa*) trees compared to random sites.

An observational study (Maher 2000) conducted in WICA and another site in Montana suggested that plant productivity has a powerful role in determining pronghorn territoriality, more so than pronghorn density and herd sex ratio. Bromley (1991) reported a dominance hierarchy existed among territorial bucks at WICA, with these bucks claiming areas for territories with the greatest abundance of preferred food.

Kauth (2017) examined resource selection of pronghorn in western South Dakota and recorded 4,786 visual observations collected via radio-telemetry. Study areas were classified as alfalfa/hay (*Medicago spp.*), winter wheat (*Triticum spp.)*/small grains, native rangeland, and harvested/idle. Kauth (2017) found that during summers of 2015 and 2016, pronghorn selected for alfalfa/hay and harvested idle fields. During winter of 2015-2016, pronghorn selected winter wheat fields.

Diet and Nutrition

Research on pronghorn forage consumption, preference, and competition with livestock in South Dakota started in the 1940s. Bever (1948) completed stomach analyses on 87 pronghorn and concluded that seasonal food habitats varied considerably and two sagebrush species big sagebrush (*Artemisia tridentata)* and silver sagebrush (*Artemisia cana*), were the most important food sources. Stomachs with >10% agricultural food sources were removed from the analyses. Competition between domestic sheep (*Ovis aries*) and pronghorn on sagebrush was an issue at the time, since it was believed that sagebrush was a major food source during severe winters for both pronghorn and domestic sheep. Kohler (1950) reported that both domestic sheep and pronghorn consumed sagebrush. However, pronghorn ate the finer parts, the florets and leaves, while domestic sheep ate the courser stems, leaving the florets.

Later research focused on pronghorn depredation on agricultural fields interspersed within the sagebrush/grasslands that typically dominated the pronghorn range in western South Dakota. Messenger and Schitoskey (1980) identified 32 plants in fecal pellets from pronghorn in Harding County and reported big sagebrush was the only plant consumed in every month of the year. Other commonly used shrub species identified were fringed sagebrush (*Artemisia frigida*), silver sagebrush; common forbs were yellow sweet clover (*Melitotus officinalis*) and gold aster (*Chrysopsis villosa*); and the most commonly used grass was blue grama (*Bouteloua gracilis*). Forbs constituted 44-68% of pronghorn diets between May and September, shrubs 69% in November and 95% or more from December to April, and grasses were relatively unimportant. Terwillinger (1946)

compiled data collected from South Dakota to conclude that the year-long average browse, forb, and grass percent of samples was 66, 23, and 11, respectively.

Berner (1949) reported that pronghorn utilized all available agricultural crops, and listed order of preference from most to least as follows: late flax (*Linum spp.*), alfalfa, corn (*Zea spp.*), sorghums (*Sorghum spp.*), wheat, oats (*Avena spp.*), barley (*Hordeum spp.*), and rye (*Secale spp.*). He also reported that small, widely scattered tracts of cultivated land within pronghorn range are subject to greater depredation than blocks of farm land adjacent to pronghorn range. Berner (1949) recommended techniques to reduce crop damage such as early planting and harvesting of flax and other crops, and increasing height and density of planted corn. Messenger and Schitoskey (1980) did not find cultivated small grain crops to be a major food source for pronghorn. Griffin (1991) did find pronghorn using alfalfa fields in March-April, and July-August in greater proportion than availability, with use of small grain fields during May-June and recommended an increase in the use of the CRP to alleviate depredation on agricultural fields. Jacques et al. (2006) identified blue grama, common juniper (*Juniperus communis*), and northern bedstraw (*Galium boreale*) as important food items in WICA, and documented annual diets included 42% grasses, 31% shrubs, and 27% forbs. Total forage production in WICA was 72% grass, 4% shrubs, and 23% forbs; pronghorn exhibited strong dietary selection for shrubs.

Disease

Pronghorn, as with other wildlife species, have the potential to acquire and transmit diseases from other wildlife or domestic species. In South Dakota, there are few diseases documented within pronghorn herds, and most diseases do not cause major concerns regarding the sustainability of pronghorn populations within the State. In the past, very little disease monitoring has occurred in South Dakota on pronghorn populations. This section will address the current knowledge of diseases that may be found and cause concern for pronghorn management in South Dakota. In any case, emerging diseases may be identified in the future that have the potential to affect pronghorn populations in South Dakota. Monitoring for any potentially new disease or evaluating current disease issues in South Dakota will continue.

Bever (1950) necropsied 14 pronghorn in Harding and Butte counties and reported parasite counts of 14 species of nematodes and cestodes; *Actinomyces* spp. and *Actinobacillus* spp. were the only bacterial infections identified, and one pronghorn death was attributed to hemorrhagic septicemia. Fawn mortality was estimated at 30-60% and was believed to be caused by internal parasites. Bever (1950) further concluded that no bacterial, protozoan, or filterable virus disease has been diagnosed in pronghorn of South Dakota. SDGFP (1965) reported that the use of phenathiozine salt blocks and abandonment of close herding prior to the completion of this project temporarily cured the potential transfer of parasite from sheep to pronghorn. The most common parasites discovered in 36 of 42 individuals sampled during the 1952 pronghorn season were nematodes (*Haemonchus contortus* and *Nematodirolla* spp.), only 4 fawn pronghorn were void of parasites (Berner 1952b). Moore et al. (1968) discovered insecticide residues in pronghorn and reported that residue levels were of little significance with regard to human consumption of pronghorn.

Bever (1957) examined hunter harvested pronghorn and reported that 91% of pronghorn harvested from overgrazed domestic sheep ranges were infected with parasites, as compared to 48% from properly grazed cattle ranges. On cattle ranges, the degree of infestation (index) was reported as 5.7 and 1.9 for *Haemonchus contortus* and *Nematodirella* spp., respectively, whereas on sheep ranges the degree was 18.2 and 48.5. A similar study in North Dakota found that 97% of examined pronghorn (*n* = 95) were parasitized, with those in ranges grazed by sheep having more abomasal parasites while those on ranges grazed by cattle having more intestinal worms (Goldsby and Eveleth 1954). Bever (1957) examined harvested pronghorn from 1952-1956 and found that 75% of specimens were infected with some species of intestinal parasites. One fawn was reported to have died from rabies after being bitten by a skunk (*Mephitis spp*.)(Wempe 1976). Reed et al. (1976) discovered calf diarrhea, a reovirus-like agent, in 3 pronghorn fawns captured on cattle ranches in Butte and Meade counties (*n* = 7). Furthermore, Lucker and Dikmans (1945) identified about 810 specimens of nematodes (*Pseudosteragia bullosa)* in the abomasum of one pronghorn, and several new records of nematodes. Additionally, Kauth (2017) noted that adult pronghorn exposure to bovine viral diarrhea virus was 5%, exposure to West Nile virus was 67.5%, and exposure to parainfluenza-3 was 40%.

The most common disease that could likely affect pronghorn in South Dakota is 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 (*Odocoileus virginianus*), while the BT virus has up to 6 serotypes and can also affect pronghorn, mule deer (*Odocoileus hemionus*), bighorn sheep (*Ovis canadensis*), and elk 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. Hemorrhagic disease is the most commonly found disease in white-tailed deer in South Dakota and has rarely been documented in pronghorn and no significant die-offs have been reported. Over the past 5 years, a total of 26 reported cases of suspected HD have been investigated, and only 5 cases have been confirmed as EHD (1) or BT (4). Kauth (2017) noted that adult pronghorn in Butte County, SD showed exposure to BT at 5% and exposure to EHD at 60%. Hemorrhagic diseases such as EHD and BT is endemic to South Dakota, and usually affects deer herds in South Dakota in the late summer or early fall, and thus have the potential to affect pronghorn herds at the same time.

Survival

Research in WICA found low summer fawn survival rates ranging from 22-42%, and adult female survival of 86-88% with coyote (*Canis latrans*) predation being the major cause of mortality (Sievers 2004). Jenks et al. (2006) found similar levels of observed heterozygosity and low inbreeding coefficients when compared with other populations in western South Dakota, indicating that genetic variability was not the primary factor in the decline of pronghorn in WICA. In a study in CSP from November 2005-November 2008, Keller (2013) observed 90% adult winter and breeding

season survival (males and females same), and parturition season adult survival rates for females and males of 79% and 83.7% respectively.

In western South Dakota, hunting was the primary cause of mortality, attributing for 26% of adult female deaths (Jacques et al. 2007b). Adult pronghorn annual survival averaged 86-87% with 12-week fawn survival ranging from 92% in the northwest to 62% in the southwest portions of the state (Jacques 2006). Kauth (2017) noted adult survival in Butte County, SD at 85% and 89% for 2015 and 2016, respectively. Overall yearling survival for 2015 and 2016 was reported as 76% and 81%, respectively. Predation has been documented as the primary cause of fawn mortality, with coyotes being responsible for most identifiable events (Jacques et al. 2007b, Kauth 2017). Jacques and Jenks (2008) reported a visual observation of bobcat (*Lynx rufus*) predation on an adult female pronghorn in 2002 in Harding County.

See Table 10 in the *Survival Monitoring* section for a summary overview of documented survival rates in South Dakota.

PUBLIC LANDS

SDGFP

The SDGFP 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. Pronghorn likely utilize various habitats primarily on GPAs in the western half of the state at some time during the year. Statewide, habitat composition on GPAs consists of approximately 50% grassland, 30% wetland, 10% annually cropped farmland, 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 western South Dakota are managed with a strong emphasis on upland game and deer habitat, while providing habitat specific to pronghorn hunting opportunities is less common. 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 pronghorn habitat needs have been identified by SDGFP managers and biologists, specific management activities occur that involves development of habitats identified as necessary to meet

seasonal life-cycle needs of pronghorn. However, these habitat development and management activities generally do not result in significant negative impacts to other wildlife and 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 (https://gfp.sd.gov/userdocs/docs/Land_Acquisition_Guidance_-_August_2016.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.

Custer State Park

Custer State Forest became CSP after action by the state legislature in 1919. Custer State Park encompasses 70,750 acres of forests and grasslands in the Black Hills of South Dakota (Figure 19). 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 (*Picea glauca*)/ponderosa pine mix on north slopes at higher elevations, by pure ponderosa pine on most forestlands, and by mixed-grass prairie on grasslands.

Pronghorn are very important as a viewable wildlife species in CSP. Following extirpation, pronghorn were reintroduced into CSP between 1919 -1922. Since 1980, minimum counts have varied from a low of 81 animals in 2018 up to a high of just over 350 in 2009 (Figure 20). Surveys

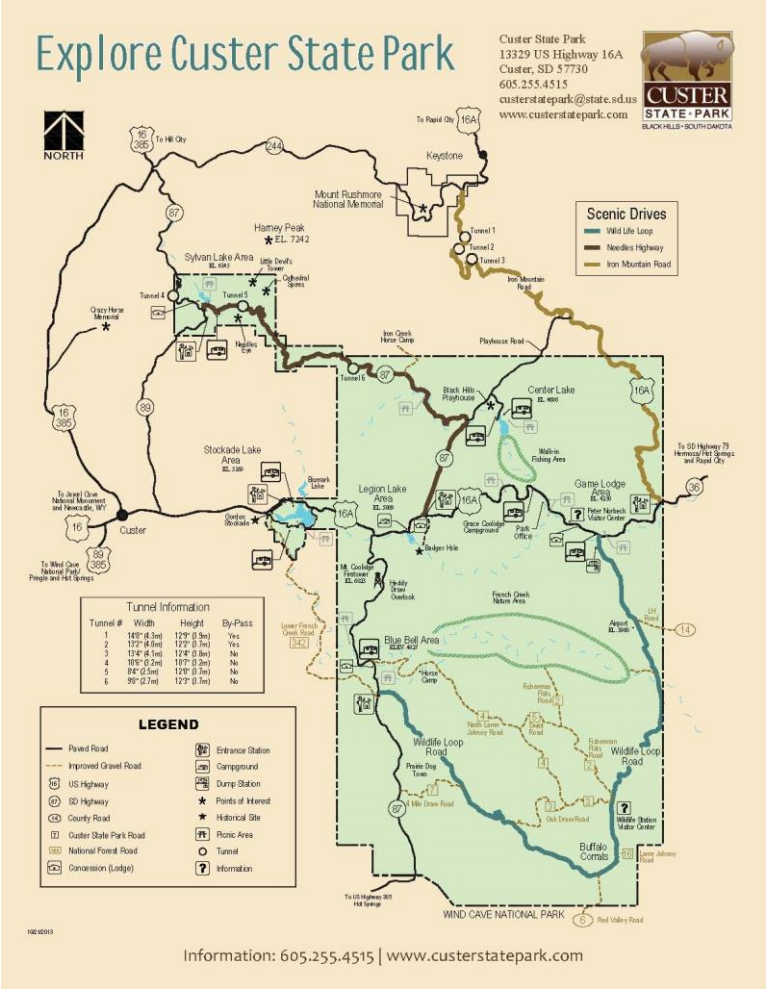


Figure 19. Location of Custer State Park in the southern Black Hills, South Dakota.

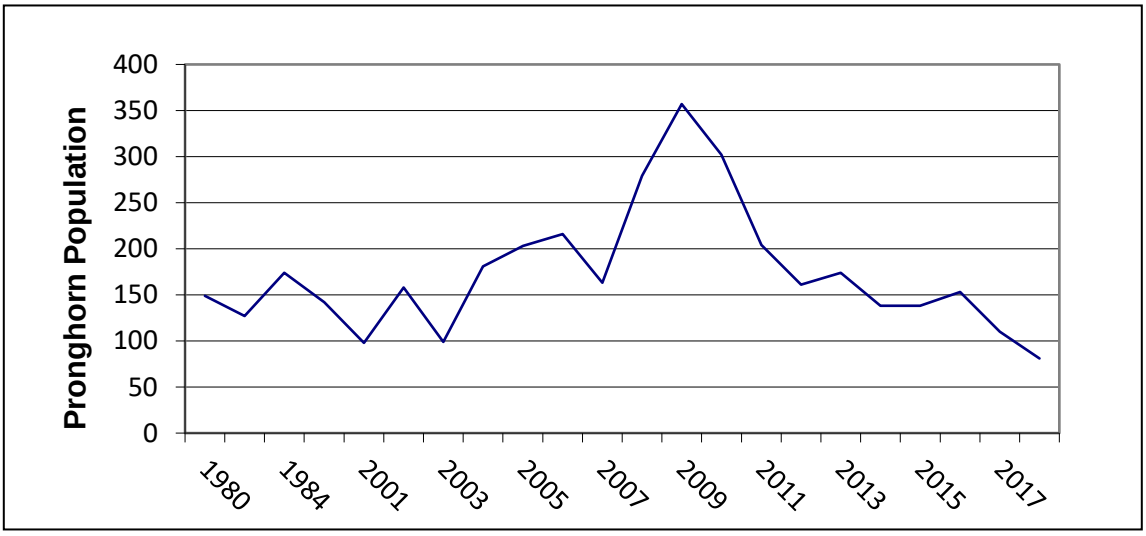


Figure 20. Pronghorn population estimates in Custer State Park, 1980-2018.

were conducted from the ground in 1980-1986 and 2014-current, while helicopter surveys were used to gain population estimates in 2001-2013. Research in CSP demonstrated that pronghorn fawns select bed sites near prairie dog towns based on a study from 2008-2009 (Lehman et al. 2009). Mountain lions (*Puma concolor*) and coyotes accounted for 69.5 % of all known adult pronghorn mortalities in CSP from 2008-2011 (Keller et al. 2013). Pronghorn were not hunted from 1986-2008, seasons were open from 2009-2016, and seasons have been closed in recent years. Harvest seasons are currently structured to provide a buck seasons when the population estimate reaches 135 and a doe/kid season once the population reaches 250 pronghorn.

Custer State Park manages pronghorn for species diversity, viewing opportunities, and to provide a high quality recreational hunting opportunity. The pronghorn population objective takes into account viewing and recreational opportunities. But most importantly, the population objective takes into account precipitation data and forage production, pronghorn resource selection, as well as historical trend information and demographic data.

Determining the size and composition of ungulate communities a landscape can support is difficult, especially in CSP, where ungulate communities are diverse and compete for resources. Theoretical carrying capacity models can be useful tools to guide management decisions; however, these models may make some assumptions about forage production, forage availability, and diet overlap. Spatially-explicit information of forage production, diet, space-use, and resource overlap was modeled to optimize stocking densities of bison, elk, pronghorn, mule deer, and white-tailed deer (Keller 2011). When evaluating forage production under normal precipitation conditions, CSP has available forage estimated at 62,830,016 lbs of dry herbaceous biomass within the park (Keller 2011). Custer State Park allocates 25% of biomass for wildlife use, and 25% would equate to 15,707,504 lbs of dry herbaceous biomass (Table 13).

Based on past demographic trend data, theoretical carrying capacity models, and allocation for other large ungulates, a pronghorn population objective of 350 was set for CSP. Under optimal foraging conditions, with increased forage production through prescribed fire and timber management, population objectives for all the species listed in Table 13 could be increased due to increased carrying capacity.

SDSPL

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 SDSPL holdings in western South Dakota. The SDSPL land holdings consist of 98% grassland and 2% cropland. School Lands are leased at public auctions with lease terms of five years with a renewable five-year option.

Table 13. Dry forage (lbs), population objectives, and allocation table for large ungulates in Custer State Park, (Keller 2011).

	Pounds dry forage (25%)	Population Objective	Range% - Forest%	Range	Forest
Available[a]	15,707,504		48%-52%	7,604,664	8,102,840
Bison	7,745,351	950	75%-25%	5,809,013	1,936,338
Elk	3,548,142	800	21%-79%	745,110	2,803,032
Pronghorn	284,824	350	80%-20%	734,992	183,748
Mule Deer	260,508	200	60%-40%	156,305	104,203
White-tail	918,740	800	15%-85%	42,724	242,100
Bighorn	327,953	200	10%-90%	32,795	295,157
Utilized forage	13,085,517			7,520,939	5,564,578
% used				99%	69%

[a]Based on 62,830,000 lbs of dry forage available in CSP during a normal precipitation year. The 15,707,504 lbs would be 25% of the annual production for CSP.

BLM

The BLM South Dakota Field Office (SDFO) manages approximately 274,000 acres in South Dakota (BLM 2015). 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 21). 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 2015). 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 2015). For management purposes, BLM has generalized habitat types on SDFO administered lands to three categories: grasslands, shrublands, and forest/woodlands (Table 14).

Mule deer, white-tailed deer, and pronghorn are the most common big game animals occupying much of the BLM lands 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 (*Oreamnos americanus*), and an occasional moose (*Alces alces*). Pronghorn 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 grassland and shrub steppe. Pronghorn are present year-round on BLM administered lands in many parts of the state.

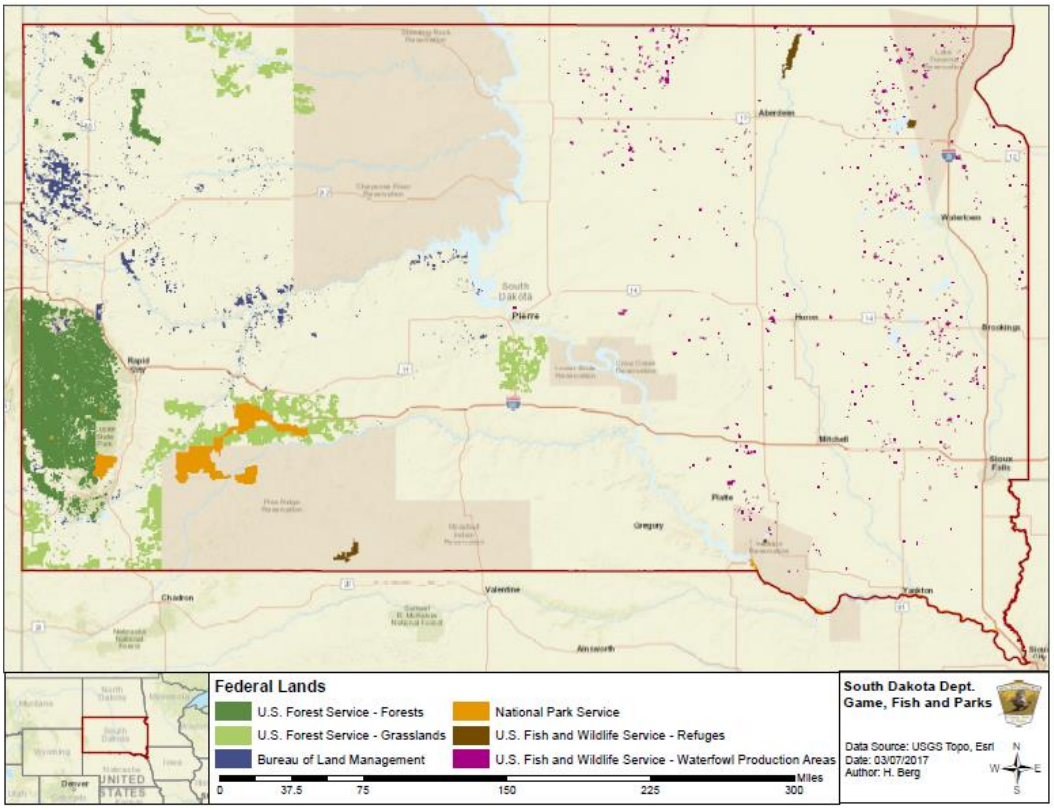


Figure 21. Federally managed public lands in South Dakota.

Table 14. 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 2015)

The BLM has identified several goals general to all wildlife within the South Dakota Approved Resource Management Plan (SD RMP) (BLM 2015). These goals, while not specific to pronghorn, are likely to benefit pronghorn. Identified goals of the SD RMP that are likely to benefit pronghorn 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 identified in the BLM's SD RMP (BLM 2015), BLM initiated measures and restrictions to benefit wildlife populations to meet these goals, 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 right-of-ways.
- 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.
- Best Management Practices (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 Memorandum Of Understanding (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 pronghorn) 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 2015).

USFS

Although there are a few limited areas that hold pronghorn on the USFS national forests (Black Hills National Forest, Custer Gallatin National Forest), national forests do not generally provide substantial habitats for pronghorn populations in South Dakota. Habitats found on USFS National Grasslands, however, are important for both pronghorn populations and hunter access in the state.

USFS National Grasslands

There are three National Grasslands located in South Dakota. Two of the National Grasslands are administered by the Nebraska National Forest, Buffalo Gap National Grassland (is located in southwest South Dakota) and Fort Pierre National Grassland (located in the center of the state, USDA2009). Dakota Prairie Grasslands administers the third National Grassland, the Grand River National Grassland in north-northwest portion of South Dakota (USDA 2001, Figure 21). Specific pronghorn management strategies are not identified at the regional level or within the individual grasslands Land and Resource Management Plans. However, general grassland wide management goals, objectives, guidelines and standards for wildlife (which provide benefit to pronghorn) are found within the Land and Resources Management Plan for the Dakota Prairie Grasslands Northern Region (USDA 2001) and for the Nebraska National Forest (USDA 2009).

The three National Grasslands collectively identified the following Plan directives for general wildlife management that also specifically benefit pronghorn on the grasslands (USDA 2001, 2009):

- Modify livestock grazing practices as needed to reduce adverse impacts of drought to food and cover for wildlife.
- Do not recommend 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.
- Enhance or maintain diverse forb and shrub components across the grasslands, riparian areas and woody draws.
- Design and implement livestock grazing and prescribed burn strategies to provide well-developed emergent vegetation through the growing season on 30-50% of the wetlands

(natural and constructed) distributed across watersheds and landscapes, contingent on local site potential.

- Design and implement livestock grazing strategies and prescription burn plans to provide for a required range of plant species composition from late to early successional states and various vegetative structure heights.
- Design and build new structures, including fences, to reduce hazards to big game and to allow big game movement throughout the year. Bottom wires will be smooth and within cattle allotments the bottom wire will be 12 inches off the ground. This does not apply to fences designed to specifically exclude wildlife.
- Establish and maintain a mosaic of successional stages, spatially and temporally.
- Enhance and maintain diverse forb and shrub components across grasslands, riparian areas and woody draws.
- Within sagebrush-steppe habitats tall, dense diverse herbaceous understories are enhanced.
- Between 1-10% of the suitable rangelands are rested from domestic livestock grazing each year depending upon specific Plan directives.

NPS

Wind Cave National Park

Wind Cave National Park, 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 21; NPS 2015). The park boundary is approximately six miles north of Hot Springs, South Dakota, and is bounded by CSP 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). The WICA Park has identified several general wildlife management strategies to ensure the park's wildlife, including pronghorn, are protected. The 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 WICA 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 WICA wildlife populations to address individual species accordingly.

Badlands National Park

Roughly half of the 244,000 acres that make up Badlands National Park (BNP) consists of badlands with the remaining half consisting of a mixed-grass prairie ecosystem (Figure 21). The mixed-grass prairie supports a vast array of wildlife species. BNP has documented 9 reptiles, 6 amphibians, 206 bird species, 69 butterfly species and 39 mammals, including pronghorn (NPS 2016). Pronghorn 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 (OSPRA) and BNP (NPS 2012). Big game includes pronghorn. These hunts, which are regulated by OSPRA 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, pronghorn are hunted on lands adjacent to the park (NPS 2012).

BNP does not identify pronghorn 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 pronghorn, are protected. BNP managers will employ policies and strategies for the benefit of the park's wildlife (NPS 2009, 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

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. The 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 pronghorn populations depends greatly on maintaining habitat of commensurate quantity and quality necessary to support desired population levels. The 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 national 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.

SDGFP Wildlife Partners Program

The 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. The 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.

SDGFP Wetlands and Grasslands Program

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.

USDA Farm Bill Programs

SDGFP private lands habitat programs are intended to complement U.S. Department of Agriculture (USDA) conservation programs, such as the CRP, Agricultural Conservation Easement Program, Environmental Quality Incentives Program, and the Conservation Stewardship Program. Because USDA conservation programs impact thousands of acres of private land across South Dakota, SDGFP private lands staff are actively involved with the USDA Natural Resources Conservation Service

(NRCS) state technical committee and its various program-specific subcommittees. Additionally, SDGFP staff serve on the USDA Farm Service Agency 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/.

Depredation Management

Pronghorn 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. Over 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 55% of pronghorn hunters relied on private land for hunting access in South Dakota. In 2017, there were over 8,000 licensed hunters for all pronghorn hunting seasons in South Dakota (Huxoll 2018). Pronghorn populations in South Dakota have changed dramatically over the past ten years with a peak in harvest in 2008. When pronghorn populations are high, decreased social tolerance can be experienced by some landowners in areas of South Dakota due to damage to crops such as winter-wheat and alfalfa (Longmire 2014). Other research in the western United States has also reported that over-abundant populations of pronghorn has increased the number of human-wildlife conflicts as well as magnified their intensity (Irby et al. 1997, Torbit et al. 1993).

Successful wildlife management programs must target private landowners and work cooperatively with farmers and ranchers to be effective (Bookhout 1996). The SDGFP works diligently to maintain a balance between viable wildlife populations, social tolerances, and the desires of a variety of stakeholders. At times, this balance is difficult to achieve as landowners suffer wildlife damage to stored-feeds intended for livestock or damage to growing crops, while at the same time hunters desire higher wildlife populations for more hunting opportunities. Fortunately, pronghorn damage is minimal in most areas of South Dakota when compared to other ungulate species such as deer or elk. Similarly, Van Tassell et al. (1999) also reported minimal pronghorn damage compared to mule deer and elk in Wyoming. Nonetheless, SDGFP understands that cooperative partnerships with private landowners are an essential component of pronghorn management and private lands serve an important role regarding all wildlife management. Without this cooperative partnership, it

would not be possible to successfully manage South Dakota's pronghorn population. It is because of these important considerations that SDGFP operates such a comprehensive wildlife damage management program and assists with pronghorn depredation abatement. The public also supports management of wildlife that are 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 big game populations increased in South Dakota in the 1990's, 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 fifty-percent goes to hunter access programs. The establishment of this funding was the financial foundation for which SDGFP's wildlife depredation abatement program was initiated (Fisk 2017). From 2005 through 2017, SDGFP has spent just over $45,000 addressing pronghorn depredation on private lands (Figure 22). In comparison, during the same time-frame, SDGFP spent over $6 million addressing deer depredation concerns. Because these programs are funded entirely by sportsmen and women, SDGFP requires all landowners that participate in pronghorn 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 pronghorn hunting access".* To achieve successful pronghorn management, it is imperative that sportsmen and women have access to private lands, especially because revenues from hunting licenses are used to operate such programs and pronghorn 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).

The demand for pronghorn depredation abatement services fluctuates annually due to population levels, seasonal variation, weather events (i.e., deep snow or severe weather) and changes to pronghorn habitat (i.e., agricultural development, crop rotation, habitat loss, and human encroachment). However, the most significant factors that affect social tolerance and the demand for pronghorn depredation abatement services are local pronghorn population levels and landowners' financial dependency on affected crops. Lacey et al. (1993) and Van Tassell et al. (1999) found that tolerance for wildlife depredation quickly diminished as landowners' economic dependency on their land increased. In a survey conducted by Longmire (2014), 29% of responding landowners that had pronghorn present on their property indicated that they had pronghorn damage to their property within the last year.

In South Dakota, conflicts with pronghorn usually occur during the winter or early-spring when large herds spend considerable time in winter-wheat and alfalfa fields. In some parts of South Dakota, pronghorn may move long distances to winter in certain areas and typically stay at these locations until they disperse in the spring (Jacques 2006). Typical herd sizes range from 30 to several hundred animals, but during the severe winter in 2008, SDGFP staff verified a herd of pronghorn larger than 800 individuals on a wind-swept winter-wheat field in western South Dakota. When these conditions exist, some landowners believe that pronghorn grazing or heavy trampling may damage

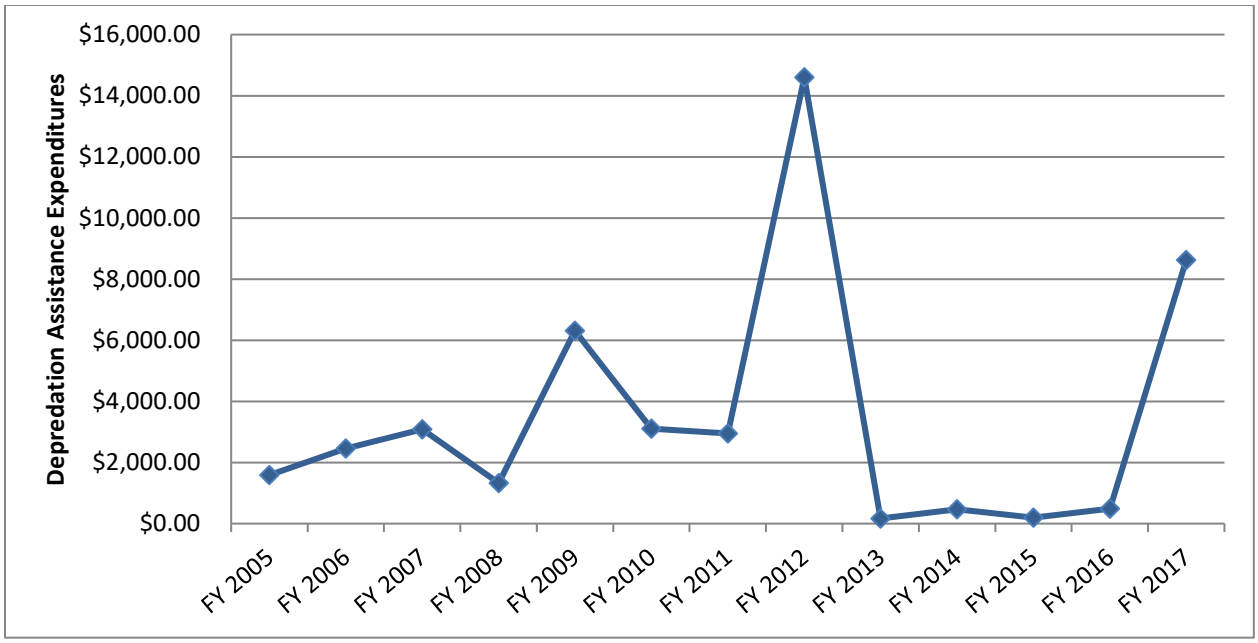


Figure 22. Annual expenditures of SDGFP's pronghorn depredation abatement programs and services, fiscal years 2005 - 2017. The total expenditure for this 12-year timeframe was over $45,000.

the winter-wheat. In Colorado however, researchers did not report damage from pronghorn that grazed wheat during the winter months when evaluating yield production (Torbit et al. 1993). Nonetheless, SDGFP has responded to these requests for assistance and utilized traditional forms of hazing techniques, but success has been limited.

First and foremost, SDGFP utilizes hunting as the primary management tool to address depredation concerns whenever possible. The SDGFP will send hunters to certain areas that are experiencing high usage. However, most depredation situations occur outside the timeframes of traditional hunting seasons requiring SDGFP to implement the other management techniques throughout their Wildlife Damage Management program. The SDGFP primarily focuses on non-lethal abatement techniques (primarily hazing) in most situations but may also utilize lethal techniques dependent upon certain circumstances. Hazing can be an effective management tool but takes repeated and consistent efforts to be effective. The SDGFP routinely works with landowners to employ different hazing practices to scare pronghorn away from problem areas when possible. These techniques include: pyrotechnics, propane cannons, hazing with ATV's or snow-machines, rubber bullets, and aircraft.

The SDGFP also implements depredation pool hunts in strategic locations where large herds exist and landowners are upset. In these cases, randomly selected hunters are enlisted to harvest pronghorn, free-of-charge, to reduce potential impacts to private property. These types of hunts occur after the pronghorn hunting season has ended and usually conclude by early-March. This management tool typically only removes a small number of pronghorn at a specific location, but

more importantly helps haze the remaining animals away from the immediate area because of the human disturbance and pressure. SDGFP staff may also utilize lethal control to remove a small number of pronghorn to help haze pronghorn away from the immediate area when authorized by the SDGFP Secretary (SDCL § 41-6-29). Any pronghorn that are removed are salvaged and donated to charitable organizations.

> *SDCL § 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.*

As human-wildlife conflicts continue into the future, SDGFP will continue to evaluate innovative strategies to potentially reduce these conflicts. These matters not only involve the management of pronghorn, but also include socio-economic and political dynamics that must be considered as well. The SDGFP must ensure that pronghorn populations are managed correctly and that management goals are being met. Defined wildlife population objectives and management goals are critical to effectively manage wildlife populations. The SDGFP also acknowledges that its wildlife damage management programs will not be able to completely resolve all issues regarding pronghorn depredation. However, SDGFP is committed to, and has a proven history of working cooperatively with private landowners to implement reasonable solutions to address wildlife damage concerns.

TRIBAL COORDINATION

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 23). Tribal lands within each reservation 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 pronghorn 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, pronghorn and other wildlife species thrive on these tribal lands, benefiting both wildlife watchers and hunters.

Figure 23. Tribal lands found in South Dakota. Source: South Dakota Department of Tribal Relations (SDDTR 2016).

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 pronghorn and other natural resources management is important. In developing recommendations for each upcoming pronghorn hunting seasons, regional SDGFP staff and tribal agencies discuss management options for firearm hunting units within tribal boarders. 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. Currently, cooperative pronghorn research and surveys have been limited. However, coordinated efforts occur with tribes to monitor disease outbreaks or severe winter loss. In addition, SDGFP staff coordinate pronghorn winter captures and survival monitoring closely with each tribe where animals are being radio-collared.

The SDGFP and some tribes are currently in the process of developing MOUs. The purpose of the MOUs is to formalize cooperative efforts between tribes and SDGFP where mutual interest exists to conduct collaborative operations. Collaborative operations between parties may include, but not be limited to the following: conducting and sharing wildlife surveys, developing big 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.

Collaboration opportunities exist between SDGFP and tribal agencies regarding pronghorn management. State pronghorn licenses are not valid on tribal-deeded land within a reservation and tribal licenses are not valid outside of deeded lands or between tribes. Hunting rules and regulations vary by tribe and hunters are encouraged to contact or visit the website of their tribal interest (Table 15). In summary, tribal lands offer substantial pronghorn habitat and additional opportunities for pronghorn hunters.

Table 15. 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.santeesiox.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.oglalasioux parksandrec.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.yanktonsioux tribe.net

INTER-STATE COORDINATION

There are currently several gatherings and events with other state wildlife agencies to coordinate pronghorn management efforts. The SDGFP meets frequently with the Nebraska, North Dakota and Wyoming Game and Fish Departments to discuss pronghorn and other species. In addition, SDGFP biologists meet and discuss pronghorn management issues, strategies, and research with other state pronghorn biologists at the Biennial Pronghorn Workshops (https://www.wafwa.org/workshops/). South Dakota will be hosting the Pronghorn Workshop in 2020, which will provide a unique opportunity for SDGFP staff to work closely with pronghorn researchers and managers across North America.

CITIZEN INVOLVEMENT AND OUTREACH

Effective decision-making by wildlife agencies necessitates the need to consider public perceptions, opinions and potential responses to management policies. Along with hunter harvest and biological data collected, public involvement is an important component in developing and implementing a Pronghorn 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 pronghorn 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 Pronghorn Management Plan. These approaches were designed to involve the public at various stages of plan development and to ensure opportunities for participation were accessible to all citizens.

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.

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, 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 pronghorn population objectives, season dates, unit boundaries, pronghorn 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 pronghorn populations and season recommendations. Upcoming meetings are advertised in local newspapers and can be found on the SDGFP website at https://gfp.sd.gov/events/.

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 pronghorn management. In addition to the public hearing process, the SDGFP Commission reviews department management plan drafts, related public comments, and formally adopts final management plans for implementation. All meeting agendas, minutes and other archived meeting documents can be found at https://gfp.sd.gov/commission/archives/.

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.

HABITAT AND GRAZING BEST MANAGEMENT PRACTICES

Ecological Setting and General Considerations

With land use across South Dakota's pronghorn range devoted primarily to agricultural production, and more specifically to livestock production, mindful stewardship of native grasslands,

reestablished grasslands, shrub-steppe habitats and associated riparian areas is critical to sustaining desired pronghorn populations. Northern mixed grass prairie plant communities with both cool- and warm-season grasses dominate native grasslands in central and western portions of the state with most production attributable to cool-season species such as western wheatgrass, and green needlegrass. Associated warm-season grasses such as blue grama, buffalograss (*Bouteloua dactyloides*), little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardi*), sideoats grama (*Bouteloua curtipendula*) are common depending on location. Readers should refer to the Natural Resources and Conservation Service Web Soil Survey https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm and electronic field guide https://efotg.sc.egov.usda.gov/#/details for detailed soils and ecologic site description information necessary to more fully understand the diversity and variability of upland grassland cover, associated forbs and shrubs that characterize the array of ecological sites (e.g., clayey, loamy, sandy, claypan, thin upland, etc.) that occur across South Dakota's pronghorn range. In general these plant communities are comprised of 80-90% grasses, 5-10% forbs and 5-10% shrubs. Along the western edge of the state these grasslands transition to sagebrush-steppe comprised of 65-85% grasses, 5-10% forbs and 10-25% shrubs.

Researchers have long recognized that plant community composition, quality and availability strongly influences pronghorn densities, recruitment, survival and seasonal movement (Yoakum 2006, Jacques 2006). They have also demonstrated that plant communities across the Northern Great Plains have changed considerably over time with widespread livestock grazing since European settlement (NRCS, https://efotg.sc.egov.usda.gov) and that like all rangelands they are complex and dynamic systems capable of a variety of responses to different management strategies (Barnes and Hild 2013). In order to manage South Dakota grassland and steppe habitats with pronghorn in mind it is essential to understand how these plant communities respond to effective grazing management based on application of four important principles: 1) matching livestock stocking rate to resource and the animal needs, 2) timing frequency and duration of grazing and recovery periods to resource constraints, 3) distributing animal use spatially to provide a diversity of plant offerings, and 4) moderating selection of those plants by grazing animals (Barnes and Hild 2013). The reader is referred to a special issue of the journal Rangelands, Vol 35, No 5 (2013) that contains many insightful articles about using strategic and adaptive grazing management decision making to achieve plant community, livestock production, profitability and a variety of other environmental services goals https://journals.uair.arizona.edu/index.php/rangelands/issue/view/1300.

Grazing management in its' simplest form is a series of defoliation events and recovery or rest periods. Researchers and progressive practitioners have long known that in order to manage for specific goals such as forage production or quality habitat for wildlife, it is critical to provide particular attention to grazing timing, duration and plant community recovery following grazing periods (Hormay 1956). The traditional practice of season long grazing in relatively large pastures in the Northern Great Plains since settlement typically did not allow for adequate recovery and composition of plant communities shifted due to overuse of preferred plants (NRCS, https://efotg.sc.egov.usda.gov). Fortunately, most producers have adopted some form of rotational (deferred or rest) grazing plan over the last few decades and opportunities to enhance rangeland for

pronghorn have improved. Maintenance, enhancement or recovery of shrubs such as big and silver sagebrush and a host of native forbs known to be particularly important to pronghorn may require special planning and diligence by managers. Steffens et al. (2013) provide an excellent treatment of adaptive grazing management principles to guide managers interested in specific plant community recovery goals. The following are their summary guidelines:

Guidelines for Providing Adequate Recovery:

Grazing strategies designed to provide sufficient recovery between defoliations should plan for and focus on desired responses of preferred species or functional groups on preferred parts of the landscape. The following should be considered:

1) How long is required for target plants to achieve target physiological development after being defoliated to the observed intensity under good growing conditions, and when are these growing conditions likely to occur? This would be the minimum period required between defoliations.

2) The number of days available in a "normal" year for rapid growth is then used to assess how much time is actually needed. This assessment should take into account moisture, optimum temperature, and photoperiod requirements for the species of concern; the degree to which it was defoliated; and the period of potential growth still available for the plant to recover.

3) If a desired plant species decreases in palatability during the year, a paddock may be available for grazing more often than the required period between defoliations would indicate, as that plant species may be ungrazed in a subsequent grazing period if it is less palatable than alternatives.

4) Longer deferment may be required for target plants that reproduce vegetatively, as establishment of new individuals from tillers, stolons, or rhizomes will likely take more time and require more resources than simply replacing tillers to maintain the plant.

5) To avoid defoliation during germination and seedling establishment, further increases in length of deferment may be necessary.

6) With an adequate seedbank, seed production may not be necessary. However, if seeds of species that do not reproduce vegetatively are not common in the seedbank—particularly desirable plants like winterfat (Krascheninnikovia lanata) or fourwing saltbush (Atriplex canescens) that have short periods of seed viability—plants may need to set seed regularly.

7) The frequency with which conditions conducive to recruitment occur may have some bearing on the length of planned recovery, but will certainly give some indication of how often notable changes in plant composition are likely.

Pronghorn Habitat Best Management Practices

Careful consideration of the above recovery guidelines in consultation with range management experts such as NRCS range managed specialists, consultants or other resource agency (SDGFP, USFWS, BLM) staff should be used to more fully inform the implementation of the following general BMPs to maintain, enhance or recover high quality grassland and shrub steppe-habitat for pronghorn and other wildlife in South Dakota.

1. Develop grazing management plans and goals using established planning principles to:
   - Identify current conditions – where are you now
   - Identify realistic goals and objectives – where you want to be
   - Implement strategies to move toward goals and objectives – how you get there
   - Monitor and assess to evaluate progress – how are you doing
   - If necessary, adapt new strategies to change course – practice adaptive management

2. Use technical and/or financial grazing management assistance available from resource agencies such as NRCS, SDSU Extension, SDGFP, USFWS, as well as other conservation organizations such as the SD Grassland Coalition, Northern Great Plains Joint Venture, Audubon and non-governmental organizations engaged in grassland conservation initiatives across the Northern Great Plains.
   - Use NRCS web-based resources to guide management planning (e.g., NRCS electronic field guide and relevant technical notes – Tech Note No. 9)
   - Learn to identify important rangeland plants, where they occur on the landscape and understand their physiology and phenology
   - Attend SD Grassland Coalition annual grazing school and other available grazing management workshops

3. Work with NRCS staff to complete a range inventory and forage balance to guide livestock stocking decisions and ultimately develop a managed grazing plan that includes a drought plan with specific actions identified to respond to drought induced rangeland stresses.

4. Develop management grazing plans with specific plant community management and enhancement goals that thoroughly address the following:
   - Plant community composition, distribution, similarity indices, rangeland heath and apparent trends – all tasks steps will likely be completed by NRCS staff
   - Timing, frequency, duration and distribution of use in each pasture based on forage and animal inventory and goals related to maintaining or changing species composition of grasses, forbs and shrubs present

- Control of utilization rates as per NRCS recommendations based on plant community goals and specific grazing plan considerations
- Selectivity of grazing use by livestock and wildlife present
- Cross-fencing needs to better management stock density, grazing efficiency and recovery/rest
- Water development needs
- Recovery periods need to be tailored to physiology of desirable plants important for forage production and wildlife values
- Regular growing season deferment of desirable plants is necessary to maintain or increase proportional representation. Low moisture and the need for new plant recruitment will likely require recovery periods of a year or more (Steffens et al. 2013).

5. Develop record keeping and an annual monitoring assessment protocols that include:
   - Precipitation records
   - Stock number, type and performance records
   - Grazing days – animal use days per pasture
   - Utilization estimates
   - Establishment of annual qualitative and/or quantitative assessment methods such as permanent photo points, detailed recorded observations or quantitative repeatable line transect surveys to track trends in bare ground, litter, species relative abundance and percent defoliation of target plant species or groups (e.g., forbs)

6. Consider pronghorn specific management objectives and strategies including:
   - Maintenance and/or recovery of native shrubs or subshrubs particularly important to pronghorn for both foraging and hiding cover for neonates (e.g., big sagebrush, silver sagebrush, rubber rabbitbrush (*Ericameria nauseosa*), saltbush, winterfat, leadplant (*Amorpha canescens*), dwarf indigo (*Amorpha nana*), greasewood (*Sarcobatus vermiculatus*), etc.)
   - Maintenance and/or recovery of a diversity of palatable native forbs that are critical pronghorn forage throughout the year – species occurrence based on NRCS ecological site descriptions
   - Management of areas to maximize overstory height of grasses and shrubs, understory height and distribution of clumped vertical structure to provide adequate concealment cover for neonates (Jacques 2006)
   - Removal of woven-wire fence no longer necessary to control sheep grazing
   - Use of wildlife friendly fence designs with smooth bottom wire no lower than 18 inches from ground and use of seasonal gates or fence let-downs at traditional wildlife crossing sites
   - Use of permanent and/or temporary electric fences for interior cross fencing necessary to implement grazing plans. Electric fences are effective, economical and wildlife friendly

- Assuring access to water in very large pastures during times of severe drought or during winters without snow cover
- Delay spring livestock turn out in known traditional pronghorn fawning areas until mid-June after most pronghorn parturition has occurred

7. Reestablishment of diverse native grass, forbs and shrub communities using appropriate NRCS ecological site species recommendations on marginal crop or hay lands for planned grazing purposes.

8. Management of cool season exotic grasses such as annual bromes, smooth brome, crested wheatgrass and Kentucky bluegrass with intense early spring grazing with high stock densities following NRCS or other expert guidance. Timely prescribed fire, fire and grazing, application of herbicide, mowing and application of herbicide and grazing annual forages on cropland after invaded pastures are intensively grazed are other techniques to consider in consultations with experts.

9. Management of encroachment of eastern red cedar (*Juniperus virginiana*), Rocky Mountain juniper (*Juniperus scopuloru*) and ponderosa pine into otherwise diverse grass, forb and shrub communities with mechanical removal, prescribed fire and even grazing with goats.

10. Management of noxious weeds such as leafy spurge (*Euphorbia esula*), Canada thistle (*Cirsium arvense*), perennial sow thistle (*Sonchus arvensis*), Russian knapweed (*Rhaponticum repens*) and salt cedar (*Tamarix spp*.).

11. Consider protection of intact native grasslands and associated agricultural lands under private ownership with conservation easements to sustain grass-based livestock production, wildlife and other environmental services these lands provide.

CHALLENGES AND OPPORTUNITIES

Habitat Loss, Conversion, and Fragmentation

In recent years, the northern plains grasslands have been subjected to substantial habitat conversion to agriculture and infrastructure, such as roads and fencing. Claassen et al. (2011), Forrest et al. (2004), and Jones et al. (2018) estimated that 770,000 acres of rangeland in the Northern Plains were converted to cultivated crops between 1997 and 2007. Habitat conversion, fragmentation and movement impediments from fencing and roads are constant threats to species dependent on grasslands. This is particularly true for migratory species such as pronghorn, as they require the ability to move between seasonal ranges or in response to extreme climatic and vegetative conditions (Autenrieth et al. 2006, Gates et al. 2012, Jones et al. 2018).

Throughout pronghorn range in the western United States, it is estimated that 53% of pronghorn populations occur on grasslands, 47% on shrub steppes, and <1% on deserts (O'Gara and Yoakum 2004). In South Dakota, most of the pronghorn population occurs in sagebrush habitat interspersed with grasslands with lower densities occupying rolling grasslands habitat. In the western portion of the pronghorn range, public lands controlled by the BLM, or the USFS hold a considerable number of pronghorn. Within these public lands habitat protection and enhancement can occur for the benefit of pronghorn.

The central and eastern portions of the pronghorn range in South Dakota consist of grasslands/agricultural mix. The conversion of rangeland landscapes to more agriculture row-crops decreases available habitat for pronghorn, although pronghorn may utilize limited agriculture crops during some seasons. Of additional consideration is that conversion of prairie to agriculture decreases social tolerance levels of pronghorn by private landowners and decreases the ability of SDGFP to manage for abundant pronghorn resources on the landscape.

As stated above, Claassen et al. (2011) estimated that 1% of 1997 rangeland acreage in the Northern Plains was converted to cultivated crops by 2007. No comprehensive and current source of information exists on the conversion of grassland to cropland or on the resulting farm program payments for newly converted land. However, the data that are available show a decline in private grassland ownership nationwide, continuing conversion of native grassland to cropland in some areas of the country, and that certain farm program incentive payments made to producers in South Dakota counties experiencing high conversion rates, were significantly higher than payments in other counties (USGAO 2007).

Ranching in South Dakota is important to maintaining native rangelands critical to the conservation of pronghorn and numerous other wildlife species. Lands utilized by ranching operations are not cultivated for farming nor lost to urbanization or other non-wildlife supportive land conversions.

Early livestock grazing programs often encouraged the overstocking of western rangelands. However, current management practices exist today for private and public land managers that can be compatible with multiple wildlife species and ranching. Grazing regimes that avoid year-long use of rangelands, practice seasonal rotation of grazing pressure, avoid overstocking, annually rest some areas from grazing, protect riparian habitats, and maintain some residual vegetative cover provide important habitat for pronghorn, other wildlife species, and livestock.

Natural vegetative communities of pronghorn rangeland contain a variety of grasses, forbs and shrubs, and range improvements that best suit pronghorn are those that produce mixed forage classes (O'Gara and Yoakum 2004). Pronghorn thrive on rangelands in subclimax vegetative conditions and habitat manipulations such as fire, mechanical treatment, and grazing at times are beneficial to the species. Fires on native mixed grasslands of the Great Plains are important for maintaining vegetative structure and function.

Shortgrass prairies are considered the most productive extant habitats for pronghorn. However, tallgrass prairies that are managed for decreased height of herbaceous vegetation will meet pronghorn habitat requirements (Lee et al. 1998). Habitat projects focused to control shrub species should not eradicate all shrubs because many shrubs (e.g., low sagebrush (*Artemisia arbuscula*), winterfat) are preferred and highly nutritious forage for pronghorn. During the winter, shrubs are highly nutritious and may be the primary forage available, and in spring shrubs provide concealment cover important to neonates (O'Gara and Yoakum 2004).

Energy development

World population growth fuels the demand for natural resources. The world population grows at 1.24% per year, yielding an additional 83 million people annually (United Nations 2017). Global energy needs are projected to exceed population growth by expanding by 30% between 2018 and 2040 (EIA 2018a). Currently, energy development surpasses urbanization as the largest driver of land use change in the United States (Trainor et al. 2016).

Energy development refers to traditional fossil fuel sources (oil and gas), transitional resources (geothermal and nuclear), and renewable resources (wind, solar, biofuels). Renewable energy sources are the fastest-growing energy sector (EIA 2018a), but fossil fuels are still the most widely used and account for over 77% of projected energy use. Energy Information Administration (EIA) projections find the United States to be the largest consumer and becoming a net exporter of all sources of energy by 2022.

By the year 2035, over 75,000 mi^2 of new lands will be affected by various forms of energy development in the United States (McDonald et al. 2009). In the western US, energy development often results in widespread landscape conversion to areas previously devoid of agricultural, cattle grazing, and wildlife conservation.

Habitat loss and fragmentation is identified as the primary cause of species endangerment, along with threatening biodiversity in the contiguous US (Czech et al. 2000). The methods of energy development have varying degrees of effects on habitat loss. When compared to other sources of energy production, biofuel, nuclear, solar, and hydropower, essentially eliminate available habitat thereby having a large direct spatial change to existing habitat (McDonald et al. 2009). The degree of habitat fragmentation affects associated infrastructure (roads, traffic volume, facilities, fences) of various energy sources (Dyke et al. 2011). Production techniques like wind, geothermal, and well drilling temporarily clear vegetation from pads, and have about 5% of their impact from direct removal of habitat, while the remaining 95% of the impact is fragmented habitat (McDonald et al. 2009). Roads and fences potentially cause direct mortality from pronghorn-vehicle collisions and entanglement in fencing, but the primary threat of this infrastructure is indirect habitat fragmentation (Hebblewhite 2008).

Extensive energy development is thought to pose a serious threat to pronghorn populations and their habitat (Sawyer et al. 2002). Impacts to wildlife species may be defined as, the change in a population's reproduction and survival, caused by some type of disturbance (Anderson 1999). Dyke

et al. (2011) reported in North Dakota that as of May 2010, 6,800 acres of habitat were directly lost due to oil pad construction and 17% of all square mile sections within pronghorn range have oil and gas development. Although the direct loss or alteration of habitat is always a concern, it is the indirect and cumulative effects (infrastructure, roads, increased vehicular traffic, fragmentation, fences) of oil and gas development that are of concern for reducing suitable pronghorn habitat. In a North Dakota study, Kolar (2009) reported that during summer, pronghorn were twice as likely to use areas that were >1.2 miles from primary roads, and were 2 times more likely to use areas >1.9 miles from secondary roads than areas <0.6 miles from secondary roads. Pronghorn avoided secondary roads in the winter and were 7.5 times less likely to select areas <0.6 miles from secondary roads than they were to select areas >0.6 miles. Gavin and Komers (2006) also found that pronghorn in Alberta spent a higher proportion of time foraging at sites > 300 m from roads. Behavioral studies of pronghorn populations in western North Dakota found avoidance of developed areas, roads, or high-value habitats that were close to oil wells (Christie et al. 2015). Reinking (2019) found pronghorn use of high valued sagebrush habitat near energy development is less about tolerance, and more of an indication of development in essential habitat.

Oil and gas development and associated infrastructure creates widespread landscape level change (Jones and Pejchar 2013). Ellenberger and Byrne (2011) suggest that further loss and fragmentation of habitat due to energy development in the Colorado/Wyoming state line area is very likely to cause additional declines in big game populations or make it very difficult for populations to recover to previous levels. In a Wyoming study, Beckmann and Seidler (2009) identified migrating pronghorn avoid more densely developed areas (oil well pads and roads) in the Pinedale Anticline and Jonah fields. Avoidance behaviors, habitat loss and fragmentation on a landscape scale together become energy development's cumulative impacts.

While a majority of studies focus on the impacts of oil and gas development in pronghorn habitats, other energy sources have impacts on pronghorn populations and habitats. Pronghorn responses to coal and uranium mining activities are found to be similar to that of oil and gas development, but on an entirely different scale. Segerstrom (1982), identifies indirect habitat loss from human activity surrounding a mine site, increases the total habitat loss to 2-3 times the direct habitat removal for the mine itself. Direct effects of mining can be mitigated by reclamation soon after disturbance; often improving vegetative structure and nutrient content of forage (Medcraft and Clark 1986, Lutz et al. 2011). Unlike some sources with slower economic returns on energy production, reclamation of mined energy sources more quickly reduces the direct impact on habitat.

Mining and energy development occur in areas of South Dakota where SDGFP has identified high pronghorn densities (Figure 24). Through time, mining projects in South Dakota's pronghorn country have included coal, uranium, bentonite and aggregate. Bentonite and aggregate mining are still important industries and an interest in uranium mining persists in the Fall River and Custer Counties (Azarga Uranium Corporation 2018, EIA 2017). Coal is no longer commercially mined in South Dakota (EIA 2018b). Sand and gravel are produced in nearly every county in South Dakota (USGS 1999), but deposits in western South Dakota tend to be outside of high-density pronghorn areas.

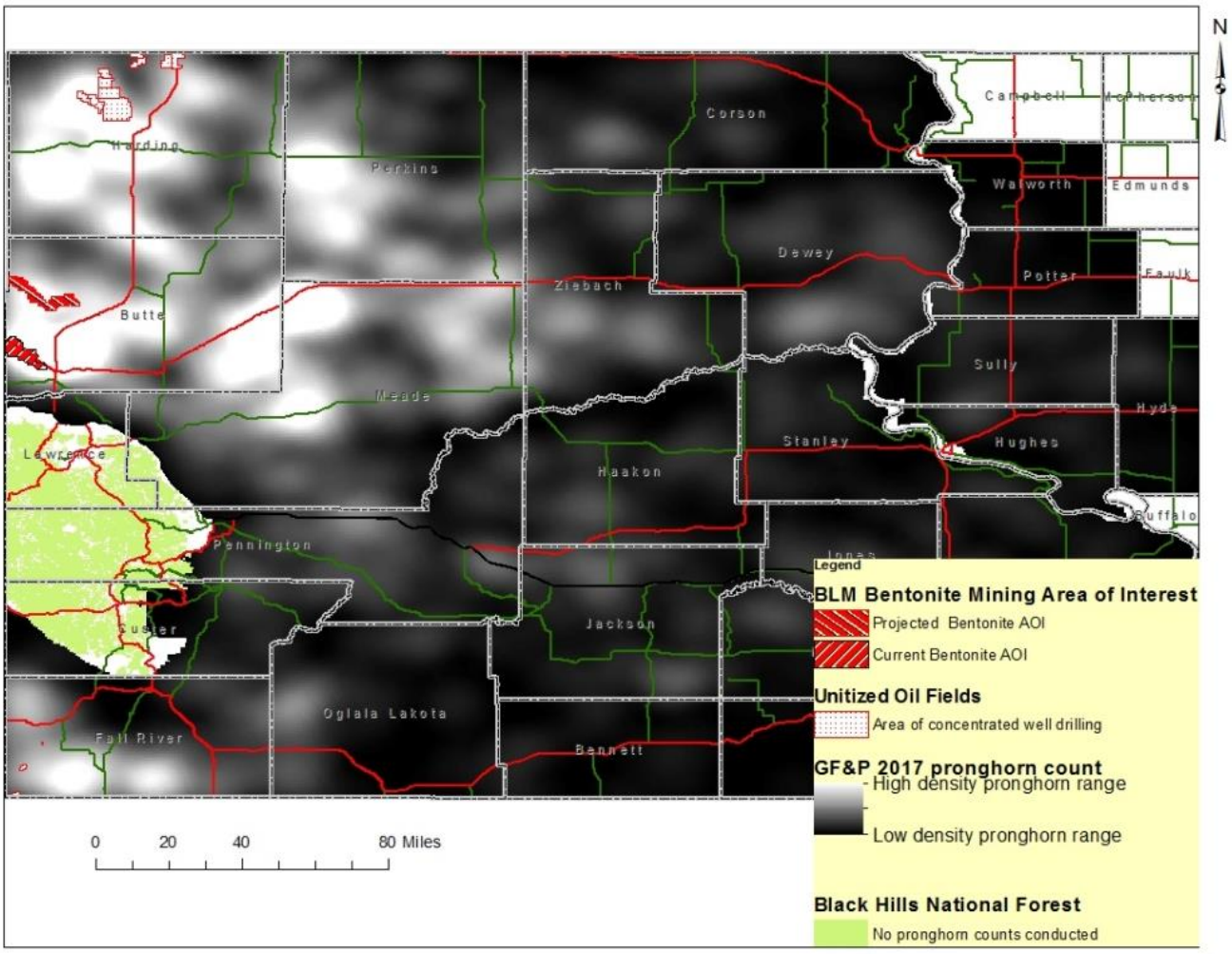


Figure 24. South Dakota bentonite mining areas of interest and current operations along with oil well concentrations, 2015-2018.

The state's important wildlife resources are protected by South Dakota mining law. Land may be determined unsuitable for mining if important resource impacts cannot be adequately mitigated (SDCL § 45-6B-33, Appendix F). Large and small scale mine sites must undergo "special, exceptional, critical, or unique lands" determination, and identification of critical wildlife resources during permitting (SDCL § 45-6B-92, Appendix F). Oil and gas development impacts are more formally mitigated by BLM management plans, which cover 2 million acres in South Dakota, than by South Dakota State Law (BLM 2015).

Some of the best wind resources in the U.S. place South Dakota in a position to become a national leader in wind power generation (AWEA 2018, Kunkle 2017, NRC 2018). Statewide, 4,000 megawatt of new wind power is under development (Chase and Kubert 2018). Most projects are sited in the

eastern part of the state and away from areas SDGFP identifies as high-density pronghorn use. Insufficient transmission capabilities, policy and public concerns are impediments to widespread wind generated electricity (Oteri et al. 2018). Higher ridgelines in western South Dakota are rated as having good site potential and could be considered for future development.

Wind generated electricity is one of the most land-use efficient forms of renewable energy when considering only 3–5% of the impact is direct clearing of habitat (McDonald et al. 2009). As with other types of energy production involving pads, the remaining 95% of the impact is indirect from spacing and activities surrounding the turbines that reduce habitat effectiveness (McDonald et al. 2009). When compared to other sources of energy, the low output-long payback profitability of renewable energy sources generally have a greater energy footprint of cumulative landscape level impact per unit of energy generated (Trainor et al. 2016). Studies however, show pronghorn demonstrate only slight avoidance of wind turbines (Baynard et al. 2017). Additionally, proximity to a wind energy facility did not affect winter survival of pronghorn herds in Wyoming (Taylor et al. 2016).

Biofuels include ethanol and biodiesel obtained from cropland and other fuels from various forms of vegetation biomass. Biofuels accounted for two thirds of the direct land conversion for U.S. energy development, despite comprising only 6% of total energy production (Taylor et al. 2015). An Energy Information Administration (EIA) analysis forecasts that biofuel use will increase dramatically in importance and area of extent (EIA 2018a). Nationally, cropland is largely shifting from urban-fringe farmlands to western U.S. rangeland (Emili and Greene 2014). In the semi-arid Great Plains where the most significant pronghorn densities are found, land use change to cropland is dependent on climate variability, shifts in farm policy, and technology (Taylor et al. 2015). Nationally, biofuel production has stimulated crop prices that in turn have resulted in the loss of grassland habitat to crop production (Fargione et al. 2009, Wiens et al. 2011). In the western part of South Dakota, a 25% increase in cropland acres was identified between 2006 and 2012 (Reitsma et al. 2014). National policy will foster expansion of biofuel use and associated land use conversion. Other factors such as climate and technology will also influence the rate of land use change on South Dakota's pronghorn range.

The agricultural setting and geological resources of South Dakota place it in a position to advance both transitional and renewable resources such as carbon sequestration, geothermal, biofuel, wind, solar, and nuclear (Johnson et al. 2005).

Fences/Movements

From 2002-2005 in South Dakota, 84% of radio-collared pronghorn did not migrate from established summer ranges to winter ranges and 10% were conditional migrants (Jacques et al. 2009). However, severe winter weather can cause pronghorn to move out of established ranges to new areas looking for forage that is not covered in snow. The SDGFP (1965) reported that a large western influx of pronghorn from Montana and Wyoming occurs in the excellent winter range found in Butte County. It was also suggested interstate movement occurs from west to east during some summers as the rangeland vegetation dries; movements were reported from Wyoming to Fall

River County, Fall River County to Nebraska. Therefore, certain types of fences can cause major problems on pronghorn range. Woven wire fences that are used to contain domestic sheep are a major obstacle to pronghorn movement. Fences can restrict seasonal movements, and during severe winters may cause substantial mortality of pronghorn by preventing southerly migrations to areas with less snow. Fences can also prevent access to water and feeding areas. Autenrieth et al. (2006) suggest that the most compatible fence design to allow pronghorn movement consists of three strands of wire, a smooth bottom wire 16-18 inches above ground, and a total height of no more than 36 inches. Jones et al. (2018) evaluated pronghorn responses to fence modifications and found that a smooth bottom wire at a height of 18 inches from the ground was the most effective for pronghorn to pass under.

The SDGFP currently provides financial assistance to private landowners to replace woven wire fences with pronghorn-friendly fence designs. The SDGFP Wildlife Friendly Fence (WFF) program is designed to facilitate ease of movement of wildlife through the landscape by replacing obstructively designed fences with a more passable alternative in order to minimize collisions, entanglement, predation, and avoidance by wildlife. Implementaion of this program is determined by a SDGFP representitive and may be denied due to funding limitations or the location on the landscape. Cooperators receive a maximum payment of $0.65/foot for material reimbursement to construct a fence of this design (Figure 25). The cooperator will be responsible for costs associated with construction and maintenance. The fence must remain as specified for ten years post construction. Since 2011, SDGFP has worked with 22 cooperators to replace 46 miles of woven wire fence in Meade, Perkins, Harding, Butte, Dewey, and Lawrence Counties (Figure 26).

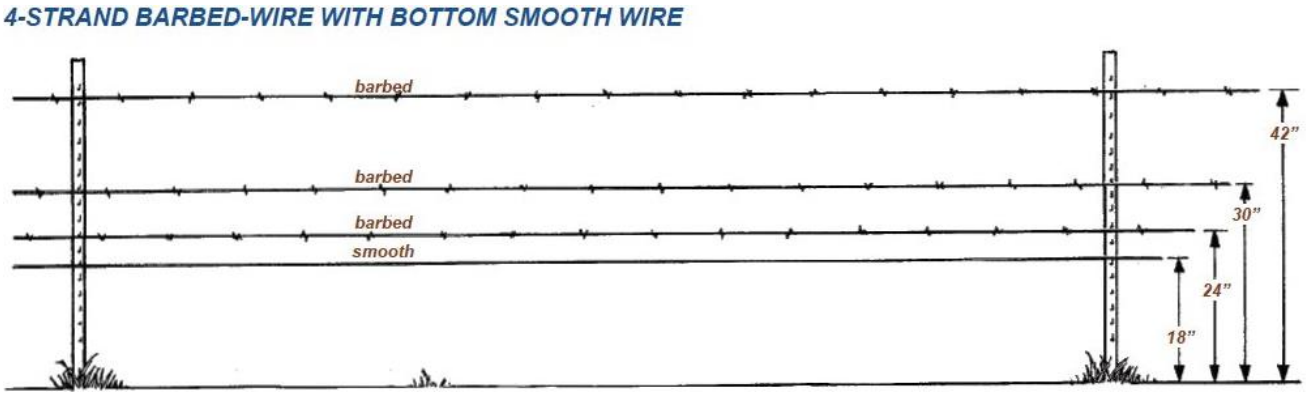


Figure 25. Wildlife Friendly Fence Design (Hanophy 2009).

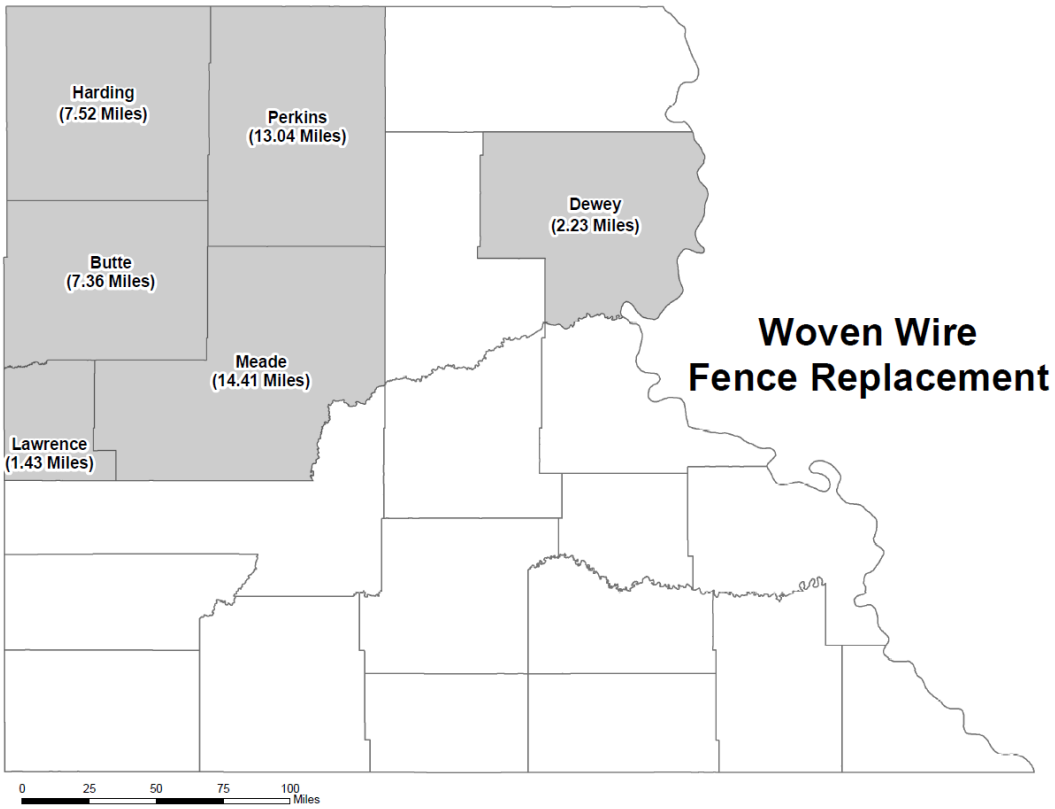


Figure 26. Woven wire fence replaced through SDGFP Wildlife Friendly Fence Program in western South Dakota, 2011-2018.

Hunter Access

One challenge is to provide enough public hunting access to fill the need to retain existing pronghorn hunters and recruit new pronghorn hunters. Fortunately, the SDGFP can purchase land as GPAs as well as lease private land through the WIA and CHAP for public hunting access. The downside of providing more public hunting opportunity is that hunters become less willing to develop landowner relationships 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.

The 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 GPAs 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 requests 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.

Hunting Regulations

License Allocation

South Dakota offers three different pronghorn seasons: Mentor, Archery and Firearm. Within the firearm pronghorn season, there are also Landowner-own-land pronghorn licenses for those that meet eligibility requirements. Unit-specific and limited license allocations are implemented for the firearm seasons, while the mentor and archery seasons offer an unlimited number of licenses.

The unregulated pronghorn harvest that can occur from the mentor and archery 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 pronghorn population objectives. In 2012, administrative rules were promulgated which closed hunting units for the mentor and archery season for those hunting units that were closed for the firearm pronghorn hunting season.

As with most other game seasons, hunting regulations and license allocations are recommended by SDGFP staff and finalized by the SDGFP Commission 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 potentially survive to one year of age contributing to the reproductive potential. The timing of these recommendations can create challenges for wildlife managers when uncontrollable events including severe winter or drought that could potentially affect survival and cause additive mortality. Therefore, the collection of long-term annual survival, fawn:doe ratios, buck:doe ratios, other biological data, and winter severity indices are critical for population modeling, which allows the Department to make science-based decisions in developing harvest recommendations and hunter opportunities. The SDGFP has made substantial investments in the collection of biological data and continues to improve population models in projecting 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 pronghorn management, license allocation, and hunter opportunities into the future.

Pronghorn Drawing System

The limited firearm 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. Beginning with the 2018 hunting season, all preference points are now cubed. For example, applicants with two preference points will basically have their name put into the draw system eight times, applicants with 3 preference points will be put in 27 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 license 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 or if an applicant chooses not to apply in the first draw. Since demand for license types for certain hunting units within a season vary widely, it is difficult to inform pronghorn hunting applicants on their general chance of drawing a pronghorn license. Applicants can view unit and season draw statistics, however, at https://apps.sd.gov/gf79license/DrawResultStat.aspx to learn more about individual drawing odds for a particular hunting unit.

The draw process for limited pronghorn licenses involves several stages. For the general firearm pronghorn season (Figure 27), 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 pronghorn license, however, are restricted to land owned or operated by the qualified applicant. Landowners who do not receive a license during the normal firearm draw are eligible to receive a reduced-price pronghorn 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 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.

The pronghorn license drawing process for CSP is different than all other hunting units (Figure 28), due to the extremely high demand by hunters for a very limited number of pronghorn licenses.

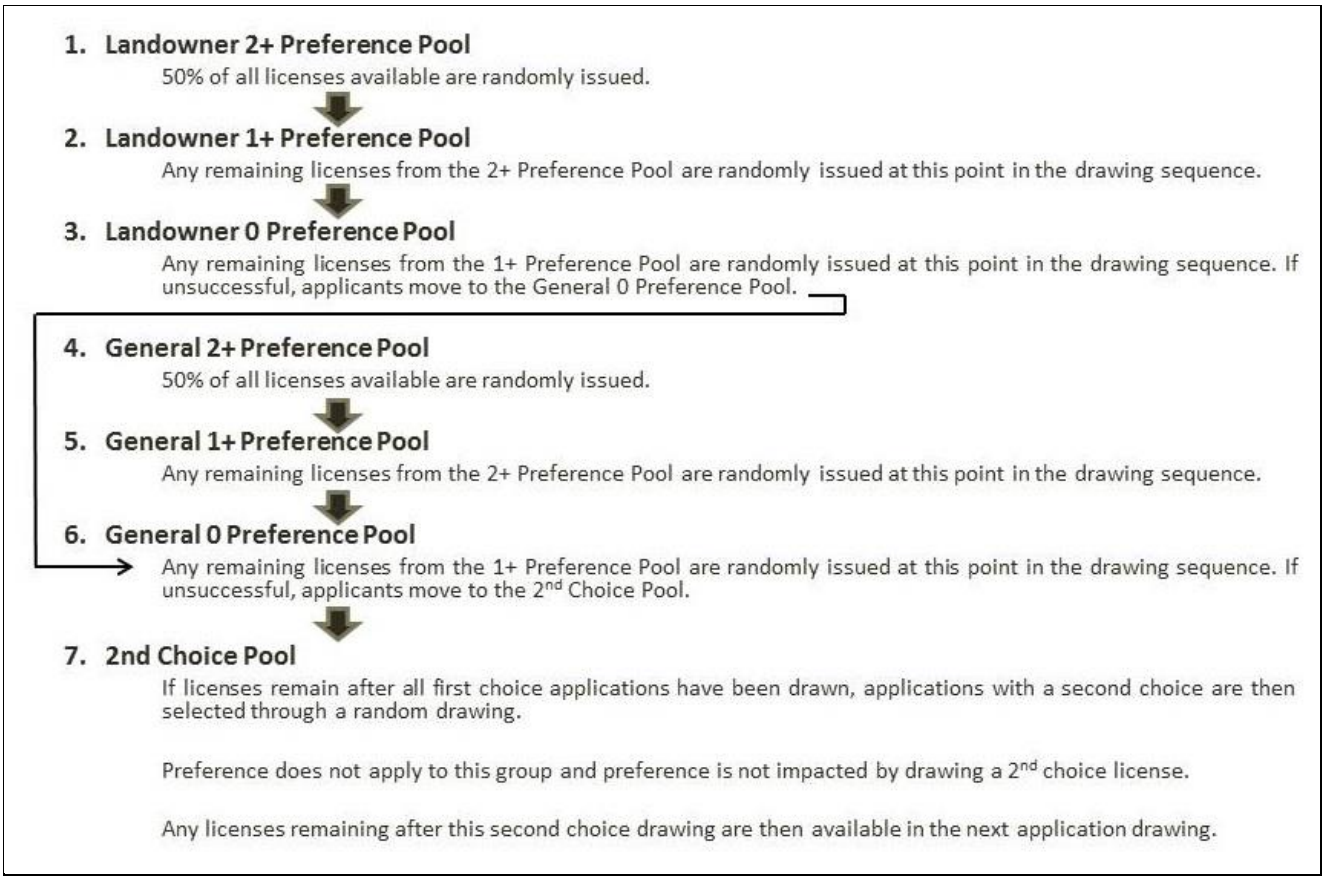


Figure 27. Pronghorn firearm license drawing process (excluding Custer State Park).

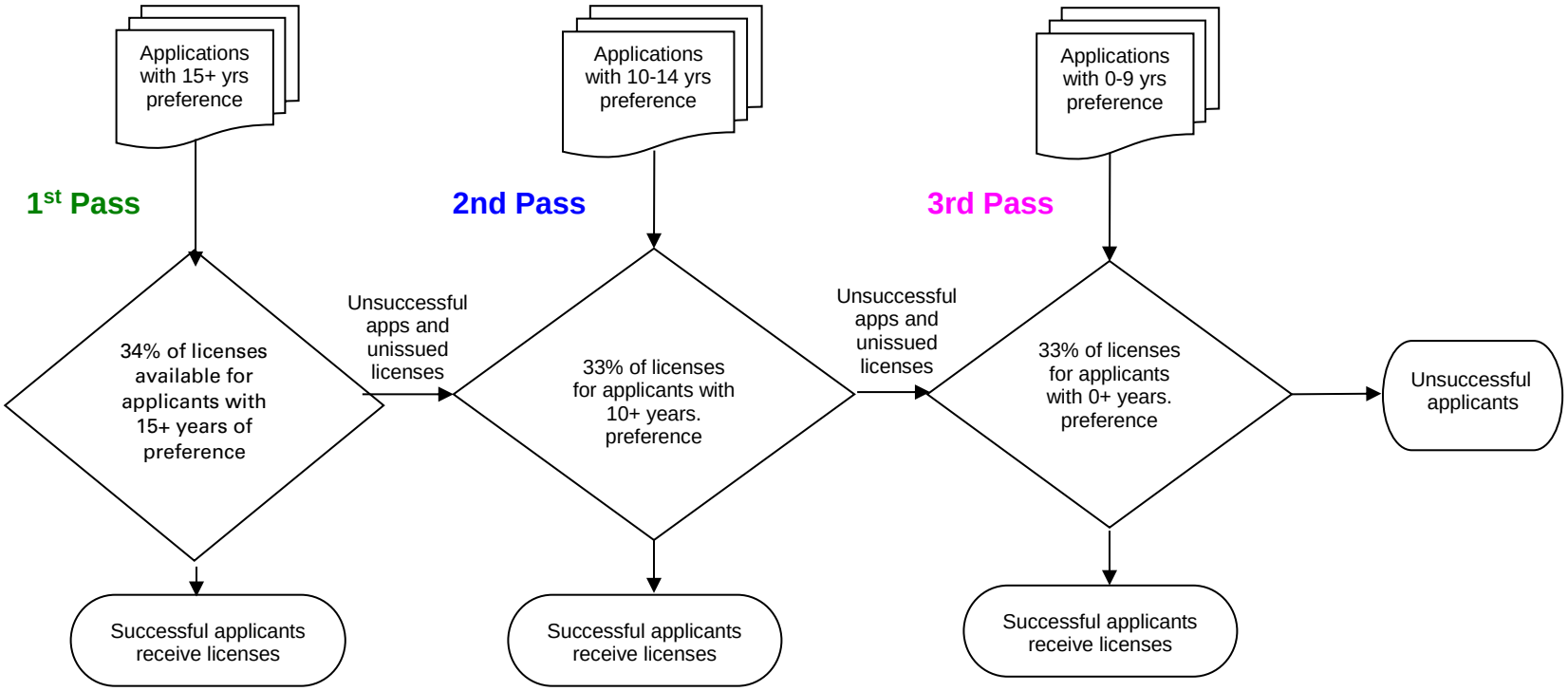


Figure 28. Pronghorn license drawing process for Custer State Park.

For nearly the past decade, hunter demand (both resident and nonresident) for "any antelope" firearm licenses exceeds supply in several pronghorn hunting units, in particular those hunting units with high pronghorn densities and a significant amount of public land. This demonstrates the high level of interest and willingness to travel for pronghorn hunting opportunities in South Dakota. Table 16 shows the top 11 highest demand firearm hunting units in 2018. Nonresident license allocation is determined based on population unit objectives, and ranges from a low of 2% in units that are below objective to a high of 8% in units that are above objective (see *Harvest* Strategies section).

Table 16. License draw statistics for the highest demand pronghorn firearm hunting units in 2018, South Dakota.

2018 Firearm Pronghorn Draw Statistics

			Residents			Nonresidents		
Unit Description	**Unit**	**Type**	**Appl. 1st Choice**	**Available**	**App Success**	**Appl. 1st Choice**	**Available**	**App Success**
F River/Custer SW	27A	41	1,497	550	37%	83	11	13%
Meade N	49A	41	906	500	55%	62	10	16%
Butte/Lawrence	15B	41	866	300	35%	47	6	13%
Harding W	35A	41	843	300	36%	115	6	5%
Butte NW	15A	48	746	300	40%	85	12	14%
Perkins S	53B	41	610	250	41%	45	5	11%
Harding E	35B	41	566	300	53%	78	6	8%
Meade S	49B	41	425	300	71%	25	12	48%
Pennington E	02A	41	328	150	46%	15	3	20%
Custer E/ Penn C	21A	41	306	125	41%	10	3	30%
Perkins N	53A	41	306	150	50%	46	3	7%

Landowner Preference

As described in the *Private Lands* section of this plan, up to 50% of all pronghorn licenses made available in each management unit for the firearm hunting season are available to those who qualify for landowner preference. While the public, including pronghorn hunters, understands the important role of farmers and ranchers for providing wildlife habitat and hunting opportunities, some pronghorn hunters question the 50% allocation of these licenses to qualifying landowners when they can already purchase a reduced price Landowner-own-land "any antelope" license valid on the property they own or lease.

Hunter demand is high for licenses that provide the opportunity to harvest a buck. In 2015, 15.4% of the "any antelope" licenses for the firearm pronghorn season were issued to those applicants qualified for landowner preference, compared to 5.1% in 2008 (Table 2 and Figure 29). As expected, as the supply of "any antelope" licenses decreases, the proportion of available licenses issued to those applicants qualified for landowner preference increases.

A more detailed analysis of "any antelope" license types issued to those qualifying for landowner preference can be found in Table 17. The percent of "any antelope" 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% of the total number of licenses allocated per hunting unit. Unlike what has been observed in some deer hunting seasons, larger farm/ranch sizes and lower human population sizes per county or pronghorn hunting unit creates less demand for obtaining these limited draw firearm licenses.

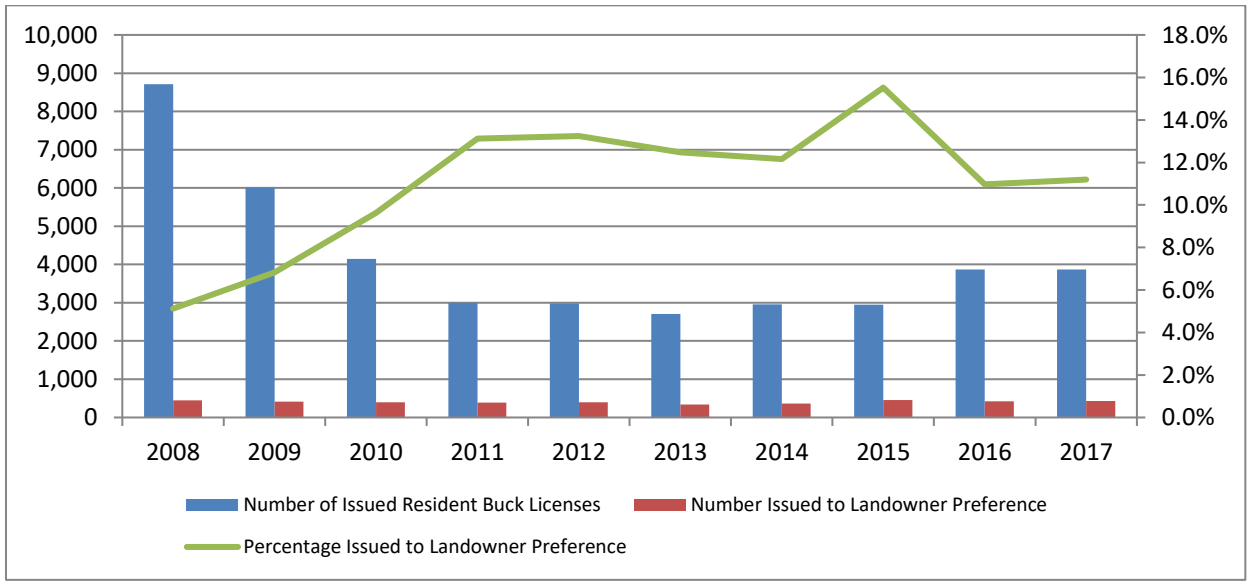


Figure 29. Firearm "any antelope" license sales and landowner preference statistics, 2008-2017.

Table 17. Percent of "any antelope" licenses by hunting unit issued to those applicants with landowner preference for the firearm pronghorn season, 2014-2017.

Percent	2014	2015	2016	2017
>50%	3	2	3	3
40-49%	1	0	4	1
30-39%	2	3	1	1
20-29%	3	3	4	6
10-19%	7	5	6	4
0-9%	9	9	4	2

*The number listed under each year indicates the number of hunting units that correspond to the percent category in the first column.

There are numerous opinions related to landowner preference for deer, elk and pronghorn licenses. For those landowners that support/tolerate big game on their lands throughout the year, a license is a way to reward them for the habitat they provide and big game depredation that may occur on their property. Landowner preference pronghorn licenses may increase landowner tolerance and the social carrying capacity for pronghorn on the landscape, which in return maximizes pronghorn hunting opportunities for all hunters.

Harvest Strategies

When determining population objectives, SDGFP staff review and analyze recruitment rates, population estimates, harvest levels, hunter success, hunter comments, depredation complaints, and landowner and public input. Once population objectives are defined, SDGFP staff develop season recommendations that strive to provide the most hunting opportunity, while shifting the population towards management objectives. The SDGFP has defined unit-specific population objective (Appendix C), which are based on input from sportsman, landowners, and other publics of South Dakota. Methods used to collect public input include hunter opinion surveys, landowner opinion surveys, harvest report cards, regional open houses, SDGFP Commission meetings and staff contacts (personal, phone, email). It is important to note that the biological and social considerations used to develop these population objectives are not static and may change over time.

Depending on population densities and objectives within each pronghorn management unit, SDGFP staff utilizes harvest strategies (Table 18) to guide management decisions. This table is presented as a guide to appropriate harvest options available for local herds based on unit objectives and herd status. This table defines harvest strategies presently available and will be modified as needed if other options become available in the future.

Table 18. Harvest management strategies used by SDGFP managers and biologists dependent on unit objectives and population estimates.

"TOOLS"	RESTRICTIVE **Increase Popn Objective**	MODERATE **Maintain Popn Objective**	LIBERAL **Decrease Popn Objective**
Doe harvest rate[1]	0-10% of adult doe population	10-20% of adult doe population	20-40% of adult doe population
License numbers	None – limited	Moderate	Liberal
License types	Any antelope Buck only Single tag	Any antelope Doe/kid Single/double tag	Any antelope Doe/kid Single/double/triple tags
Firearm license eligibility	Residents and Nonresidents (2%)	Residents and Nonresidents (4%)	Residents and Nonresidents (8%)
Season structure	Single season Closed season	Single season	Single season Split seasons
Extra seasons	None	None	Doe/kid legal during deer season
Archery[2,4]	Limited archery[3]	Unlimited archery	Unlimited archery
Mentored Youth[2]	Unlimited youth	Unlimited youth	Unlimited youth

[1] See population growth table for more specific harvest rate information (Table 12).
[2]Archery and mentored youth seasons will be closed in units closed to firearm.
[3] Archery hunters limited to 1 single-tag (any-antelope) license.
[4]Archery hunters eligible for double-tag (any-antelope and doe/kid antelope) license when >50% of firearm units offer licenses containing at least one doe/kid tag.

Hunting Season Setting Process

Under the present SDGFP Commission season setting schedule, proposals for pronghorn seasons and license numbers are made in June of every other year. Aerial surveys are also conducted biennially and occur on the same years the SDGFP Commission sets season regulations. Because aerial surveys are completed in May and the first half of June, however, season regulations are sometimes proposed before densities of adult pronghorn can be estimated for every management unit. Although proposed license numbers can be adjusted during rule finalizations at the July SDGFP Commission meeting, and thus after all units have been surveyed, regulations are set well before fall herd composition surveys are completed in September. Fawn:doe ratios provide data necessary to estimate annual recruitment rates and are critical in calculating total pronghorn population estimates. The inability to estimate fall recruitment prior to setting season regulations can lead to possible over/under harvest of pronghorn herds, thus challenging SDGFP's ability to meet population objectives. To minimize variability in fall recruitment, the previous 3-year average recruitment rate is used to project the estimated fall recruitment.

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 pronghorn hunters are manufactured with a lead-based core surrounded by a copper jacket. Lead based bullets are known to fragment upon impact. Although research has not specifically been conducted on lead content in meat from harvested pronghorn, the research that has been conducted on deer would show the potential for lead residue in harvested pronghorn. 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.

Hunters and consumers of pronghorn 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 SDGFP currently does not have any regulations against the use of lead bullets for pronghorn hunting, but hunters should be aware of the availability of alternative copper bullets that do not contain lead.

Predation Management

Adult female survival and fawn recruitment rates are arguably the most important vital rates to consider when managing ungulate populations. Adult doe pronghorn survival is relatively high in South Dakota with research reporting survival rates typically in excess of 80% (Jacques 2006; Kauth 2017; SDGFP unpub.). Neonate survival is more variable with recent research suggesting survival may range from 22-92% (Jacques et al. 2007b). Causes of mortality range from predation to hunter harvest and starvation, but predation may account for as much as 86% of the overall mortality in pronghorn fawns (Jacques et al. 2007b). If increasing pronghorn populations is the goal, and predation is determined to be the limiting factor in fawn survival, reducing the effects of predation on fawn survival may be beneficial.

Much research has been conducted in the last 50 years examining the efficacy of removing coyotes to increase pronghorn fawn survival. Recent research suggests that coyote removal programs can be effective at increasing fawn:doe ratios immediately following predator reduction. However, much of the research fails to document significant increases in pronghorn abundance over time, suggesting other limiting factors may be at play (Menzel 1992; Hack and Menzel 2002). Using population modeling, Phillips and White (2003) were able to demonstrate that following three years of coyote control, a pronghorn population in Oregon would likely remain above a certain minimum threshold but not increase to management objectives in ten years, suggesting other factors are limiting the growth of the population.

There have been instances where coyote removal has resulted in an increase in recruitment as well as population growth in pronghorn. In Arizona, a pronghorn herd was reduced by 85% following a severe winter. The population increased nearly 300% in the next 3 years while coyote control was conducted with ground-based toxicants. Once this removal effort stopped, the pronghorn population stagnated. Following resumed coyote removal with aerial gunning, the population increased 400% over a three-year period (Smith et al. 1986). This suggests that

coyote removal can be effective if predation is determined to be a limiting factor for the population.

The efforts and expenditures necessary to remove a significant number of coyotes may arguably make predator control seem like a cost-prohibitive tool for pronghorn management. Several attempts have been made to conduct a cost:benefit analysis based on costs associated with coyote removal and actual and perceived financial benefits to producers, wildlife agencies and the local economy. An analysis in Wyoming by Shwiff and Merrell (2004) determined that benefits may outweigh costs 400-fold. The analysis used a variety of figures for both cattle and pronghorn based on the market value of the animal, the cost of fines associated with poaching and the perceived economic benefit of having additional livestock and wildlife on the landscape. It should be noted that every additional animal that was sent to market or counted in surveys in years following treatment was considered a positive effect of coyote removal.

Another cost:benefit analysis was conducted in Arizona (Smith et al. 1986) using modeling to project increased pronghorn buck license allocation based on an increase in fawn:doe ratios resulting from five years of increased predator control. Using the price of the license as well as the projected dollar amount contributed to the economy by hunters as the benefits, the model predicted that the benefits didn't outweigh the costs of coyote removal until the fourth or fifth year of control and that the greatest benefit was achieved over a 10-year period when coyote removal was conducted at least every other year.

An analysis conducted by the Arizona Game and Fish Department in 2008-2013 (Wakeling et al. 2014) used direct costs of coyote removal compared with license fees and hunter dollars contributed to the economy. This study demonstrated that in order to achieve a cost:benefit ratio of 1 (no net benefit), license allocation would need to remain at an elevated level for at least four years following the cessation of coyote removal activities. Ultimately, the results suggest that it is cost prohibitive to actively remove coyotes to increase pronghorn numbers. Yoakum et al. (2004) summarized 34 investigations that documented interactions between pronghorn fawns and predators. They developed 14 recommendations for wildlife managers and suggest that coyote control programs may be effective at increasing pronghorn populations if predation rates are high and populations exists well below carrying capacity, such as what maybe the case in a translocation or reintroduction situation. Outside of these specific instances, the authors advise that range and forage management are the most important factors for maintaining or increasing a pronghorn population.

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 of wildlife (Zinn et al. 2000). From 2007 to 2012 landowners' evaluations of the number of pronghorn on their property decreased, on average from just about right to slightly too few (Longmire 2014). In 2007, approximately 31% of landowners rated the pronghorn populations on their property as too many and 25% believed the populations were too few. By 2012 the proportion of landowners rating pronghorn populations on their property as too many had decreased to 15%, while those rating the populations as too few increased to 42% (Longmire 2014). Additionally, landowners' evaluation of pronghorn depredation damage decreased from 2007 to 2012. Just over 29% of landowners in 2012 reported damage was a problem, which was down from 43% in 2007 (Longmire 2014). This increase in social tolerance of pronghorn is likely influenced by pronghorn populations in 2012, which were about 43% of the densities found in 2008.

Winter Severity and Drought

Winter severity is an important metric contributing to survival of free ranging ungulates (Baccannte and Woods 2010, Verme 1968). Relating how climatic conditions impact pronghorn 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 in a linear model that quantifies a WSI. Monthly WSI (WSI_{month}) are quantified for each pronghorn unit using the following formula:

$$WSI_{month} = (T*(-0.1) +1)*S$$

Where:
(T) = mean monthly temperature
(S) = accumulated monthly snow fall

Monthly station data are obtained from approximately 350 weather stations across South Dakota and surrounding states from the National Oceanic and Atmospheric Administration. The SDGFP interpolated mean monthly temperature and aggregated monthly snow depths from weather station data to each pronghorn hunting unit using an inverse distance weighted interpolation function (R Core Team 2015; R package Intamap). The monthly values (November- April) are then summed together to get a cumulative WSI value for the year, and these are compared to a 30-year average from 1980 to 2010 (Figure 30 and Figure 31).

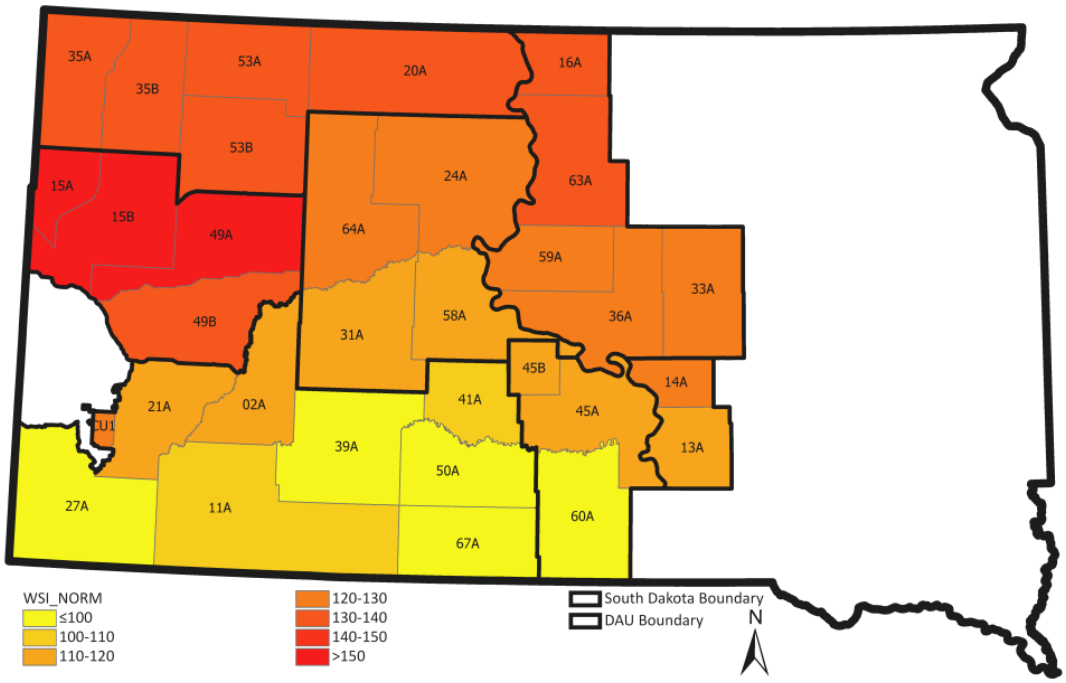


Figure 30. 30-year Winter Severity Index (WSI) average for each Unit, 1980-2010.

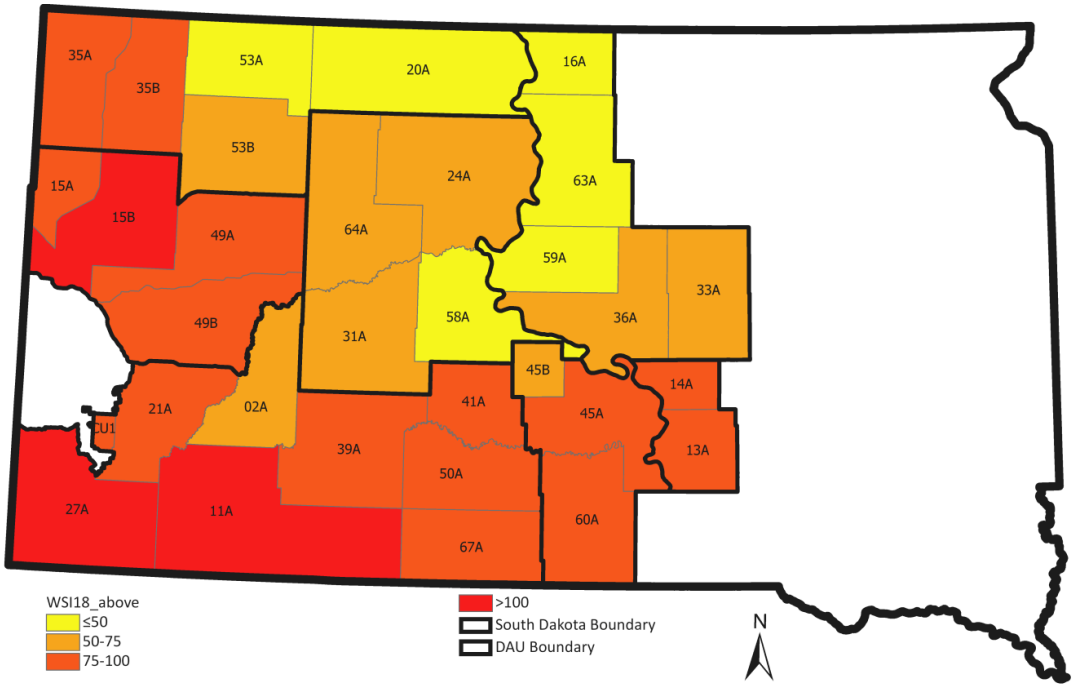


Figure 31. Winter severity index values above the 30-year normal for pronghorn units in the winter of 2017/18.

Severe winter weather can have detrimental impacts on pronghorn populations in South Dakota. Spring aerial surveys conducted subsequent to severe winters provide sufficient data to predict impacts to pronghorn populations. In years when no aerial surveys are conducted, however, SDGFP uses WSIs and population models to quantify potential impacts of severe winters. The cumulative WSI value is entered into a logistic regression model that predicts adult overwinter survival based on the severity of the winter. Historic survival estimates from radio collared pronghorn in South Dakota were used to develop the relationship between overwinter survival and the cumulative WSI value (Figure 32).

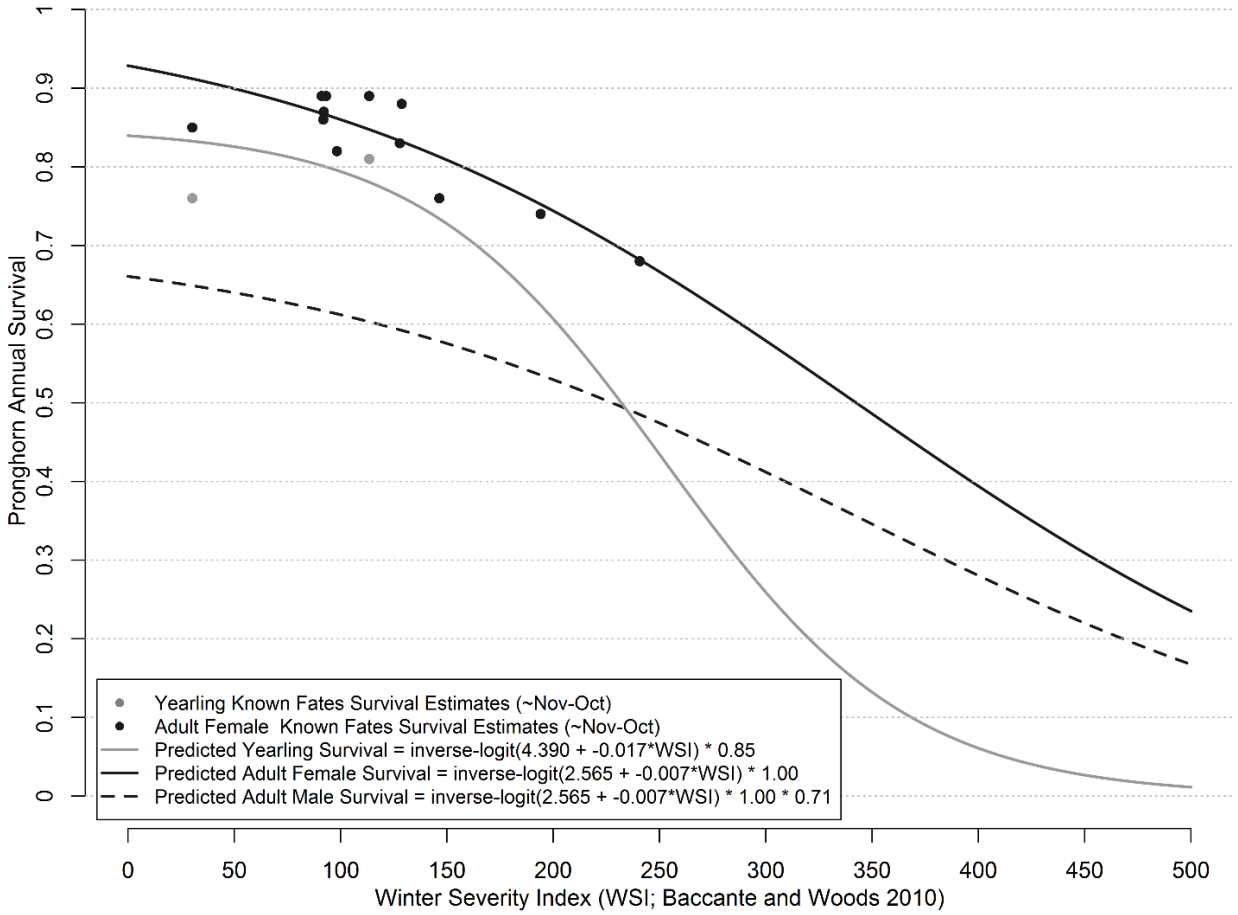


Figure 32. Predictive relationship between adult and yearling pronghorn annual survival and winter severity indices (preliminary).

Substantial declines in pronghorn densities have been observed following severe winters in the late 1970s, mid 1980s, late 1990s, and 2008-2010 (Figure 4). In recent years, three consecutive winters (2008/09, 2009/10 and 2010/11) produced statewide WSI values substantially greater

than the 30-year normal WSI of 132 (Figure 33) and populations declined as a result. The winter of 2017/18 also demonstrated above average WSI values in some areas which likely had a negative effect on population growth of pronghorn (Figure 31).

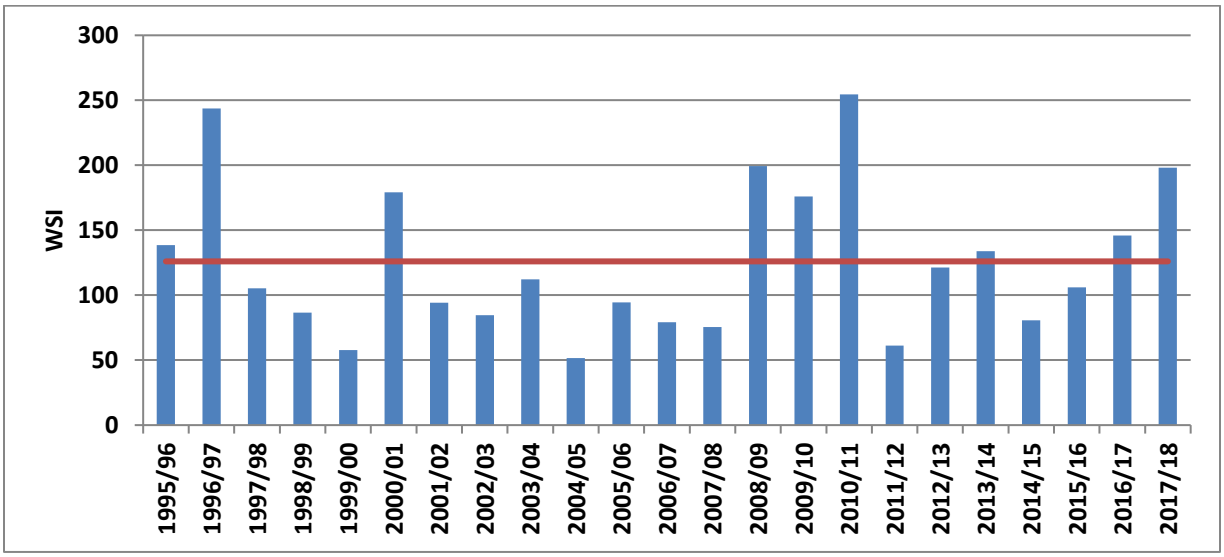


Figure 33. Yearly fluctuations and average statewide winter severity indices (WSI) for the pronghorn range in South Dakota, 1996-2018.

Recovery from severe winter mortalities is affected by the direct loss of animals and often subsequent reduced fawn recruitment the year following a harsh winter (O'Gara and Yoakum, 2004). Data analyses to evaluate how varying degrees of winter severity values impact pronghorn population performance in South Dakota are on-going. The continued compilation of adult doe survival, aerial survey data, and fawn recruitment data are necessary to evaluate both spatial and temporal relationships between winter severity and pronghorn population performance. The occurrence of a severe winter while statistically valid sample sizes are available is vitally important in formulating robust relationships to predict survival and reproductive rates during future years with similar winter severity values.

The effects of drought on pronghorn populations are not as well studied and understood as the effects of harsh winter events (O'Gara and Yoakum 2004). Studies have been performed in New Mexico, Texas and Arizona (Brown et al. 2006, Hailey 1979, Simpson et al. 2007) but limited information is available about South Dakota drought impacts on pronghorn. Drought ultimately affects the forage production and forage quality available to pronghorn. Competition with other ungulate species, including domestic cattle and sheep, further diminish the ability of pronghorn to find sufficient necessary food sources to survive drought conditions

(Hailey 1979). The hindrance of traditional migration routes due to fencing, especially woven wire fencing, also increases the detrimental effects of drought on a pronghorn population.

GOALS, OBJECTIVES & STRATEGIES

The following statements have guided the development of the pronghorn management goals and objectives and reflect the collective values of the SDGFP in relation to management of pronghorn in South Dakota:

- that wildlife, including pronghorn, contributes significantly to the quality of life in South Dakota and therefore must be sustained for future generations.
- that pronghorn play an important role in the grassland ecosystem.
- in providing for and sustaining the diversity of our wildlife heritage for present and future generations.
- in management of pronghorn in accordance with biologically sound principles.
- in providing accurate and timely information to the public concerning pronghorn and recreational opportunities in South Dakota.
- that the future of pronghorn in South Dakota depends on a public that appreciates, understands and supports pronghorn and their habitats.

Population Goals

The SDGFP will manage pronghorn populations and habitats consistent with ecological, social, aesthetic, and economic values of South Dakota citizens while addressing the concerns and issues of both residents and visitors of South Dakota.

The current statewide population objective is approximately 69,000 total pre-season pronghorn, but actual population abundance may range from 59,000 to 80,000 (Figure 34). The statewide objective is a summation of all hunting unit objectives (Appendix C). Pronghorn densities will vary by management unit, but the overall average throughout the pronghorn range in the state will be 1.69 pronghorn per square mile when objectives are reached. Pronghorn unit objectives may fluctuate due to landowner tolerances, which are often influenced by winter severity, crop rotation, and changing habitat conditions due to drought and/or livestock grazing. Unit population objectives were developed after thorough analyses of pronghorn population data, recreation opportunities, private land depredation issues, and substantial input from a wide variety of publics with an interest in pronghorn management in South Dakota. The SDGFP will adopt harvest strategies that will allow the pronghorn population to stay within the objective range. The SDGFP will manage pronghorn populations and habitats by fostering partnerships and stewardship and applying biological and social sciences.

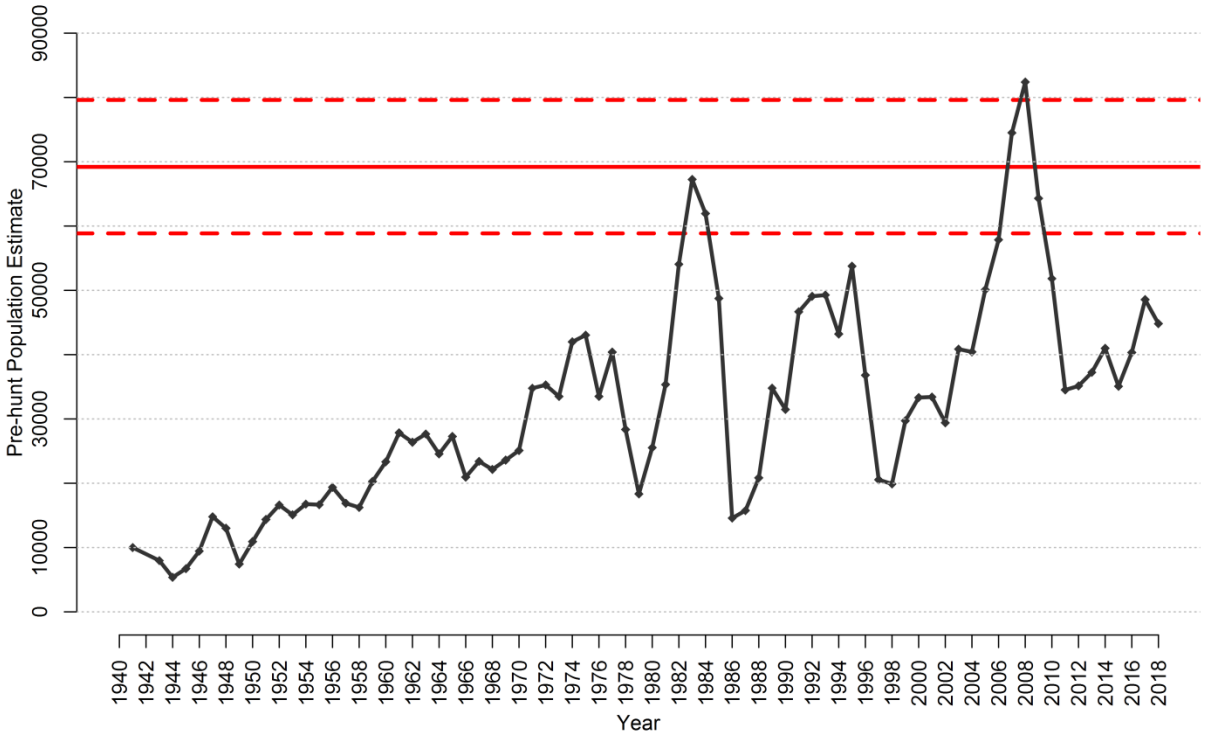


Figure 34. South Dakota pronghorn pre-hunt population estimates (black solid line) and current statewide population objective of approximately 69,000 (red solid line; dashed lines are ± 15%), 1941 – 2018.

Objectives and Strategies

Objective 1: Within 10 years of this plan's approval, enhance the conditions and capacities to help preserve, protect, enhance, and manage pronghorn habitat across South Dakota.

Strategy 1A. By December 2020, utilize land use data and other decision support tools to identify and prioritize pronghorn habitat management focus areas across South Dakota.

Strategy 1B. Utilize SDGFP staff, programs, partnerships, and other resources to provide private land owners with technical and financial assistance to preserve, protect, enhance, and manage pronghorn habitat across South Dakota.

1. Assist private landowners in implementing grazing management practices through GFP's private lands habitat cost-share program to promote long-term sustainable use of native rangelands and tame pastures for livestock production while enhancing the wildlife values these grasslands provide.

Strategy 1C. Promote rangeland fence modification to allow for pronghorn dispersals and seasonal migrations by providing technical and financial assistance to private landowners through the SDGFP's private lands habitat program.
1. By December 2020, develop a fact sheet outlining SDGFP's wildlife-friendly fence (WFF) program, including design requirements and priority areas.
2. Assist private landowners in annually replacing 20 miles of woven-wire fences with WFF in high pronghorn density areas.

Strategy 1D. By December 2020, develop and distribute a fact sheet to promote BMPs that enhance pronghorn habitat.

Strategy 1E. Advocate for USDA Farm Bill programs and policies that preserve, protect, enhance, and help manage pronghorn habitat on private working ranchlands across South Dakota.

Strategy 1F. Utilize land acquisition according to SDGFP Land Acquisition Priorities and Guidelines to enhance or protect existing pronghorn habitat in South Dakota. https://gfp.sd.gov/userdocs/docs/Land_Acquisition_Guidance_-_August_2016.pdf

Strategy 1G. Support the use of conservation easements to protect native prairie and shrub steppe habitats and sustain private working ranchlands in the pronghorn range.

Objective 2: Monitor and assess pronghorn populations by conducting scientifically based biological surveys within South Dakota.

Strategy 2A. Assess and monitor pronghorn population levels and trends by biennially completing spring aerial surveys in all management units.
1. By August 2024, evaluate effectiveness of current aerial survey systematic design.
2. By August 2024, estimate costs and benefits of modifying design and frequency of survey.
3. Evaluate utility of incorporating sightability coefficients into modeled abundance projections.

Strategy 2B. Model pronghorn abundance and growth rates during years with and without aerial surveys.
1. Further evaluate winter severity impacts on pronghorn population performance.
2. Further evaluate drought severity impacts on pronghorn population performance.
3. By August 2024, develop integrated state-space population modeling program for pronghorn.

Strategy 2C. Annually conduct and assess fall herd composition surveys to estimate sex and age ratios in each pronghorn Data Analysis Unit.

Strategy 2D. Annually survey hunters to estimate pronghorn harvest levels and distribution, number of hunters, hunter success, and hunter satisfaction.
1. Evaluate season regulations and options for pronghorn hunting units that are open only to archery hunting opportunities.
2. Evaluate the Black Hills archery access permits.
3. Evaluate the need for developing Limited Access Areas for pronghorn.
4. Evaluate hunting season units in low pronghorn density areas.

Strategy 2E. Annually conduct survival and movement studies to assess pronghorn population trends, migrations, dispersals, and habitat use.
1. Evaluate feasibility and necessity to monitor annual survival of various age and sex categories.
2. Increase pronghorn GPS radio-collaring and survival monitoring efforts by adding one DAU every 3 years.
3. Monitor survival and other population parameters in each DAU for approximately six years.
4. Qualitatively evaluate overwinter mortality by recording all confirmed and unconfirmed reports of suspected pronghorn winter losses in the wildlife disease database.

Objective 3: Manage pronghorn populations for both maximum and quality recreational hunting opportunities, considering all social and biological inputs.

Strategy 3A. Where habitat and social tolerances allow, manage pronghorn populations in South Dakota for a pre-season population abundance of approximately 69,000 (59,000-80,000) pronghorn.

Strategy 3B. Biennially evaluate management unit objectives for each pronghorn firearm management unit.
1. Annually gather public input on pronghorn management unit objectives as described in the Seasons Setting Process section.
2. Utilize necessary doe/fawn harvest management tools to ensure management objectives are met as outlined in the Harvest Strategies section.
3. Set pronghorn 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.

Strategy 3C. Collect scientific-based public input from hunters, landowners, and the general public during every management plan revision to assess public perceptions regarding pronghorn management, better define social tolerance levels, and re-evaluate population objectives.

Strategy 3D. Manage pronghorn in Custer State Park (CSP) primarily for quality wildlife viewing opportunities, with limited hunting opportunities provided as follows:

1. "Any antelope" licenses will be set at 3% of the pre-season CSP pronghorn population estimate. No licenses will be issued if the CSP pre-season population estimate is < 135 pronghorn.
2. "Doe/kid" licenses will be set at 3% of the pre-season CSP pronghorn population estimate. No licenses will be issued if the CSP pre-season population estimate is < 250 pronghorn.

Strategy 3E. Evaluate pronghorn population, harvest, habitat, and other data to designate a primary and secondary range in South Dakota.

1. Evaluate and consider harvest strategies for hunting units in primary vs secondary range.
2. Further define harvest management strategies as needed by June 2024.
3. Evaluate hunter success and satisfaction trends and potential thresholds.

Objective 4: Cooperatively work with private landowners, organizations, and other agencies to resolve pronghorn depredation to agricultural crops and other social conflict issues.

Strategy 4A. Continue to respond to all pronghorn depredation concerns on private land in a timely manner.

Strategy 4B. Explore new management techniques that could minimize damage to private property caused by pronghorn.

Strategy 4C. Encourage the enrollment of willing landowners that are experiencing chronic pronghorn depredation issues into Walk-In Area and Controlled Hunting Access Programs to allow public hunting access.

Strategy 4D. Utilize pronghorn depredation pool hunts (see Depredation Management section) when warranted, to address pronghorn depredation concerns.

Strategy 4E. Expand hunting opportunities where/when possible to address pronghorn depredation on private lands.

Strategy 4F. Where needed, evaluate additional depredation management strategies to increase acceptance of pronghorn 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.

Strategy 4I. Work with the SD Department of Transportation (SDDOT) and SD Department of Public Safety to identify and mark critical areas where high numbers of pronghorn-vehicle collisions occur.

1. Designate a SDGFP representative to participate in SDDOT road development and improvement planning efforts to provide input regarding wildlife movements.

2. Consider cooperative and new management techniques and strategies that can minimize pronghorn-vehicle collisions at appropriate locations.
3. Periodically meet with SDDOT to discuss upcoming road projects, pronghorn-vehicle collisions, and potential mitigation strategies.

Objective 5: Monitor and evaluate risk and impact of disease in pronghorn herds in South Dakota.

Strategy 5A. Investigate and collect biological samples from reported or observed sick and/or dead pronghorn demonstrating symptoms of concern and document in the SDGFP Wildlife Disease Database.

Strategy 5B. Monitor pronghorn disease by collecting and sampling voluntary hunter submissions as needed.

Strategy 5C. Work with Tribal entities and government agencies within South Dakota, and surrounding State agencies of Montana, Nebraska, North Dakota, and Wyoming on disease concerns of pronghorn.

Objective 6: Provide the public with access to private and public land for quality pronghorn hunting opportunities.

Strategy 6A. Promote the SDGFP Walk-In Area and Controlled Hunting Access Programs with private landowners.

Strategy 6B. Provide publicly accessible public and private lands hunting access information, maps, and GPS compatible data layers.

Strategy 6C. Use various media platforms to promote and encourage hunters to respect private property boundaries when hunting and to seek hunting access permission from private landowners in advance of hunting seasons.

Strategy 6D. Work cooperatively with state and federal land management agencies to identify and address road closure and recreational access issues during hunting seasons and critical wintering months.

Strategy 6E. Identify and address public land areas that would benefit from signing or additional signing.

1. Coordinate with state and federal land management agencies to identify boundary signing needs and opportunities.
2. Invite NGOs to assist in volunteer signage of public lands.

Strategy 6F. Continue to work with state and federal land management agencies to identify hunter access needs to public lands.

Objective 7: Evaluate pronghorn research and management needs.

Strategy 7A. Annually collaborate with stakeholders to collect and assess research and management needs and ideas.

Strategy 7B. Periodically review pronghorn survey protocols and discuss changes that could improve data collection efficiency and accuracy.

Strategy 7C. Formally evaluate the Pronghorn Management Plan at least every 10 years. Plan updates and changes, however, may occur more frequently as needed.

Strategy 7D. Meet and discuss pronghorn management issues and strategies with other mid-western and western states' biologists by attending the Biennial Western States Pronghorn Workshop.

Objective 8: Promote public, landowner, and conservation agency awareness of pronghorn management needs and challenges.

Strategy 8A. By August of 2019, make available paper and electronic copies of "South Dakota Pronghorn Management Plan for South Dakota, 2019-2029" to all interested conservation partners, the public, and private landowners.

Strategy 8B. Periodically include articles about pronghorn and associated habitats in the South Dakota Conservation Digest and other popular magazines, journals, and media outlets.

Strategy 8C. Maintain and update as necessary the SDGFP web page with a pronghorn section.

Strategy 8D. Produce a biennial report on the status of pronghorn in South Dakota.

LITERATURE CITED

Anderson, S. H. 1999. Managing our wildlife resources. Prentice Hall, Upper Saddle River, New Jersey. USA.

Autenrieth, R. E., D. E. Brown, J. Cancino, R. M. Lee, R. A. Ockenfels, B. W. O'gara, T. M. Pojar, and J. D. Yoakum. 2006. Pronghorn Management Guides: 2006, Fourth Edition. 21st Pronghorn Workshop and North Dakota Game and Fish Department, Bismarck, North Dakota, USA.

American Wind Energy Association (AWEA). 2018. Wind Energy in South Dakota. www.awea.org . http://awea.files.cms-plus.com/FileDownloads/pdfs/South%20Dakota.pdf Accessed 28 August. 2018.

Azarga Uranium Corporation. 2018. America's next uranium developer. http://azargauranium.com/ Accessed 30 August 2018.

Baccannte, D. and R. Woods. 2010. Relationship between winter severity and survival of mule deer fawns in the Peace Region of British Columbia. BC Journal of Ecosystems and Management. 10(3):145.153.

Barnes, M., and A. Hild. 2013. Strategic grazing management for complex creative systems. Rangelands 35(5):3-5.

Baynard, C. W., K. Mjachina, R. D. Richardson, R. W. Schupp, J. D. Lambert and A. A. Chibilyev. 2017. Energy development in Colorado's Pawnee National Grasslands: Mapping and measuring the disturbance footprint of renewables and non-renewables. Environmental Management 59(6):995-1016.

Beckmann, J. P., and R. G. Seidler. 2009. Wildlife and Energy Development: Pronghorn of the Upper Green River Basin – Year 4 Summary. Wildlife Conservation Society, Bronx, New York, USA.

Berner, L. M. 1949. Pronghorn crop damage study in western South Dakota. PR Quarterly Report 12-R-6. South Dakota Department of Game, Fish, and Parks, Pierre, South Dakota, USA.

Berner, L. M. 1952a. Pronghorn restoration. Job Completion Report, Federal Aid in Wildlife Restoration Project 22-D-2. South Dakota Department of Game, Fish and Parks, Pierre, South Dakota, USA.

Berner, L. M. 1952b. The incidence of and the development of field techniques for parasitological examinations of the antelope of South Dakota. Job Completion Report, Federal Aid in Wildlife Restoration Project 12-R-10. South Dakota Department of Game, Fish and Parks, Pierre, South Dakota, USA.

Bever, W., undated. The Pronghorn in South Dakota. South Dakota Game, Fish, and Parks, Pierre, South Dakota, USA.

Bever, W. 1948. Food habits of pronghorn in Northwestern South Dakota. South Dakota Department of Game, Fish and Parks, Pierre, South Dakota, USA.

Bever, W. 1949. A report on the suitability of grazing lands north of Winner, Tripp County, for pronghorn. South Dakota Department of Game, Fish and Parks, Pierre, South Dakota, USA.

Bever, W. 1950. Parasites and diseases of South Dakota pronghorn. PR Report 12-R-7. South Dakota Department of Game, Fish and Parks, Pierre, South Dakota, USA.

Bever, W. 1951. The effect of different spacing intervals between aerial transects upon accuracy during the aerial census of pronghorn. South Dakota Department of Game, Fish, and Parks. W2-4.2

Bever, W. 1957. The incidence and degree of the parasitic load among pronghorn and the development of field techniques to measure such parasitism. PR Completion Report 12-R-14. South Dakota Department of Game, Fish, and Parks, Pierre, South Dakota, USA.

Bookhout, T. A. 1996. Research and management techniques for wildlife and habitats. The Wildlife Society, Lawrence, Kansas, USA.

Bromley, P. R. 1991. Manifestations of social dominance in pronghorn bucks. Applied Animal Behavior Science 29:147-164.

Brown. D. E, D. Warneche, and T. McKenney. 2006. Effects of midsummer drought on mortality of doe pronghorn (*Antilocapra americana*). The Southwestern Naturalist 51(2):220-225.

Bureau of Land Management (BLM). 2015. South Dakota Approved Resources Management Plan. Prepared by the US Department of the Interior, Bureau of Land Management South Dakota Field Office. September 2015. https://www.blm.gov/sites/blm.gov/files/South%20Dakota%20Approved%20RMP.pdf Accessed 28 August 2018.

Caudill J. 2014. Wildlife watching in the U.S.: the economic impacts of national and state economies in 2011. Addendum to the 2011 National Survey of Fishing, Hunting, and Wildlife – Associated Recreation. Report 2011-2. U.S. Fish and Wildlife Service. USA.

Caughley, G. 1977. Sampling in aerial survey. The Journal of Wildlife Management 41:605-615.

Chadwick, S. B. 2002. Automating a winter severity index for Michigan wildlife. Michigan Department of Natural Resources, Wildlife Division Report 3375. Lansing, Michigan, USA.

Chase, S., and C. Kubert. 2018. Wind Power Development in South Dakota. Environmental Law and Policy Center. http://elpc.org/wp-content/uploads/2008/10/sd-wind-july.pdf Accessed 28 August 2018.

Christie, K. S., W. F. Jensen, J. H. Schmidt, and M. S. Boyce. 2015. Long-term changes in pronghorn abundance index linked to climate and oil development in North Dakota. Biological Conservation 192:445-453.

Claassen, R., F. Carriazo, J. C. Cooper, D. Hellerstein, and K. Udea. 2011. Grassland to cropland conversion in the northern plains: The role of crop insurance, commodity, and disaster programs, ERR-120, U.S. Department of Agricultural Economics Research Service. June 2011.

Conover, M. R. 2001. Effect of hunting and trapping on wildlife damage. Wildlife Society Bulletin 29:521-532.

Cornatzer, W. E., E. F. Fogarty, and E. W. Cornatzer. 2009. Qualitative and quantitative detection of lead bullet fragments in random venison packages donated to the Community Action Food Centers of North Dakota, 2007. *In* R. T. Watson, M. Fuller, M. Pokras, and W. G. Hund, Editors. Ingestion of lead from spent ammunition: Implications for wildlife and humans. The Peregrine Fund, Boise, Idaho, USA.

Cudmore, K. W. 2017. An evaluation of deer and pronghorn surveys in South Dakota. Thesis, South Dakota State University, Brookings, South Dakota, USA.

Czech, B., P. R. Krausman, P. K. Devers. 2000. Economic associations among causes of species endangerment in the United States. BioScience 50:593-601.

Davidson, W. R. 2006. Field manual of diseases in the Southeastern United States, Third Edition. Southeastern Cooperative Wildlife Disease Study. Athens, Georgia, USA.

Decker, D. J. and K. G. Purdy. 1988. Toward a concept of wildlife acceptance capacity in wildlife management. Wildlife Society Bulletin 16:53-57.

Dillman, D. A., J. D. Smyth, L. M. Christian. 2014. Internet, phone, mail and mixed-mode surveys: The Tailored Design Method, 4th Edition. John Wiley and Sons, Inc. Hoboken, New Jersey, USA.

Dyke, S., D. Fryda, D. Kleyer, J. Williams, B. Hosek, W. Jensen, S. Johnson, A. Robinson, F. Ryckman, B. Stillings, M. Szymanski, S. Tucker and B. Wiedmann. 2011. Potential impacts of oil and gas development on select North Dakota natural resources; a report to the director. North Dakota Game and Fish Department, Bismarck, North Dakota, USA.

Energy Information Administration (EIA). 2017. Domestic Uranium Production Report 3rd Quarter 2017 (November 2017), Table 4, U.S. uranium in-situ-leach plants by owner, location, capacity, and operating status.

Energy Information Administration (EIA). 2018a. International Energy Outlook 2017 https://www.eia.gov/outlooks/ieo/pdf/0484(2017).pdf Accessed 15 August 2018.

Energy Information Administration (EIA). 2018b. South Dakota - State Energy Profile Analysis - U.S. Energy Information Administration (EIA). https://www.eia.gov/state/analysis.php?sid=SD Accessed 28 August 2018.

Ellenberger, J. H. and A. E. Byrne. 2011. Population status and trends of big game and greater sage grouse along the Colorado/Wyoming state line. Wildlife Management Consultants and Associates, LLC, Palisade, Colorado, USA.

Emili L. A., and R. P. Greene. 2014. New cropland on former rangeland and lost cropland from urban development: The “Replacement Land” Debate. Land. 3:658-674.

Fargione, J. E., T. R. Cooper, D. J. Flaspohler, J. Hill, C. Lehman. 2009. Bioenergy and wildlife: threats and opportunities for grassland conservation. BioScience 59:767–77.

Fisk, K. J. 2017. Wildlife damage management program – Fiscal Year 2017. Wildlife Division Report Number 2017-09. South Dakota Game, Fish and Parks, Pierre, South Dakota, USA.

Forrest, S. C., H. Strand, W. H. Haskins, C. Freese, J. Proctor, and E. Dinerstein. 2004. Oceans of grass: a conservation assessment for the northern Great Plains. Northern Plains Conservation Network and Northern Great Plains Ecoregion, WWF-US, Bozeman, Montana, USA.

Gates C. C., P. Jones, M. Suitor, A. Jakes, M. S. Boyce, K. Kunkel, K. Wilson. 2012. The influence of land use and fences on habitat effectiveness, movements and distribution of

pronghorn in the grasslands of North America. *In*: M. Somers, M. Hayward, Editors. Fencing for Conservation. Springer, New York, USA.

Gavin, S. D., and P. E. Komers. 2006. Do pronghorn (*Antilocapra americana*) perceive roads as a predation risk? Canadian Journal of Zoology 84:1775-1780.

Gigliotti, L. M. 2009. Hunter evaluation of the 2009 Walk-in areas. HD-7-10. AMS South Dakota Game, Fish and Parks, Pierre, South Dakota, USA.

Gigliotti, L. M. 2012. Wildlife and environmental attitudes of South Dakota citizens: a 2012 survey. Progress Report: 1-2012. U.S. Geological Survey, South Dakota Cooperative Fish and Wildlife Research Unit. Department of Natural Resource Management, South Dakota State University, Brookings, South Dakota, USA.

Goldsby, A. I., and D. F. Eveleth. 1954. Internal parasites in North Dakota pronghorn. Journal of Parasitology 40:637-648.

Griffin, S. L. 1991. Pronghorn use of agricultural land in northwestern South Dakota. Thesis, South Dakota State University, Brookings, South Dakota, USA.

Grund, M. D., L. Cornicelli, L. T. Carlson, and E. A. Butler. 2010. Bullet fragmentation and lead deposition in white-tailed deer and domestic sheep. Human-Wildlife Interactions 4(2):257-265.

Hack, M. A. and K. E. Menzel. 2002. Pronghorn state and province status reports: 2001. Proceedings of the pronghorn antelope workshop 20:5-23.

Hailey, T. L. 1979. A handbook on pronghorn antelope management in Texas. P-R Project. W-45-R, W-57-R, W-94-R, and W-14-C. series 20. Texas Department of Wildlife, Austin, Texas, USA.

Hanophy, W. 2009. Fencing with Wildlife in Mind. Colorado Division of Wildlife, Denver, Colorado, USA.

Hebblewhite, M. 2008. A literature review of the effects of energy development on ungulates: Implications for central and eastern Montana. Report prepared for Montana Fish, Wildlife and Parks, Miles City, Montana, USA.

Hipschman, D. 1959. Looking back past 50 years. 1958-1959 annual report of the Department of Game, Fish, and Parks. South Dakota Game, Fish, and Parks. Pierre, South Dakota. USA.

Hormay, A. L. 1956. How livestock grazing habits and growth requirements of range plants determine sound grazing management. Journal of Range Management 9:161–164.

Horton, R. R. and S. C. Craven. 1997. Perceptions of shooting-permit use for deer damage abatement in Wisconsin. Wildlife Society Bulletin 25:330-336.

Hunt, W. G., R. T. Watson, J. L. Oaks, C. N. Parish, K. K. Burnham, R. L. Tucker, J. R. Belthoff, and G. Hart. 2009. Lead bullet fragments in venison from rifle-killed deer: potential for human dietary exposure. PLoS ONE 4(4): e5330. doi:10.1371/journal.pone.0005330.

Huxoll, C. 2018. Big game harvest projections. South Dakota Game Report No. 2018-05. South Dakota Game, Fish and Parks. Pierre, South Dakota, USA.

Irby, L. R., J. Saltiel, W. E. Zidack, and J. B. Johnson. 1997. Wild ungulate damage: perceptions of farmers and ranchers in Montana. Wildlife Society Bulletin 25:320-329.

Jacques, C. N. 2006. Evaluation of aerial transect surveys, survival, and movements of pronghorns in western South Dakota. Dissertation, South Dakota State University, Brookings, South Dakota, USA.

Jacques, C. N., J. D. Sievers, J. A. Jenks, and D. E. Roddy. 2006. Evaluating diet composition of pronghorn in Wind Cave National Park, South Dakota. The Prairie Naturalist 38: 239-25.

Jacques C. N., J. A. Jenks, J. D. Sievers, and D. E. Roddy. 2007a. Vegetative characteristics of pronghorn bed sites in Wind Cave National Park, South Dakota. The Prairie Naturalist 39:49-53.

Jacques, C. N., J. A. Jenks, J. D. Sievers, D. E. Roddy, and F. G. Lindzey. 2007b. Survival of pronghorns in western South Dakota. Journal of Wildlife Management 71: 737-743.

Jacques, C. N., and J. A. Jenks. 2008. Visual observation of bobcat predation on an adult female pronghorn in northwestern South Dakota. American Midland Naturalist 160: 259-261.

Jacques, C. N., J. A. Jenks, and R. W. Klaver. 2009. Seasonal movements and home-range use by female pronghorns in sagebrush-Steppe communities of western South Dakota. Journal of Mammalogy 90: 433-441.

Jenks, J. A., C. N. Jacques, J. D. Sievers, R. W. Klaver, R. T. Bowyer, and D. E. Roddy. 2006. Evaluating genetic viability of pronghorn in Wind Cave National Park. The Prairie Naturalist 38:155-165.

Johnson, D., B. Sahr, G. Hanson. 2005. Joint Report of the South Dakota Energy Infrastructure Authority and the South Dakota Energy Task Force, December 2005. http://www.sdeia.com/PDF/SDEIAReport. pdf Accessed 30 August 2018.

Jones N. F., and L. Pejchar. 2013. Comparing the ecological impacts of wind and oil & gas development: A landscape scale assessment. PLoS ONE 8(11): e81391. https://doi.org/10.1371/journal.pone.0081391.

Jones, P. F., A. F. Jakes, D. R. Eacker, B. C. Seward, M. Hebblewhite, and B. H. Martin. 2018. Evaluating responses by pronghorn to fence modifications across the Northern Great Plains. Wildlife Society Bulletin 42:225-236.

Kauth, A. 2017. Reassessing survival, movement, resource selection, and sightability of pronghorn in western South Dakota. Thesis, South Dakota State University, Brookings, South Dakota, USA.

Keller, B. J. 2011. Factors affecting spatial and temporal dynamics of an ungulate assemblage in the Black Hills, South Dakota. Dissertation, University of Missouri, Columbia, Missouri. USA.

Keller, B. J., C. P. Lehman, G. C. Brundige, T. Mong, and J. J. Millspaugh. 2013. Adult pronghorn (*Antilocapra americana*) survival and cause-specific mortality in Custer State Park, SD. The American Midland Naturalist, 170(2):311–322.

Kohler, P. 1950. Digestion studies with sheep and wild pronghorn on sagebrush ration. Thesis, South Dakota State University, Brookings, South Dakota, USA.

Kolar, J. L. 2009. Pronghorn migration and resource selection in southwestern North Dakota Thesis. University of Missouri, Columbia, Missouri, USA.

Kolar, J. L., J. J. Millspaugh, and B. A. Stillings. 2011. Migration patterns of pronghorn in southwestern North Dakota. Journal of Wildlife Management 75:198-203.

Kunkle, C. 2017. A wind energy boom is coming to South Dakota. North American Windpower company. https://issues.nawindpower.com/article/wind-energy-boom-coming-south-dakota Accessed 28 August 2018.

Lacy, J. R., K. Jamtgaard, L. Riggle, and T. Hayes. 1993. Impacts of big game on private land in southwestern Montana: landowner perceptions. Journal of Range Management 46:31-37.

Lee, R. M., J. D. Yoakum, B. W. O'Gara, T. M. Pojar and R. A. Ockenfels, editors. 1998. Pronghorn management guides. Pronghorn Antelope Workshop 18, Prescott, Arizona, USA.

Lehman, C. P., J. D. Hartland, B. J. Keller, J. J. Millspaugh, and G. C. Brundige. 2009. Bed site selection of fawn pronghorn in Custer State Park, South Dakota. The Prairie Naturalist 41:100-109.

Leopold, A. 1918. Forestry and game conservation. Journal of Forestry 16(4):404-411.

Longmire, C. L. 2014. Wildlife on private lands: Status Report 2012. Report ID# HD-2-14.AMS. South Dakota Game, Fish, and Parks, Pierre, South Dakota, USA.

Lucker, J. T., and G. Dikmans. 1945. The distribution of *Pseudosteragia bullosa* and some new records of nematodes from pronghorn (*Antilocapra americana*). Proceedings of the Helminthological Society 12:2-4.

Lutz, D. W., J. R. Heffelfinger, S. A. Tessmann, R. S. Gamo, and S. Siegel. 2011. Energy development guidelines for mule deer. Mule Deer Working Group, Western Association of Fish and Wildlife Agencies, USA.

Maher, C. R. 2000. Quantitative variation in ecological and hormonal variables correlates with spatial organization of pronghorn (*Antilocapra americana*) males. Behavioral Ecology and Sociobiology 47(5): 327-338.

Martinka, C. J. 1966. The international antelope herd. Montana Wildlife July:28-30.

McDonald R. I., J. Fargione, J. Kiesecker, W. M. Miller, and J. Powell. 2009. Energy sprawl or energy efficiency: Climate policy impacts on natural habitat for the United States of America. PLoS ONE 4(8): e6802. doi:10.1371/journal.pone.0006802.

Medcraft, J. R., and W. R. Clark. 1986. Big game habitat use and diets on a surface mine in northeastern Wyoming. Journal of Wildlife Management 50(2):135-142.

Menzel, K. E. 1992. Improved survival of pronghorn fawns with coyote control. Proceedings of the pronghorn antelope workshop 15:93-99.

Messenger, N. C., and F. Schitoskey. 1980. Component and digestibility of pronghorn diets. Proceedings of the South Dakota Academy of Science 59:194-204.

Miller, G. S. Jr., and R. Kellogg. 1955. List of North American recent mammals. U.S. National Museum Bulletin 205:816-817.

Moore, G. L., Y. A. Greichus, and E. J. Hugghins. 1968. Insecticide residues in pronghorn of South Dakota. Bulletin of Environmental Contamination and Toxicology 3:269-273.

National Park Service (NPS), U.S. Department of Interior. 2009. Final general management plan environmental impact statement, Badlands National Park north unit. National Park Service, US Department of the Interior, Badlands National Park/North Unit, South Dakota, November 2, 2009.

National Park Service (NPS), U.S. Department of Interior. 2012. South unit Badlands National Park final general management plan environmental impact statement. National Park Service, US Department of the Interior, Badlands National Park/North Unit, South Dakota and Oglala Sioux Tribe parks and recreation authority, Oglala Sioux Tribe. April 2012.

National Park Service (NPS), U.S. Department of Interior. 2015. Wind Cave National Park zoning management plan amendment environmental assessment, Prepared by the National Park Service, August 2015.

National Park Service (NPS), U.S. Department of Interior. 2016. Badlands National Park webpage, Badlands National Park mammal list. https://www.nps.gov/badl/learn/nature/mammals-list.htm. Accessed 3 October 2016.

Nuclear Regulatory Commission (NRC). 2018. Wind energy facts: South Dakota. https://www.nrc.gov/docs/ML1224/ML12243A243.pdf Accessed 28 August 2018.

O'Gara, B. and J. D. Yoakum. 2004. Pronghorn ecology and management. University Press of Colorado, Boulder, Colorado, USA.

Oteri, F., R. Baranowski, I. Baring-Gould, and S. Tegen. 2018. The 2017 state of wind development in the United States by region. Golden, Colorado: National Renewable Energy Laboratory. NREL/TP-5000-70738. https://www.nrel.gov/docs/fy18osti/70738.pdf. Accessed 15 February 2019.

Philips, G. E. and G. C. White. 2003. Pronghorn population response to coyote control: modeling and management. Wildlife Society Bulletin 31:1162-1175.

Popowski, B. 1959. Hunting pronghorn antelope. Stackpole Co., Harrisburg, Pennsylvania, USA.

R Core Team. 2015. R: A language and environment for statistical computing. R foundation for statistical computing, Vienna, Austria. http://www.R-project.org

Reed, D. E., C. A. Daley, and H. J. Shave. 1976. Reovirus-like agent associated with neonatal diarrhea in pronghorn. Journal of Wildlife Diseases 12:488-491.

Reinking, A. K., Smith, K. T., Mong, T. W., Read, M. J., and Beck, J. L.. 2019. Across scales, pronghorn select sagebrush, avoid fences, and show negative responses to anthropogenic features in winter. *Ecosphere* 10(5):e02722.

Reiter, D. K., M. W. Brunson, and R. H. Schmidt. 1999. Public attitudes toward wildlife damage management and policy. Wildlife Society Bulletin 27:746-758.

Reitsma, K. D., D. E. Clay, C. G. Carlson, B. H. Dunn, A. J. Smart, D. L. Wright, and S. A. Clay. 2014. Estimated South Dakota land use change from 2006 to 2012. Agronomy, Horticulture and Plant Science Faculty Publications. 18. https://openprairie.sdstate.edu/plant_faculty_pubs/18 Accessed 15 February 2019.

Robbins, R. L. 1964. Exploratory efficiency studies of wildlife management techniques 1962-1963, South Dakota. P-R Project W-75-R-5. South Dakota Game, Fish, and Parks, Pierre, South Dakota, USA.

Rossi, P. A., and D. C. Hunt. 1971. The art of the Old West. Alfred A. Knopf, Inc. New York, New York, USA.

Sawyer, H. M., F. Lindzey, D. McWhirter, and K. Andrews. 2002. Potential effects of oil and gas development on mule deer and pronghorn populations in western Wyoming. Transactions of the 67th North American Wildlife and Natural Resources Conference 67:350-355.

Sawyer, H., F. Lindzey and D. McWhirter. 2005. Mule deer and pronghorn migration in western Wyoming. Wildlife Society Bulletin 33:1266-1273.

Schroeder, C. 2018. Western state and provence pronghorn status report, 2018 In; Wakeling, B.F., C. Schroeder, editors. 2018. Proceedings of the twenty-eighth biennial pronghorn workshop. Nevada Department of Wildlife, Reno, Nevada, USA.

Segerstrom, T. B. 1982. Effect of an operational coal strip mine on pronghorn antelope. Thesis, Montana State University, Bozeman, Montana, USA. https://scholarworks.montana.edu/xmlui/bitstream/handle/1/3655/31762001123049.pdf?sequence=1 Accessed 15 February 2019.

Seidler, R. G., R. A. Long, J. Berger, S. Bergen, and J. P. Beckmann. 2014. Identifying impediments to long-distance mammal migrations. Conservation Biology 29:99-109.

Shwiff, S. A. and R. J. Merrell. 2004. Coyote predation management: an economic analysis of increased antelope recruitment and cattle production in south central Wyoming. Sheep and Goat Research Journal 15:29-33.

Sievers, J. D. 2004. Factors influencing a declining pronghorn population in Wind Cave National Park, South Dakota. Thesis, South Dakota State University, Brookings, South Dakota, USA.

Simpson, D. C., L. A. Harveson, C. E. Brewer, R. E. Walser, and A. R. Sides. 2007. Influence of precipitation on pronghorn demography in Texas. Journal of Wildlife Management 71(3): 906-910.

Smith, R. H., D. J. Neff and N. G. Woolsey. 1986. Pronghorn response to coyote control: a benefit:cost analysis. Wildlife Society Bulletin 14:226-231.

South Dakota Department of Tribal Relations (SDDTR). 2016. http://www.sdtribalrelations.com. Accessed 17 August 2016.

South Dakota Game, Fish, and Parks (SDGFP). 1965. Pronghorn management in South Dakota. Proceedings of the pronghorn antelope workshop 1:22-31.

Steffens, T., G. Grissom, M. Barnes, F. Provenza, and R. Roath. 2013. Adaptive grazing management for recovery. Rangelands 35(5):28-34.

Suitor, M. J., C. C. Gates, P. Jones, K. Kunkel, M. Grue, and J. Landry-DeBoer. 2008. Role of population phenotype in ensuring resilient, abundant populations of pronghorn antelope. Proceedings of the pronghorn antelope workshop 23:137.

Taylor, J. L., W. Acevedo, R. F. Auch, and M. A. Drummond, editors. 2015. Status and trends of land change in the Great Plains of the United States—1973 to 2000: U.S. Geological Survey Professional Paper 1794–B, 180 p., http://dx.doi.org/10.3133/pp1794B. https://pubs.usgs.gov/pp/1794/b/pp1794b.pdf. Accessed 15 February 2019.

Taylor K. L., J. L. Beck, and S. V. Huzurbazar. 2016. Factors influencing winter mortality risk for pronghorn exposed to wind energy development. Rangeland Ecological Management 69:108–116.

Terwillinger, C. 1946. Food habits of pronghorn. Game Management Problem. Colorado State University, Fort Collins, Colorado, USA.

Torbit, S. C., B. R. Gill, W. A. Alldredge, and J. C. Liewer. 1993. Impacts of pronghorn grazing on winter wheat in Colorado. Journal of Wildlife Management 57:173-181.

Thompson, S. K. 2002. Sampling. Second edition. John Wiley & Sons, New York, New York, USA.

Trainor A. M., R. I. McDonald, and J. Fargione. 2016. Energy sprawl is the largest driver of land use change in United States. PLoS ONE 11(9): e0162269. doi:10.1371/journal.pone.0162269.

U. S. Department of Agriculture (USDA). 1925. Bureau of biological survey – "Status of pronghorn". USDA Bulletin No. 1346.

U.S. Department of Agriculture, Forest Service (USDA). 2001. Land and resource management plan for the Dakota prairie grasslands northern region 2001. U.S. Department of Agriculture Forest Service. http://www.fs.usda.gov/detailfull/dpg/landmanagement/?cid=stelprdb5340280&width=full. Accessed 21 July 2016.

U.S. Department of Agriculture, Forest Service (USDA). 2009. Revised land resource management plan for the Nebraska national forest 2001 as Amended 2009. U.S. Department of Agriculture Forest Service. http://www.fs.usda.gov/detail/nebraska/landmanagement/planning/?cid=fsm9_028050. Accessed 21 July 2016.

U.S. Department of Interior, U.S. Fish and Wildlife Service (USFWS), and U.S. Department of Commerce, U.S. Census Bureau (USCB). 2006. National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

U.S. Department of the Interior, U.S. Fish and Wildlife Service (USFWS), and U.S. Department of Commerce, U.S. Census Bureau (USCB). 2011. National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

U.S. Department of the Interior, U.S. Fish and Wildlife Service (USFWS), and U.S. Department of Commerce, U.S. Census Bureau (USCB). 2016. National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

U.S. Geological Survey (USGS). 1999. The mineral industry of South Dakota. https://minerals.usgs.gov/minerals/pubs/state/984600.pdf Accessed 28 August 2018.

U.S. Government Accountability Office. (USGAO) 2007. Agricultural conservation. Farm program payments are an important factor in landowners' decisions to convert grassland to cropland, Report to Congressional Requesters, September.

United Nations, Department of Economic and Social Affairs, Population Division. 2017. World population prospects: The 2017 revision, key findings and advance tables. Working Paper No. ESA/P/WP/248.

Van Tassell, L. W., C. Phillips, B. Yang. 1999. Depredation claim settlements in Wyoming. Wildlife Society Bulletin 27:479-487.

Verme, L. J. 1968. An index of winter severity for northern deer. Journal of Wildlife Management 32(3):566-574.

Wakeling, B. F., R. L. Day and A. A. Munig. 2014. The efficacy and economics of limited lethal removal of coyotes to benefit pronghorn in Arizona. Proceedings of the pronghorn antelope workshop 26:26-34.

Wempe, J. M. 1976. Rabies in a pronghorn. Journal of Wildlife Diseases 12:347-348.

Wiens, J., J. Fargione, and J. Hill. 2011. Biofuels and biodiversity. Ecological Applications, 21: 1085-1095. doi:10.1890/09-0673.1

Yoakum, J. D., H. G. Shaw, T. M. Pojar and R. H. Barrett. 2004. Pronghorn neonates, predators and predator control. Proceedings of the pronghorn antelope workshop 21:73-95.

Yoakum, J. D. 2006. Influences of vegetation of pronghorn in the intermountain west. Proceeding of the 22nd Biennial Pronghorn Workshop, 53-68.

Zinn, H. C., M. J. Manfredo, and J. J. Vaske. 2000. Social psychological basis for stakeholder acceptance capacity. Human Dimensions of Wildlife 5:20-33.

APPENDIX

Appendix A. Total pronghorn harvest (excluding CSP) and firearm hunter success and satisfaction estimates from hunter surveys, in comparison with total number of hunting licenses sold and statewide population estimates, 1941-2018, South Dakota.

Year	Population Estimate	Total Harvest	Firearm Hunter Success (%)	Hunter Satisfaction	Total Firearm Licenses Sold
1941	10,000	no season	no season		no season
1942	no data	480	96		500
1943	7,973	976	98		1,000
1944	5,370	480	96		500
1945	6,721	season closed	season closed		season closed
1946	9,442	609	87		700
1947	14,800	1,875	94		2,000
1948	13,000	2,371	93		2,549
1949	7,425	season closed	season closed		season closed
1950	10,920	759	89		850
1951	14,356	3,151	94		3,350
1952	16,608	7,880	94		8,350
1953	15,090	4,750	91		5,244
1954	16,756	5,196	91		5,700
1955	16,664	4,281	88		4,850
1956	19,374	5,616	90		6,266
1957	16,885	3,885	88		4,415
1958	16,235	2,900	88		3,300
1959	20,272	4,950	89		5,569
1960	23,330	6,037	90		6,708
1961	27,480	7,990	93		8,596
1962	26,382	6,152	88		6,991
1963	27,658	7,280	90		8,090
1964	24,566	6,050	81		7,470
1965	27,286	6,776	77		8,750
1966	20,954	4,244	85		4,965
1967	23,400	4,847	74		6,547
1968	22,142	2,419	75		3,229
1969	23,595	2,880	66		4,382
1970	25,100	3,807	78		4,850
1971	34,690	5,452	78		7,004

Appendix A. Continued

Year	Population Estimate	Total Harvest	Firearm Hunter Success (%)	Hunter Satisfaction	Total Firearm Licenses Sold
1972	34,894	6,370	88		7,225
1973	33,128	6,831	88		7,770
1974	41,358	8,542	84		10,114
1975	43,083	10,331	85		12,139
1976	33,505	6,722	81		8,340
1977	40,390	7,592	81		9,335
1978	28,425	4,714	81		5,849
1979	18,333	2,473	79		3,128
1980	25,402	4,408	84		5,236
1981	37,277	6,530	84		7,804
1982	53,934	11,145	80		13,899
1983	67,281	14,697	84		17,439 [a]
1984	61,644	16,999	76		15,388 (22,456 tags)
1985	48,741	12,601	77		12,656 (16,320 tags)
1986	14,570	953	64		1,484
1987	15,753	1,271	75		1,690
1988	20,836	1,779	78		2,274
1989	34,943	3,702	84		4,433
1990	31,476	4,408	78		5,104 (5,645 tags)
1991	46,668	7,542	83		7,138 (8,537 tags)
1992	49,010	8,796	78		8,391 (11,212 tags)
1993	49,270	9,367	77		9,506 (13,872 tags)
1994	43,205	7,254	65		7,568 (11,150 tags)
1995	53,765	8,752	69		8,721 (12,707 tags)
1996	36,809	5,501	71		6,472 (7,726 tags)
1997	20,551	1,984	68		2,901 (2,901 tags)
1998	19,895	1,828	66		2,749 (2,749 tags)
1999	29,708	2,627	72	4.98[b]	3,651 (3,752 tags)
2000	33,322	3,376	71	5.31	4,165 (4,705 tags)
2001	33,419	4,656	70	5.30	4,965 (6,634 tags)
2002	29,402	4,444	68	5.39	4,813 (6,495 tags)
2003	40,854	5,948	70	5.39	5,795 (8,505 tags)
2004	40,427	7,032	71	5.36	6,231 (9,866 tags)
2005	50,099	9,140	64	5.62	7,809 (13,850 tags)
2006	57,863	11,799	67	5.08	9,352 (17,602 tags)
2007	74,499	13,669	62	5.28	11,244 (21,898 tags)

Appendix A. Continued

Year	Population Estimate	Total Harvest	Firearm Hunter Success (%)	Hunter Satisfaction	Total Firearm Licenses Sold
2008	82,392	17,870	50	5.11	15,046 (36,816 tags)
2009	64,304	14,912	44	4.50	15,130 (36,931 tags)
2010	51,828	9,520	49	4.69	12,087 (22,213 tags)
2011	34,505	4,918	50	4.54	8,037 (11,312 tags)
2012	35,135	3,084	53	4.79	5,748 (6,719 tags)
2013	37,238	2,372	48	4.72	5,261 (5,800 tags)
2014	41,141	2,631	66	5.12	4,935 (5059 tags)
2015	35,075	2,962	64	5.23	5,562 (5726 tags)
2016	40,446	3,236	70	5.42	5,792 (5971 tags)
2017	48,553	4,669	64	5.26	7,805 (8,154 tags)
2018	46,026	4,810	68	5.27	5,539 (6,078 tags)

[a] Includes 4,000 bonus doe/kid tags.

[b] Begin use of Likert scale to measure hunter satisfaction.

Appendix B. Statewide pronghorn sex ratios and age ratios derived from aerial surveys and fall recruitment surveys, 1968-2018, South Dakota.

Year	Bucks: 100 Does	Fawns: 100 Does
1968	64	95
1969	60	94
1970	60	96
1971	42	91
1972	41	101
1973	52	87
1974	42	87
1975	40	83
1976	47	93
1977	38	97
1978	35	82
1979	38	71
1980	42	85
1981	41	88
1982	41	96
1983	44	90
1984	37	88
1985	31	94
1986	16	64
1987	28	82
1988	32	91
1989	38	102
1990	37	87
1991	38	97
1992	44	110
1993	43	86
1994	39	106
1995	no data	no data
1996	39	111

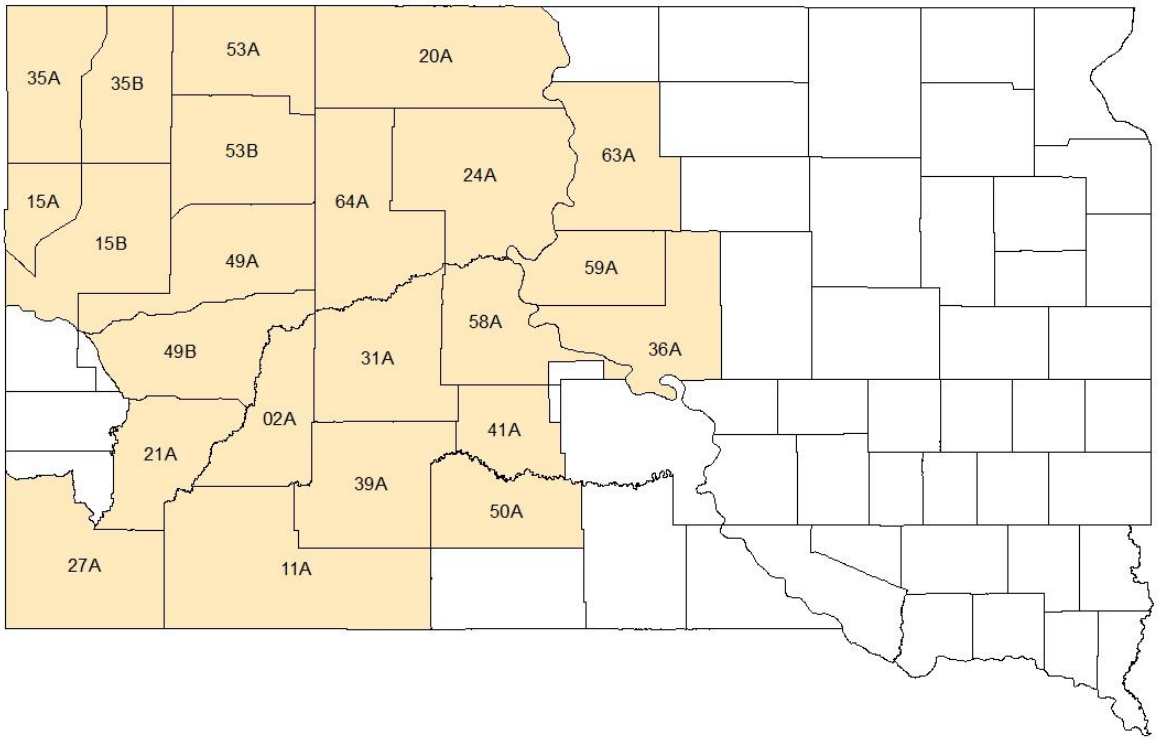
Appendix B. Continued.

Year	Bucks: 100 Does	Fawns: 100 Does
1997	35	74
1998	43	89
1999	48	92
2000	43	92
2001	54	85
2002	52	81
2003	47	91
2004	42	92
2005	55	91
2006	43	86
2007	55	104
2008	62	97
2009	45	75
2010	41	79
2011	39	67
2012	41	71
2013	45	59
2014	30	47
2015	34	68
2016	33	69
2017	36	62
2018	42	58

Appendix C. Population objectives and 2017 population estimates for pronghorn management units in South Dakota.

			2017	2019			Densities (per sq mi)	
Unit	**Unit#**	**SQ MILES**	**Pre-season Estimate**	**Population Objective**	**Popn Obj Range (+/- 15%; rounded)**		**2017**	**2019 Objective**
Pennington	02A	1,263	805	2,000	1,700	2,300	0.64	1.58
Bennett/Oglala Lakota	11A	3,290	1,373	2,000	1,700	2,300	0.42	0.61
NW Butte	15A	624	2,582	2,500	2,130	2,880	4.14	4.01
Butte	15B	1,808	6,677	8,000	6,800	9,200	3.69	4.42
Corson	20A	2,529	1,215	2,500	2,150	2,880	0.48	0.99
Custer	21A	1,313	1,183	2,500	2,130	2,880	0.9	1.89
Dewey (North)	24A	2,445	1,653	2,500	2,130	2,880	0.68	1.51
Fall River	27A	2,213	3,486	5,000	4,250	5,750	1.58	2.26
Haakon	31A	1,828	791	2,000	1,700	2,300	0.43	1.09
West Harding	35A	1,351	5,571	8,000	6,800	9,200	4.12	5.92
East Harding	35B	1,332	3,345	6,000	5,100	6,900	2.51	4.5
Hughes	36A	1,666	464	550	470	630	0.28	0.33
Jackson	39A	1,872	1,221	1,500	1,280	1,730	0.65	0.8
Jones	41A	924	503	600	510	690	0.54	0.65
Lyman	45A	1,499	336	400	340	460	0.22	0.27
FPNG	45B	373	180	250	210	290	0.48	0.67
North Meade	49A	1,722	5,282	6,000	5,100	6,900	3.07	3.48
South Meade	49B	1,706	2,218	2,000	1,700	2,300	1.3	1.17
Mellette	50A	1,309	419	700	600	810	0.32	0.53
North Perkins	53A	1,359	1,592	4,000	3,400	4,600	1.17	2.94
South Perkins	53B	1,599	4,417	5,000	4,250	5,750	2.76	3.13
Stanley	58A	1,398	475	1,000	850	1,150	0.34	0.72
Sully	59A	1,070	424	400	340	460	0.4	0.37
Tripp	60A	1,616	39	150	130	170	0.02	0.09
Walworth/ Potter	63A	1,642	258	300	260	350	0.16	0.18
Ziebach	64A	1,972	1,932	3,000	2,550	3,450	0.98	1.52
CSP	CSP	110	110	350	300	400	0.64	1.58
Total		41,055	48,551	69,200	59,000	80,000	1.15	1.69

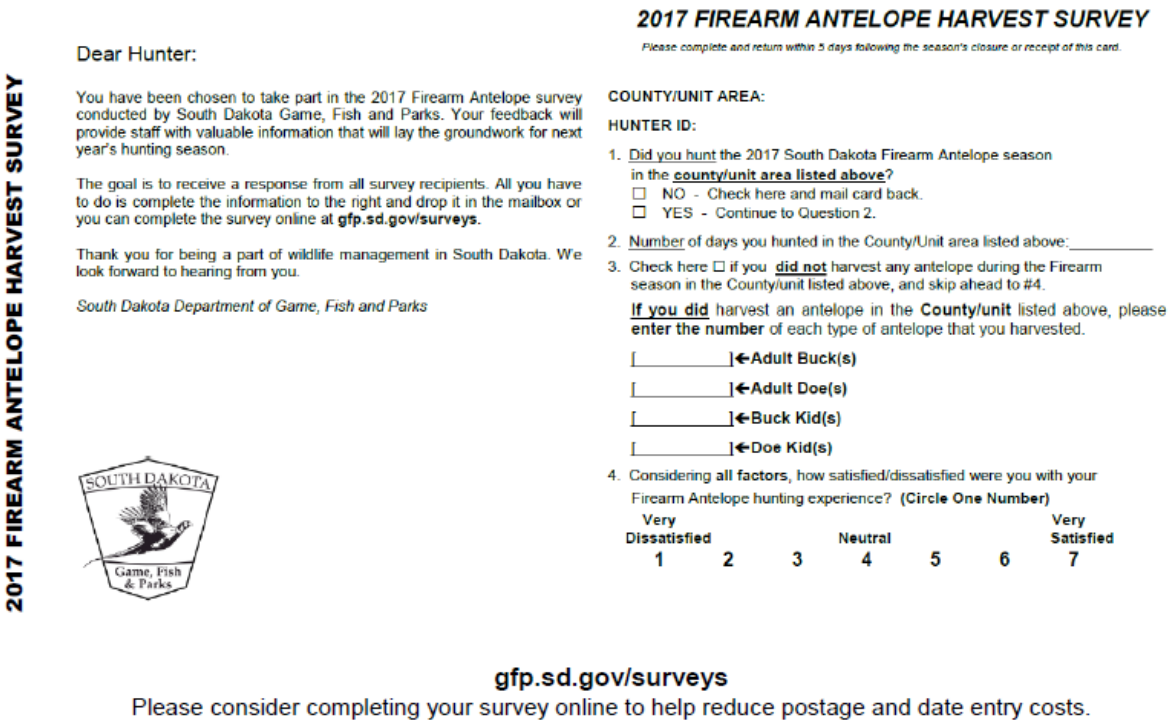
Appendix D. Game Management Units established for the Firearm Pronghorn 2017 Season.



Unit Number	Unit Name
02A	Pennington
11A	Bennett/Oglala Lakota
15A	NW Butte
15B	Butte
20A	Corson
21A	Custer
24A	Dewey (North)
27A	Fall River
31A	Haakon
35A	West Harding
35B	East Harding
36A	Hughes

Unit Number	Unit Name
39A	Jackson
41A	Jones
49A	North Meade
49B	South Meade
50A	Mellette
53A	North Perkins
53B	South Perkins
58A	Stanley
59A	Sully
63A	Walworth/Potter
64A	Ziebach
CU1	CSP

Appendix E. Hunter harvest survey card used to survey hunters for the 2017 Firearm Pronghorn season.



2017 FIREARM ANTELOPE HARVEST SURVEY

Dear Hunter:

You have been chosen to take part in the 2017 Firearm Antelope survey conducted by South Dakota Game, Fish and Parks. Your feedback will provide staff with valuable information that will lay the groundwork for next year's hunting season.

The goal is to receive a response from all survey recipients. All you have to do is complete the information to the right and drop it in the mailbox or you can complete the survey online at **gfp.sd.gov/surveys**.

Thank you for being a part of wildlife management in South Dakota. We look forward to hearing from you.

South Dakota Department of Game, Fish and Parks

SOUTH DAKOTA Game, Fish & Parks

2017 FIREARM ANTELOPE HARVEST SURVEY

Please complete and return within 5 days following the season's closure or receipt of this card.

COUNTY/UNIT AREA:

HUNTER ID:

1. Did you hunt the 2017 South Dakota Firearm Antelope season in the **county/unit area listed above**?
   - ☐ NO - Check here and mail card back.
   - ☐ YES - Continue to Question 2.
2. Number of days you hunted in the County/Unit area listed above:_____
3. Check here ☐ if you **did not** harvest any antelope during the Firearm season in the County/unit listed above, and skip ahead to #4.

   If you did harvest an antelope in the **County/unit** listed above, please **enter the number** of each type of antelope that you harvested.

   [_____]←**Adult Buck(s)**

   [_____]←**Adult Doe(s)**

   [_____]←**Buck Kid(s)**

   [_____]←**Doe Kid(s)**
4. Considering **all factors**, how satisfied/dissatisfied were you with your Firearm Antelope hunting experience? **(Circle One Number)**

Very Dissatisfied			Neutral			Very Satisfied
1	2	3	4	5	6	7

gfp.sd.gov/surveys

Please consider completing your survey online to help reduce postage and date entry costs.

Appendix F. South Dakota Mining Laws

SDCL 45-6B-33.

Unsuitable land--No permit issued. No permit may be issued for a mining operation proposed on unsuitable land. Land is unsuitable if the following conditions cannot be satisfactorily mitigated:

(1) Reclamation of the affected land pursuant to the requirements of this chapter is not physically or economically feasible;

(2) Substantial disposition of sediment in stream or lake beds, landslides, or water pollution cannot feasibly be prevented;

(3) The land to be affected by a proposed mining operation includes land that is special, exceptional, critical, or unique as defined in § 45-6B-33.3 and satisfactory mitigation is not possible;

(4) The proposed mining operation will result in the loss or reduction of long-range productivity of aquifer, public and domestic water wells, watershed lands, aquifer recharge areas, or significant agricultural areas;

(5) The biological productivity of the land is such that the loss would jeopardize threatened or endangered species of wildlife indigenous to the area; or

(6) The board finds that any probable adverse socioeconomic impacts of the proposed mining operation outweigh the probable beneficial impacts of the operation.

SDCL 45-6B-33.3.

Special, exceptional, critical, or unique land defined. For the purposes of § 45-6B-33, land is special, exceptional, critical, or unique if it possesses one or more of the following characteristics:

(1) The land is so ecologically fragile that, once it is adversely affected, it could not return to its former ecological role in the reasonably foreseeable future;

(2) The land has such a strong influence on the total ecosystem of which it is a part that even temporary effects felt by it could precipitate a system-wide ecological reaction of unpredictable scope or dimension; or

(3) The land has scenic, historic, archaeologic, topographic, geologic, ethnologic, scientific, cultural, or recreational significance.

SDCL 45-6B-92.

Description of critical resources affected by reclamation plan. The applicant shall, as part of the reclamation plan, include a description of all critical resources potentially affected by the mining operation and plans for mitigating potential impacts to such critical resources. Critical resources shall be addressed by the applicant during the evidentiary portion of a contested case hearing before the board on the mine permit application.

For purposes of this chapter, critical resources include the following:

(1) Wildlife--critical deer winter range, threatened or endangered species, and any other critical wildlife resource identified by the Department of Game, Fish and Parks;

(2) Aquatic resources--cold water fish life propagation water;

(3) Vegetation--riparian zones, mountain meadows, wetlands, and threatened or endangered species;

(4) Water--direct or indirect sources of drinking water;

(5) Visual resources--areas of severe visual constraint or retention quality objective;

(6) Soils--soils with high erosion and low revegetation potential;

(7) Cultural resources--cultural resources that are eligible for the national register of historic places;

(8) Air quality--areas with minimal ambient airborne particulates and areas near potential receptors including residences and recreational areas;

(9) Noise--areas near potential receptors including residences and recreational areas; and

(10) Lands designated as special, exceptional, critical, or unique pursuant to subdivision 45-6B-33 (3).


SOUTH DAKOTA
Game, Fish
& Parks