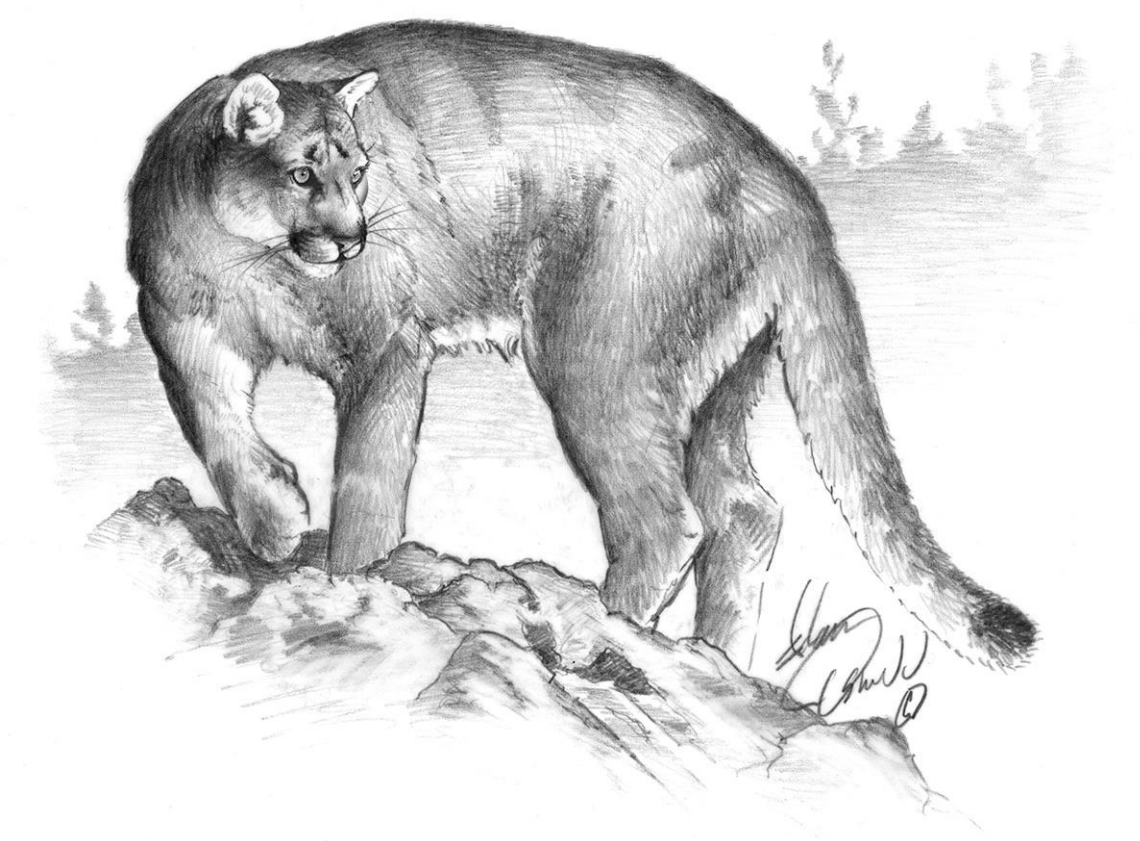
SOUTH DAKOTA
MOUNTAIN LION MANAGEMENT PLAN
2019-2029



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

WILDLIFE DIVISION REPORT 2019-06

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This plan is a product of substantial discussion and input from many wildlife professionals. Comments and suggestions received from members of the South Dakota Mountain Lion Stakeholder Group, private landowners, hunters, and those who recognize the value of mountain lions and their associated habitats were also considered.

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SDGFP Mountain Lion Management Plan Revision Team that assisted with plan writing, data review and analyses, critical reviews and/or edits to the South Dakota Mountain Lion Management Plan, 2019-2029 – Nathan Baker, Chalis Bird, Kris Cudmore, Josh Delger, Jacquie Ermer, Keith Fisk, Steve Griffin, Trenton Haffley, John Kanta, Tom Kirschenmann, Chad Lehman, Cynthia Longmire, Andrew Norton, Chad Switzer, Chad Tussing, and Lauren Wiechmann. Cover art was provided by Adam Oswald.

Those who served on the South Dakota Mountain Lion Stakeholder Group during this planning process included: Larry Bowden (Western Fur Harvesters); Kerry Burns (U.S. Forest Service, Black Hills National Forest); Mason Cooper (Rocky Mountain Elk Foundation); Mark DeVries (SD Stockgrowers Association); Sean Fulton (Citizen-Hunter); Rob Goodman (Oglala Sioux Parks and Recreation); Tim Goodwin (Citizen-Hunter); James Halverson (SD Stockgrowers Association); Nancy Hilding (Prairie Hills Audubon Society); Chris Hesla (SD Wildlife Federation); Tom Krafka (Black Hills Sportsmen Club); Jim Margadant (SD Chapter of the Sierra Club); Terry Mayes (Black Hills Sportsmen Club); Bill Rentz (SD Big Game Coalition); Jim Scherrer (Landowner); Ross Swedeen (SD Big Game Coalition); Brad Tisdall (SD Houndsmen Association). In addition to those citizens that volunteered for the stakeholder group, Commissioner Gary Jensen of the SDGFP Commission also attended and participated in the meetings.

This document is for general, strategic guidance for SDGFP and serves to identify what we strive to accomplish related to management of mountain lion populations. This plan will be utilized by Department staff and Commission on an annual basis and will be formally evaluated in 2029. Plan updates and changes, however, may occur more frequently as needed.

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

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ACRONYMS AND ABBREVIATIONS

AD	Adult
ArcGIS	ESRI mapping program (Global Information Systems)
ARSD	Administrative Rules of South Dakota
BFM	South Dakota Bureau of Finance and Management
BH	Black Hills
BHFPD	Black Hills Fire Protection District
BLM	Bureau of Land Management
CDV	Canine distemper virus
CI	Confidence Interval
CPUE	Catch per Unit Effort
CRD	Commission Recommendation and Development Group
CSP	Custer State Park
ETKFI	Estimated total kidney fat index
F	Female
F/CPV	Feline/canine parvovirus
FCV	Feline calicivirus
FIV	Feline immunodeficiency virus
FPLV	Feline panleukopenia virus
FPV	Feline parvovirus
GPS	Global Positioning System
HPUE	Harvest per Unit Effort
IRRC	Interim Rules Review Committee
K	Kitten
km	Kilometer
LRC	South Dakota Legislative Research Council
LSCV	Least squared-cross validated
M	Male
MOU	Memorandum of Understanding
NPS	National Park Service
SA	Sub-Adult
SD	South Dakota
SDCL	South Dakota Codified Law
SDGFP	South Dakota Game, Fish, and Parks
SDSU	South Dakota State University
SE	Standard Error
USFS	United States Forest Service
WGFD	Wyoming Game and Fish Department
WICA	Wind Cave National Park

EXECUTIVE SUMMARY

Historically, mountain lions (*Puma concolor*) occurred throughout South Dakota and were considered numerous in the Black Hills. However, the population declined in the early 1900's due to unregulated hunting and bounties that were placed on mountain lions until 1966. In 1978, mountain lions were listed as a state threatened species. With a breeding population established in the Black Hills and a better understanding of population dynamics within the Black Hills, the mountain lion was removed from the state threatened species list and classified as a big game animal in 2003 with protection under a year-round closed season. The first regulated mountain lion hunting season in South Dakota was established in 2005 and continues today to provide hunting opportunities and manage populations towards desired social and biological objectives.

The "South Dakota Mountain Lion Management Plan 2019-2029" provides a comprehensive overview of topics such as historical background, habitat, season setting process, hunting, population surveys, research, depredation, citizen involvement, education and outreach, and challenges and opportunities related to mountain lion management.

The South Dakota Game, Fish and Parks will manage mountain lion 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 Black Hills population objective is 200-300 total mountain lions, but actual population abundance may range depending on a multitude of factors. Population objectives for mountain lions on the prairie habitats of South Dakota have not been established as these areas are managed primarily to abate potential livestock losses on private property, minimize human conflicts, and maximize hunter opportunity.

To achieve the stated management goals for mountain lions in South Dakota, the following objectives have been identified:

1. Monitor and assess mountain lion populations by conducting scientifically based biological surveys within South Dakota.
2. Manage mountain lion populations for both maximum and quality recreational hunting opportunities, considering all social and biological inputs.
3. Cooperatively work with private landowners, municipalities, and the general public to resolve mountain lion depredation to livestock, human safety concerns, and urban mountain lion conflicts.
4. Monitor and evaluate risk and impact of disease in mountain lions in South Dakota.
5. Evaluate mountain lion research and management needs.
6. Promote public, landowner, and conservation agency awareness of mountain lion management needs and challenges.

Overall, South Dakota residents have a positive attitude towards mountain lions. Public opinions on mountain lions vary, however, and there will always be a certain level of controversy surrounding the management of large carnivores. With the use of science-based knowledge to make management decisions, this plan will ensure a healthy, self-sustaining population of mountain lions in the Black Hills of South Dakota.

INTRODUCTION

Historically, mountain lions had the largest range of any terrestrial mammal in the western Hemisphere (Logan and Sweanor 2001). Today, they continue to range from northern British Columbia to South America (Logan and Sweanor 2001), being extirpated from the eastern United States and Canada with the exception of southern Florida by the late 1800s to early 1900s (Young and Goldman 1946, Nowak 1976). During the first half of the 20th century, emphasis was placed on eradication, with bounties paid in most of the western US until the 1960s (Cougar Management Guidelines Working Group 2005). During the 1960s, bounties were removed in most western states, and depredation policies leaning towards removing animals directly involved with livestock losses became the general management scheme. In South Dakota, bounties on mountain lions were in place from 1889 to 1966. During 1906 through 1931, only one mountain lion was recorded as being taken in the Black Hills (Young and Goldman 1946). A detailed hunt of a male mountain lion in December of 1958 on Elk Mountain was described in the southern Black Hills (Mann 1959).

In 1978, the mountain lion was placed on the South Dakota state threatened species list affording it protection under South Dakota's Endangered and Threatened Species Law (SDCL § 34A-8). In 1985, the South Dakota Game, Fish and Parks (SDGFP) began investigating and recording sightings of mountain lions in the Black Hills due to the increasing frequency of reports. Reports of sightings and verifications of those reports continued to increase through the late 1980s and early 1990s, and in 1997 the SDGFP estimated 40-50 mountain lions resided in the Black Hills, though these estimates were largely based on anecdotal information. Due to the increase in verified sightings, a 5-year research project was begun by South Dakota State University (SDSU) in cooperation with SDGFP to estimate the distribution and abundance of mountain lions in the Black Hills. At the end of that research project in 2003, results indicated a population estimate of 127-149 mountain lions within the Black Hills ecosystem (Fecske 2003). Due to better understanding of population dynamics of mountain lions within the Black Hills, the mountain lion was removed from the state threatened species list and classified as a big game animal in 2003 with protection under a year-round closed season. The first hunting season was established in 2005 and a season occurs to this day, with refinements made to the season structure to meet population management objectives.

The historic range of mountain lions highlights the ability of the species to adapt to large geographic and climate variations that provide adequate prey and cover. Genetic evidence combined with dispersal movements indicates that most of the mountain lion populations in the western US are well connected (Culver et al. 2000, Sinclair et al. 2001, Anderson et al. 2004), with movements of over 1,000 km being documented (Thompson and Jenks 2005). It is this ability to adapt to a variety of habitats that provide cover and prey combined with the act of dispersal in response to "crowded situations" and density dependence (Howard 1960) that likely led to the re-establishment of mountain lions within the Black Hills.

MOUNTAIN LION HABITAT

Black Hills

The Black Hills, located in west-central South Dakota and northeastern Wyoming, represent the eastern most extension of the Rocky Mountains and represent the oldest mountains in North America (Froiland 1990). The mountain range is isolated by the surrounding grasslands of the Northern Great Plains (Thompson 2009). The closest breeding populations of mountain lions occur in the Pine Ridge region of Nebraska (80 km to the south; Wilson et al. 2010), Laramie and Bighorn mountain ranges of Wyoming (120 km to the southwest and 200 km to the west, respectively; Anderson et al. 2004), and the Badlands of North Dakota (120 km to the north). The Black Hills occupy approximately 8,400 km^2 (Fecske and Jenks 2002) in area and are dome-shaped, sloping more steeply to the east than to the west; highest elevation is 2,207 m above mean sea level (Froiland 1990). Soils of the Black Hills are classified as the gray wooded soil region, which is unique for South Dakota (Froiland 1990). These soils, developed under timber in dry sub-humid to humid climate, were derived from limestone, sandstone, igneous, and metamorphic rocks (Froiland 1990). The Black Hills ecosystem is comprised of four distinct vegetation complexes: 1) Rocky Mountain coniferous forest, 2) Northern coniferous forest, 3) Grassland complex, and 4) Deciduous complex. Forest cover in the Black Hills is predominantly evergreen forest including, ponderosa pine (*Pinus ponderosa*) with co-dominants of white spruce (*Picea glauca*) and quaking aspen (*Populus tremuloides*) at higher elevations (Figure 1).

Large ungulate prey species available to mountain lions in the Black Hills include white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), bighorn sheep (*Ovis canadnesis*), and mountain goat (*Oreamnos americanus*). Other species commonly consumed by mountain lions in the Black Hills includes turkeys (*Meleagris gallapavo*), porcupine (*Erethizon* spp.), and other small mammals. Coyote (*Canis latrans*) and bobcat (*Lynx rufus*) are other predators that co-occupy the region; wolves (*Canis lupus*), grizzly bears (*Ursus arctos*), and black bears (*Ursus americanus*) were extirpated from the region around the late 1800's to early 1900's (Higgins et al. 2000). The combination of adequate prey and a variety of available habitat within the Black Hills provided evidence that the region was capable of sustaining a viable population of mountain lions (Fecske 2003). Mountain lions in Custer State Park (CSP) are a subcomponent of the Black Hills mountain population and are managed as an integral part of the overall population within the unique management considerations of the Park.

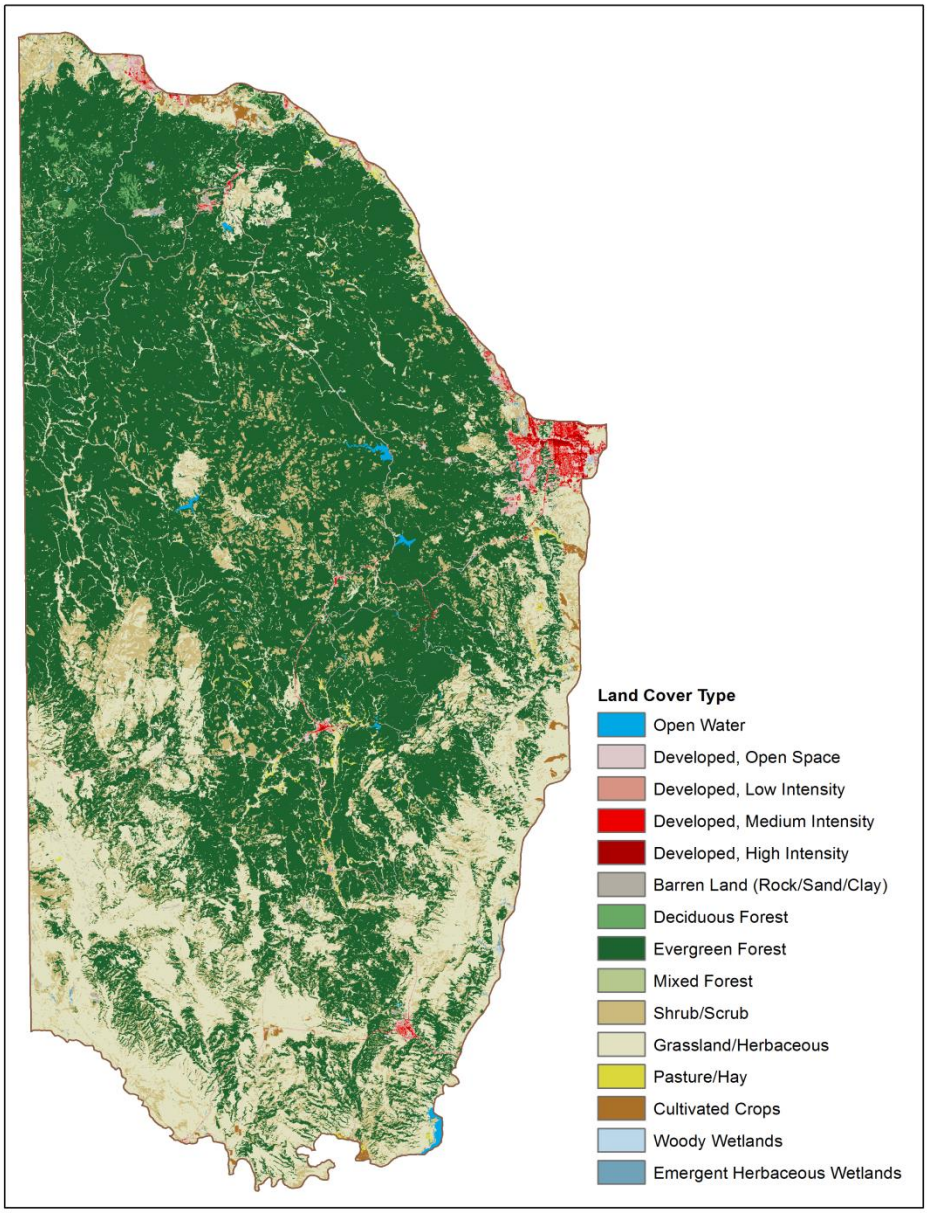

Figure 1. Land cover of the Black Hills ecosystem (USGS 2014).

Prairie

Historically mountain lions were noted in riparian regions of the Dakotas and Badlands (Roosevelt 1926, Young and Goldman 1946). The western prairie of South Dakota consists of grasslands with less than 25% in agricultural use (Johnson and Nichols 1982) dissected by broken rough drainages with cedar breaks. Most of the land is in private ownership with some USDA Forest Service (USFS), Bureau of Land Management (BLM), and National Park Service (NPS) public lands and tribal lands interspersed among private lands. The middle of the state is split with the Missouri river and associated river breaks. The eastern prairie consists of mostly

private lands with more than 75% in agricultural use (Johnson and Nichols 1982). Although a mountain lion habitat analysis has not been conducted for the prairies of western South Dakota, there are existing habitats that include wooded river breaks, deep wooded draws, and river bottoms that support deer populations and prey species conducive to mountain lion needs.

SEASON SETTING PROCESS

Managing wildlife populations within various social tolerances, hunter desires, and expectations of the general public is a challenging task. Mountain lion hunting is a popular and much awaited outdoor activity for many sportsmen and women in South Dakota. The demand for mountain lion hunting opportunities requires careful consideration by SDGFP to provide the highest amount of hunting opportunity in the most fair and responsible manner in accordance with current population management objectives.

South Dakota Codified Law (SDCL) § 41–2–18 grants authority to the SDGFP Commission to establish hunting seasons for big game species, including mountain lion. 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; and specific mountain lion 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 mountain lion seasons are currently considered by the SDGFP Commission on a biennial basis.

The mountain lion 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 mountain lion hunting season recommendations by SDGFP staff. From a workload perspective, SDGFP staff spend a significant amount of time on mountain lion management and mountain lion hunting seasons largely due to the high demand by resident hunters, the various hunting seasons and user groups (e.g., boot hunters (those hunting without the aid of dogs), houndsmen), and the challenges of finding that balance between biological and social carrying capacities of a large carnivore. The process for the development of mountain lion hunting recommendations by SDGFP staff includes the evaluation of three groups of information: biological data, harvest data, and social data (Figure 2).

As described in the *Mountain Lion Population Surveys* section of this plan, mountain lion biological data are collected from documented mortalities, mark/recapture surveys,

observation reports, and population modeling. These data are used in a population model to assist SDGFP in determining current population abundance and trends for mountain lions in the Black Hills. Depending on the objectives of each biological survey, data are analyzed at the Black Hills 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 adjust hunting seasons (e.g., harvest limits, season length).

Harvest data, also described in the *Mountain Lion Population Surveys* section of this plan, provide useful information on hunter success, harvest, harvest composition, 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 mountain lion seasons. Harvest and hunter effort can be used to estimate trends in mountain lion harvest per unit effort rates, and are used as a potential assessment of mountain lion population trends; however, harvest success may be affected by many factors other than mountain lion population abundance so careful interpretation is warranted. Hunter harvest and satisfaction ratings can be used to evaluate specific management strategies, and hunter satisfaction is an important consideration when developing season recommendations. Harvest composition, in particular adult female harvest proportions, is important to quantify and may be an indicator of harvest impacts or population trends. 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) is used by SDGFP to help determine the Black Hills mountain lion population objective. This process involves SDGFP staff obtaining stakeholder's opinions regarding the status of the mountain lion population in Black Hills. A management objective for mountain lions on the prairie has not been established, and current management involves a year-round and unlimited season. Multiple sources of public opinion are used in formulating the Black Hills management objective and include personal contacts with landowners and hunters, open houses, regional advisory meetings, hunter and landowner opinion surveys, hunter harvest surveys quantifying success and satisfaction ratings, and other submitted comments. Once the data are reviewed and summarized, internal staff meetings are then conducted at the regional level to discuss public input received regarding mountain lion population abundance, depredation issues, landowner tolerance, hunter comments, and harvest results from the previous season. The end result is a defined management objective for the Black Hills.

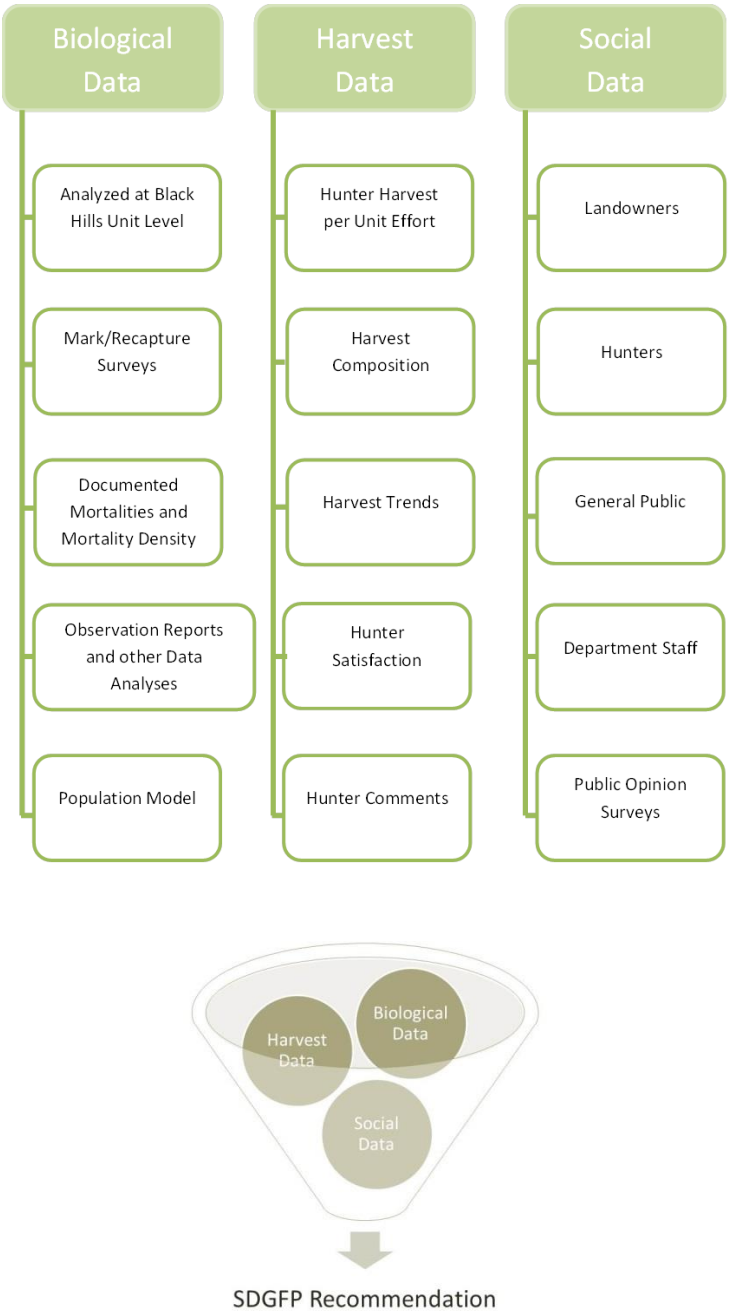

Figure 2. Simplistic model describing the process for the development of SDGFP mountain lion hunting recommendations.

Each of the four SDGFP Wildlife Division administrative regions work closely with big game program staff, human dimension specialist, 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 Commission Recommendation and

Development (CRD) group, which corresponds with appropriate harvest strategies to meet mountain lion population objectives. Comprised of regional terrestrial resources supervisors, senior biologists, and administrators, the CRD group meets two-three weeks before each Commission meeting to review all regional recommendations and develop recommendations for consideration. The wildlife program administrators and senior big game biologist then meet with the SDGFP Secretary, Wildlife Division Director, and Wildlife Division Deputy Director to present the recommendations for consideration that were formulated by the CRD group. A final decision is made on a SDGFP recommendation and presented to the SDGFP Commission in the form of an action sheet for consideration by the Commission. Any changes to the formal SDGFP recommendation from regional recommendations or the recommendations for consideration from the CRD group are then communicated back to the CRD group and regional 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 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 the Commission meeting in September, SDGFP presents recommendations for adoption as an official rule proposal for all mountain lion seasons and regulations. The SDGFP Commission has the flexibility to modify the recommendation as they determine appropriate or to simply take no action, which results in no change to current administrative rule.

Once the Commission adopts a formal proposal, the proposal is then open for public comment for one month or until the next Commission meeting. Commission proposals available for public comment can be found online at: https://gfp.sd.gov/commission/information/. It is during this time period 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 Commission and SDGFP indicating full name and city of residence are entered as part of the public record.

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

The proposed rules are submitted to the South Dakota Legislative Research Council (LRC) and are thoroughly reviewed for legality, form, and style. A small business impact statement form is completed and submitted to the South Dakota Bureau of Finance and Management (BFM) indicating changes to fees and license numbers. Figure 3 shows a model as to how the Commission formally adopts changes to administrative rule.

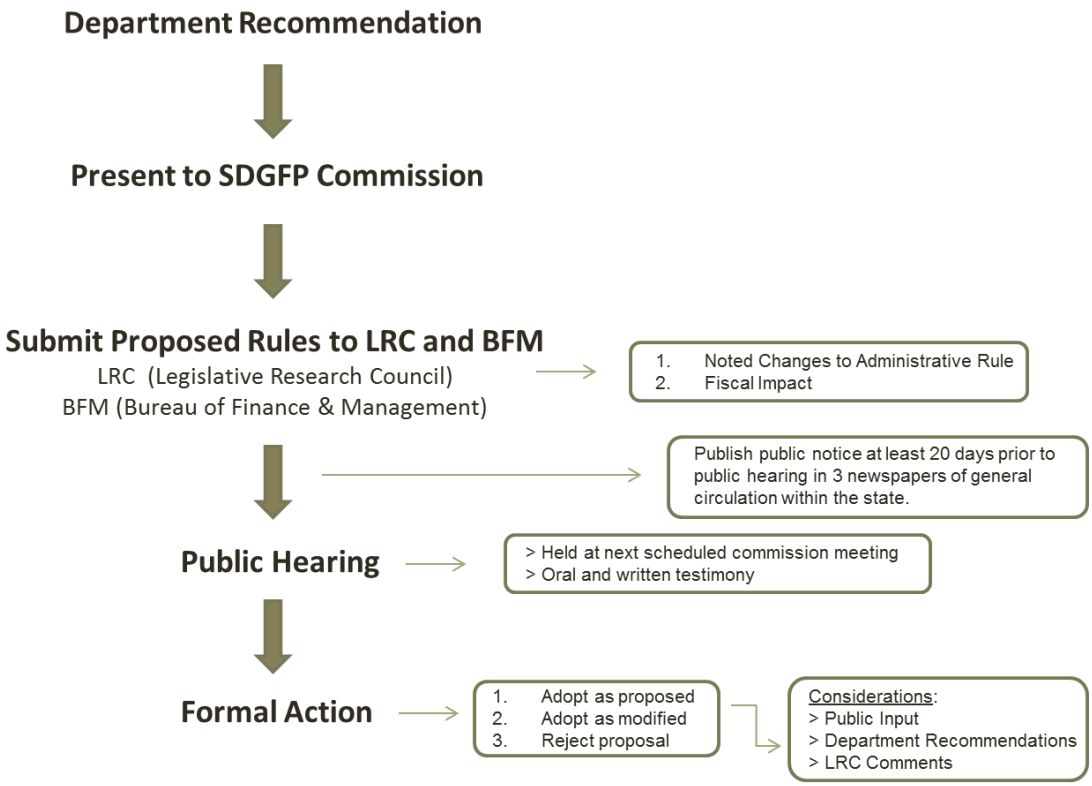

Figure 3. SDGFP Commission process for establishing hunting season regulations.

Post-SDGFP Commission Action

The final rules adopted by the SDGFP Commission rules are again reviewed by LRC, and the final rules and minutes of the public hearing are sent to the Interim Rules Research Committee (IRRC), where the Wildlife Division Director or designee formally presents the materials. Following acceptance by the IRRC, the final rules and certificate of acceptance are then filed with the Secretary of State. Administrative rules may be implemented a minimum of 20 days after the final rules and certificate of compliance are filed with the Secretary of State (Figure 4).

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, and for future mountain lion seasons, SDGFP is moving towards paperless applications for mountain lion seasons. Paper applications will be available online and will still be accepted if the application is printed or requested at field offices and mailed to the licensing office in Fort Pierre.

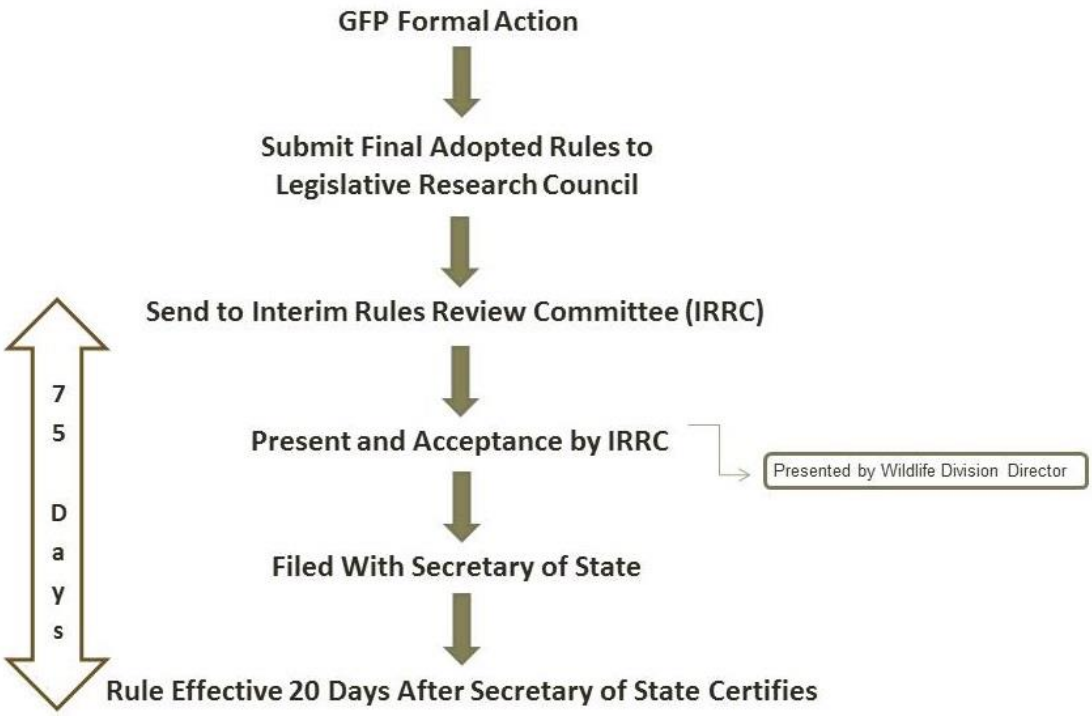

Figure 4. Post-SDGFP Commission administrative rule promulgation process.

MOUNTAIN LION HUNTING

Historical Harvest

Mountain lion management in South Dakota began in 1978 when the species was placed on the state threatened species list. As more monitoring and research data were gathered on the species and a better understanding of the population numbers and dynamics was acquired, it was removed from the threatened list and reclassified as a big game animal in 2003 with protection under a year-round closed season. Mountain lion management in South Dakota, as in the western United States and Canada, can be a controversial subject. Public desires and values vary widely concerning the species. On one end of the spectrum is the public that believe mountain lions are a keystone species and that nature can manage itself thus mountain lions should not be hunted. On the other end of the spectrum is the public concerned about livestock depredation and human safety that believe all mountain lions should be killed. Wildlife agencies charged with mountain lion management must consider all varying public desires and values while still maintaining the species where habitat can support a viable population.

After 20 years of monitoring mountain lion reports and seven years of research, the first hunting season was established in 2005 as an "experimental season". The goal of this season was to gather more data on mountain lions and determine the feasibility of a hunting season to provide recreational opportunity while sustaining a viable population of mountain lions within the Black Hills. The first hunting season provided additional data on population numbers and dynamics, and public desire for the season resulted in subsequent seasons. Modifications to season timing, restrictions, and harvest limits have occurred as more information has been acquired and refinement to season structure has been warranted.

Black Hills, Prairie and CSP

Due to the preponderance of private land ownership on the prairie and limited available habitat preferred by mountain lions, SDGFP does not have established population objectives or management goals for mountain lions outside of the Black Hills ecosystem. The current hunting season structure for mountain lions includes a license that is valid statewide but with different regulations in the Black Hills unit (located within the Black Hills Fire Protection District) and the Prairie unit (the rest of the state). Harvest limits and season dates have been established for the Black Hills unit while Prairie unit regulations have been less restrictive since the 2008/09 season (Table 1, Table 2).

Mountain lion hunting in South Dakota began with two units for the 2005/06 season (Black Hills and Prairie). There were unlimited licenses offered in the Black Hills unit and unlimited licenses for landowners on their own land for the Prairie unit. The harvest limit was set at 25 total mountain lions or 5 "breeding age" females. A "breeding age" female was defined as a female that had lactated or was currently lactating or was two and a half years old or older. All harvested mountain lions counted towards the harvest limit. Season dates were October 1

through December 15. It was assumed these dates would give both the elk and deer hunters the opportunity to harvest a mountain lion while pursuing other big game species. The goal was to have an adequate season length and hunter participation to acquire the desired harvest numbers. In other western states and provinces, with the exception of Oregon and Washington, mountain lion hunting is mainly accomplished with the use of dogs. Due to the patch-work of private lands throughout the Black Hills, it was felt that the use of dogs could result in considerable problems with trespass on private lands, and that hunting without dogs would provide for maximum hunter opportunity.

Table 1. Black Hills management unit mountain lion season structure, 2005/06 - 2017/18.

Harvest Year	Season Dates	Total Harvest Limit	Female Harvest Limit
2005/06[1]	Oct 1 - Dec 15	25	5
2006/07[1]	Nov 1 - Dec 31	25	8
2007/08[1]	Nov 1 - Dec 31	35	15
2008/09[1]	Jan 1 - Mar 31	35	15
2009/10[1]	Jan 1 - Mar 31	40	25
2010/11[2]	Jan 1 - Mar 31	45	30
2011/12	Jan 1 - Mar 31	70	50
2012/13[3]	Dec 26 - Mar 31	100	70
2013/14[3]	Dec 26 - Mar 31	75	50
2014/15[3]	Dec 26 - Mar 31	75	50
2015/16[3]	Dec 26 - Mar 31	60	40
2016/17[3]	Dec 26 - Mar 31	60	40
2017/18[3]	Dec 26 - Mar 31	60	40

[1] Harvest limit includes all or part of prairie harvest
[2] CSP harvest limit separate from Black Hills harvest limit
[3] Hunting with dogs allowed in Custer State Park

Subsequent hunting seasons were modified for several years after the first season as more information was acquired and refinements were warranted (Table 1). In 2006/07, the harvest limit for total mountain lions was again 25, however the female limit was increased to eight and the "breeding age" definition was removed, due to the discrepancies over the definition of what constituted a "breeding age" female. In addition, the season dates were changed to November 1 through December 31. In 2007/08, the total limit was increased to 35 and female limit increased to 15, and the season was opened to the entire state. For the 2008/09 season, season dates were changed to January 1, 2009 through March 31, 2009 in an attempt to reduce harvest of females with dependent young less than three months of age (see *Orphaned Kittens* section). The season harvest limit remained at a total of 35 or 15 females, however, landowners on their own land or land they leased were able to harvest a mountain lion year-

round and mountain lions harvested outside of the season dates in the Black Hills did not count toward the harvest limit.

From 2009/10-2012/13 the Black Hills harvest limit increased from 40 to 100 total mountain lions with a female limit increasing from 25 to 70. During the 2012/13 mountain lion season, season dates changed to December 26 through March 31. The harvest limit decreased in 2013/14 to 75 total mountain lions or 50 females. In 2015/16, the harvest limit was set at 60 total mountain lions with a 40 female limit and has remained constant to 2017/18. The 2015/16 season was also the first full season that dogs were allowed for Prairie Unit harvest since administrative rule (ARSD § 41:06:61:06) went into effect on March 2, 2015.

Table 2. Prairie unit mountain lion season structure, 2005/06 - 2017/18.

Harvest Year	Season Dates	Total Harvest Limit	Female Harvest Limit	Included with BH harvest limit
2005/06[1]	Oct 1 - Dec 15	25	5	yes
2006/07[1]	Nov 1 - Dec 31	25	8	yes
2007/08[2]	Nov 1 - Dec 31	35	15	yes
2008/09[3,4]	Jan 1 - Mar 31	35	15	yes
2009/10[3,4]	Jan 1 - Mar 31	40	25	yes
2010/11	Year-round	unlimited	unlimited	no
2011/12	Year-round	unlimited	unlimited	no
2012/13	Year-round	unlimited	unlimited	no
2013/14	Year-round	unlimited	unlimited	no
2014/15	Year-round	unlimited	unlimited	no
2015/16[5]	Year-round	unlimited	unlimited	no
2016/07[5]	Year-round	unlimited	unlimited	no
2017/18[5]	Year-round	unlimited	unlimited	no

[1] Prairie season only valid for landowner on own land
[2] Prairie season valid for all private land
[3] Prairie season open year-round for landowner on own land
[4] Harvest included with the Black Hills unit limits only during season dates
[5] Hunting with dogs allowed

In 2010/11, SDGFP established a mountain lion hunting season in CSP. Hunters were originally required to have a separate CSP license, and harvest in CSP during the 2010/11 season did not contribute to the Black Hills harvest limit. Since the 2011/12 season, all harvest within the CSP boundary counts towards the overall Black Hills harvest limit. Further, since 2011/12, hunters can hunt mountain lions in CSP with a statewide mountain lion license but must obtain a free access permit. All access permits are limited entry and are issued via a lottery draw system.

Access permits that allow hunters to use dogs in CSP were first provided in the 2012/13 season.

Specific requirements and rules for the mountain lion seasons have remained fairly consistent through the years, and currently include the following:

- No person may release dogs on tracks indicating multiple mountain lions traveling together.
- Any mountain lion accompanying another mountain lion may not be harvested.
- All mountain lions taken, including carcass and pelt, must be presented to SDGFP staff within 24 hours of the kill for inspection.
- All firearms, muzzleloaders and archery equipment must meet the same minimum requirements established for deer hunting in South Dakota.
- Shooting hours are ½ hour before sunrise to ½ hour after sunset.
- Hunters may not hunt with the aid of traps or bait.
- The use of dogs is allowed in Custer State Park during specified hunting intervals and year-round outside of the Black Hills Fire Protection District on private land with the permission of the landowner or leasee. A pursuit of a mountain lion by dogs that originates on private land may cross over or culminate on property owned by the Office of School and Public Lands or the United State Bureau of Land Management other than the Fort Meade Recreation Area. Licensed hunters must accompany the dog handler when the dogs are released and must continuously participate in the hunt thereafter until the hunt is completed.
- Hunters may use electronic calls.
- All licenses are sold by application through the SDGFP License Office in Fort Pierre.

All mountain lion hunting seasons in the Black Hills of South Dakota have followed a similar season structure to maintain control of the harvest and ensure sustainable populations. Every mountain lion season has had a total harvest limit, which allows SDGFP to establish a maximum threshold for overall mountain lion harvest. In addition, a sublimit for female harvest has also been established to limit the harvest of female mountain lions and the most influential parameter impacting population growth rates. Furthermore, if maximum harvest limits are not met, each season since 2005 has had established beginning and ending season dates in order to provide harvest opportunities during a time of year that best meets population and hunter opportunity objectives.

Mountain Lion Hunter Profile

South Dakota has held a residents-only mountain lion season since 2005. Since that time mountain lion hunters have been surveyed annually following the close of the Black Hills mountain lion season. Currently, the Black Hills mountain lion season begins on December 26th and ends March 31st of the following year. The season, however, ends immediately if the total harvest limit or the total female harvest limit is reached at an earlier date. The use of dogs is limited to those hunters who successfully draw an access permit in Custer State Park for specified hunting intervals; however, the use of dogs to hunt mountain lions within the general

Black Hills season is prohibited.

The proportion of licensed mountain lion hunters who actively participate in the Black Hills mountain lion hunting season has steadily decreased in recent years from 77 percent during the 2010/2011 hunting season to a low of 42 percent in the 2017/2018 hunting season (Huxoll 2018). When hunters are asked about the reasons for not participating in the season, the top three reasons were: not enough time (53%); not enough snowfall (26%); and hunted or planned to hunt outside the Black Hills Fire Protection District (21%). Approximately nine percent indicated they had a license in case it was needed for a mountain lion on their own property (Longmire 2013). Regardless of the overall season length, the average number of days hunted for mountain lions during the Black Hills season has remained fairly consistent, ranging from 6.2 days during the 2009/2010 season to 7.3 days during the 2017/2018 season. Over the past 10 seasons, mountain lion hunters have been slightly satisfied, on average, with the Black Hills mountain lion season (Huxoll 2018).

Questions measuring hunters' general attitudes toward mountain lions in South Dakota have been asked periodically over years. In 2013, mountain lion hunters slightly agreed, on average, with the statement that the presence of mountain lions was a sign of a healthy environment (Longmire 2013). Hunters neither agreed nor disagreed, on average, with the statement that having a healthy viable population of mountain lions in South Dakota was important to them; and moderately agreed that they were concerned about mountain lions killing too many game animals. Hunters, however, slightly disagreed with the statement that having mountain lions in South Dakota was too dangerous a risk to people. Similar to the attitudes and beliefs of South Dakota residents, hunters' attitudes regarding mountain lions in SD have fluctuated over the years. In 2013, hunters' level of agreement was down from 2005 levels regarding the presence of mountain lions as a sign of a healthy environment, and on having a healthy, viable population of mountain lions in SD being important to them. The level of concern over mountain lions killing too many game animals increased from 2005 to 2013; however, attitudes regarding mountain lions being too dangerous a risk to people remained stable over this same time period (Longmire 2013). These fluctuations in attitudes toward mountain lions, similar to those seen in South Dakota residents, may be due, in part, to overall population fluctuations in mountain lions, deer, and elk.

Over the past six years, there has been a shift from a majority of hunters wanting to see the population decrease, to approximately one-third of hunters wanting to see the population decrease. After the 2012/2013 and 2013/2014 mountain lion seasons the majority of hunters wanted to see the mountain lion population decrease to some extent (64% and 54%, respectively). After the 2014/2015 season, there was no majority consensus among mountain lion hunters on preference for population goals (Longmire 2017, 2016, 2015, 2014, 2013 and 2012a). This trend has continued with the latest survey results showing 35 percent of mountain lion hunters wanting to see the population decrease, 40 percent wanted the population to remain about the same, 17 percent wanted the population to increase, and eight percent were not sure (Huxoll 2018). Looking at only those hunters who actively participated in the 2017/2018 Black Hills mountain lion season 28 percent want the population to decrease, 46

percent wanted to see it remain about the same, 21 percent preferred an increase, and 5 percent were not sure about mountain lion population goals (Huxoll 2018).

MOUNTAIN LION POPULATION SURVEYS

In general, mountain lions exhibit secretive behavior, occur in low densities, and occupy habitats with relatively dense vegetative cover and rough topography. These characteristics make estimates of population abundance and trend difficult. SDGFP uses numerous trend indicators to assess the mountain lion population in the Black Hills. The primary surveys and data used to assess trends include: 1) hunting season data (e.g., total harvest, age and sex composition, harvest per unit effort), 2) documented mortalities (e.g., harvest/non-harvest, densities), 3) DNA mark/recapture data, and 4) observation reports.

Furthermore, qualitative monitoring and assessment of auxiliary data is completed annually by SDGFP to evaluate other potentially useful datasets, including nutritional condition surveys, injuries of harvested mountain lions and snow conditions during hunting seasons.

Hunting Season Data

Hunting season dates and harvest limits are currently used to manage mountain lions in the Black Hills Fire Protection District (BHFPD), and a year-round season with no limit exists in the remainder of South Dakota.

Harvest

There were 3,384 mountain lion hunting licenses sold in 2017/18, with past license sales ranging from 2,274 – 4,637 (Table 3). The 2017/18 mountain lion hunting season for the BHFPD was December 26, 2017 – March 31, 2018. Regulations were in place to end the season immediately if the harvest limit of 60 mountain lions, or 40 females, was met. Within the BHFPD, the use of dogs to hunt mountain lions was prohibited except during specified hunting intervals in Custer State Park (CSP). The 2017/18 mountain lion season in the BHFPD ended on March 31 with a total of 31 mountain lions harvested; nine of these mountain lions were harvested with the aid of dogs in CSP (Table 3).

Outside of the BHFPD, the season is year-round and the use of dogs to pursue mountain lions is allowed on private land. A pursuit by dogs that originates on private land may cross over or culminate on property owned by the Office of School and Public Lands or the United States Bureau of Land Management. On the prairie, 11 mountain lions (nine males, two females) were harvested in the 2017/18 season (April 1 – March 31; Table 3).

Hunting seasons for mountain lions in South Dakota began in 2005; historical mountain lion harvest, season dates, and associated season data are depicted in Table 3. Harvest peaked in 2011/12 at 73 and has been trending downwards in subsequent years (Table 3). Harvest limits are established to ensure harvest does not exceed management objectives, and limits have not

been reached since the 2011/12 season, allowing hunting opportunity the entire hunting season.

Table 3. Mountain lion hunting season data for South Dakota, 2005/06 – 2017/18.

			Black Hills Harvest						
Year	Licenses Sold[1]	Season Dates	Males	Females	Total	Prairie[2]	Harvest Limit	Limit Reached	Season Length (days)
2005/06	2,588	Oct. 1-Dec. 15	6	7	13	1	25 or 5 females	Female	24
2006/07	3,295	Nov. 1-Dec 31	7	8	15	1	25 or 8 females	Female	19
2007/08	4,070	Nov. 1-Dec 31	2	15	17	2	35 of 15 females	Female	23
2008/09	2,335	Jan. 1-March 31	11	15	26	2	35 of 15 females	Female	45
2009/10	2,274	Jan. 1-March 31	16	24	40	3	40 or 25 females	Total	41
2010/11	2,591	Jan. 1-March 31	20	27	47	5	45 or 30 females	Total	52
2011/12	3,720	Jan. 1-March 31	27	46	73	2	70 or 50 females	Total	61
2012/13	4,637	Dec. 26-March 31	26	35	61	6	100 or 70 females	Date	96
2013/14	3,856	Dec. 26-March 31	22	31	53	4	75 or 50 females	Date	96
2014/15	3,767	Dec. 26-March 31	21	22	43	5	75 or 50 females	Date	96
2015/16	3,681	Dec. 26-March 31	16	25	41	8	60 or 40 females	Date	97
2016/17	3,067	Dec. 26-March 31	14	16	30	5	60 or 40 females	Date	96
2017/18	3,384	Dec. 26-March 31	12	19	31	11	60 or 40 females	Date	96

[1]Licenses sold from April 1 - March 31 (adjusted year).
[2] Prairie and Black Hills season dates and harvest limits completely or partially overlap from 2005/06 – 2009/10.

Harvest Data Collection

All harvested mountain lions in South Dakota must be presented to a SDGFP representative within 24 hours of harvest for inspection. Information about the harvest is collected and includes: hunter information, date of harvest, location of harvest, hunting method, and specific information about the mountain lion such as estimated age, sex, and weight (Table 4, Figure 5, Figure 6, Appendix A). Age estimates are categorized as: < one year old is a kitten (K), one – three year old is a sub-adult (SA), and > three years old is an adult (AD). Female mountain lions follow the same age estimation with the exception that a female mountain lion is classified as

an adult if there is evidence of lactation. Harvest surveys are also sent to all licensed hunters (Appendix B, Appendix C).

Table 4. Hunting methods used by successful Black Hills mountain lion hunters, 2005/06 to 2017/18.

Year	Predator Call	Tracking	Kill Site	Incidental	Other	CSP Dogs	Total
2005/06	6	0	1	4	2		13
2006/07	9	0	0	4	2		15
2007/08	6	1	0	8	2		17
2008/09	15	7	1	0	3		26
2009/10	22	13	4	0	1		40
2010/11	15	26	4	1	1		47
2011/12	27	37	4	5	0		73
2012/13	24	17	6	6	2	6	61
2013/14	15	18	6	4	2	8	53
2014/15	20	10	3	4	1	5	43
2015/16	18	12	2	0	3	6	41
2016/17	8	7	5	3	0	7	30
2017/18	9	6	4	3	0	9	31

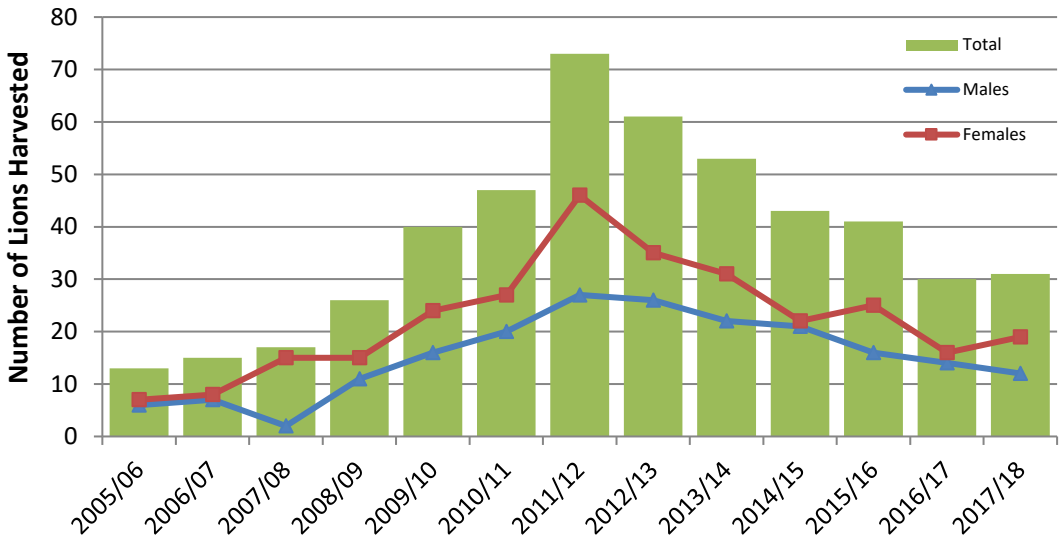

Figure 5. Male and female mountain lion harvest in the Black Hills of South Dakota, 2005/06 – 2017/18 (April 1 – March 31).

Tissue samples are also collected from harvested mountain lions for genetic analyses used in mark/recapture population estimates. All harvest data are used to assess the impacts of harvest on population demographics and inform future hunting season structure and harvest limit.

Harvest Composition

Trends in harvest age and sex proportions are evaluated annually in the Black Hills (Figure 5, Table 5, Figure 6). Since the first regulated hunting season in 2005, 60% of all adult/sub-adult mountain lions harvested in South Dakota have been females (35% adult, 25% sub-adult), and 40% have been males (19% adult, 21% sub-adult). Approximately 46% of all mountain lions harvested have been sub-adults. No apparent trends in sex and age compositions are suggestive of population changes.

Age and sex composition of harvest may be a useful index to mountain lion populations in Wyoming that are hunted primarily with the use of dogs (Anderson and Lindzey 2005). The majority of harvest in South Dakota, however, occurs without the use of dogs (dogs are only legal outside the BHFPD and in CSP during designated hunting intervals), and therefore interpretation of harvest composition trends may not be comparable. For example, after the state of Washington made it illegal to hunt mountain lions with dogs, subsequent harvest data showed that the median age of harvested mountain lions declined and percentage of females increased (Martorello and Beausoleil 2003).

Table 5. Black Hills management unit mountain lion harvest age structure, 2005/06 – 2017/18.

Year	Total	Males		Females	
		Adult	Sub-Adult	Adult	Sub-Adult
2005/06	13	2	4	5	2
2006/07	15	2	5	2	6
2007/08	17	0	2	9	6
2008/09	26	7	4(2)	3	12(1)
2009/10	40	7	9(2)	17	7(4)
2010/11	47	13	7(1)	15	12(4)
2011/12	73	12	15(5)	29	17(3)
2012/13	61	7	19(4)	18	17(1)
2013/14	53	9	13(3)	15	16(3)
2014/15	43	10	11	15	7
2015/16	41	7	9(1)	10	15(3)
2016/17	30	4	10(3)	8	8(1)
2017/18	31	6	6(1)	9	10(1)

(#) Indicates the number of kittens (< one year old) included within the Sub-adult count.

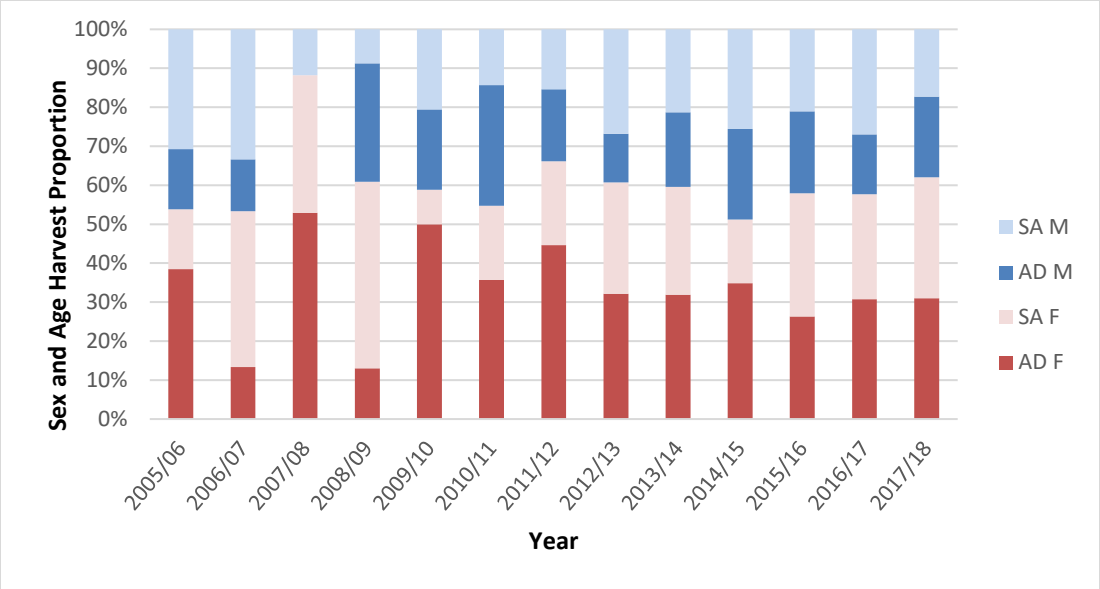

Figure 6. Sex and age harvest proportions of mountain lion harvest in the Black Hills of South Dakota, 2005/06 – 2017/18 (April 1 – March 31; SA = sub-adult, AD = adult, M = male, F = female).

Female age structure of harvested mountain lions is also evaluated, as research of some western mountain lion populations suggests a relationship between mountain lion harvest age and population trends (Anderson and Lindzey 2005, Stoner et al. 2006). The average age of harvested adult females in South Dakota since the 2005/06 has fluctuated between four to six years old, with an overall average of 5.2 (*n* = 146, Figure 7). SDGFP will continue to evaluate new data for long term trends.

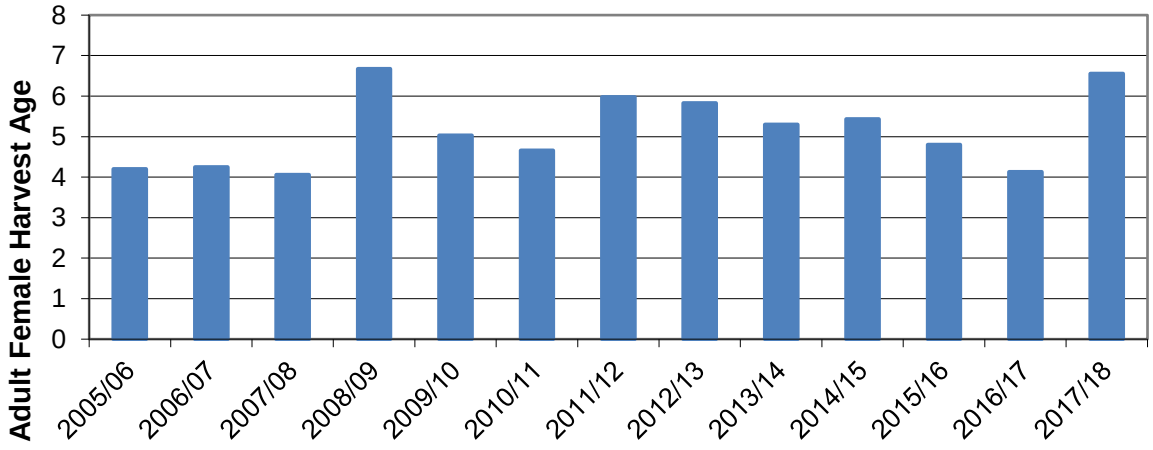

Figure 7. Average age of harvested adult female mountain lions in the Black Hills of South Dakota, 2005/06 – 2016/17 (April 1 – March 31).

Harvest Success and Effort

Because mountain lion hunting in South Dakota is primarily conducted without the use of dogs, harvest success rates are lower than regions that allow this hunting method. Overall, hunting success for all licensed boot hunters (those hunting without the aid of dogs) in the BHFPD from 2005/06 – 2017/18 averaged 1.2%; hunting success for hunters using dogs in CSP averaged 51% during 2012/13 to 2017/18.

Season dates in the 2005/06, 2006/07, and 2007/08 mountain lion seasons allowed for incidental harvest of mountain lions during deer and/or elk seasons; mountain lion hunting was allowed after the primary deer and elk hunting seasons concluded if the mountain lion harvest limit was not met. The season start date was delayed to January 1 from 2008/09 to 2011/12 and modified to December 26 for the 2012/13 to present hunting seasons, and thus incidental mountain lion harvest opportunities while hunting other species were nearly eliminated. As a result, hunting methods have changed over time with most harvest now occurring from hunters specifically targeting mountain lions. The average number of reported days hunted for successful hunters increased by nearly two days when the mountain lion season became a stand-alone season and peaked in 2014/15 at approximately 12 days (Figure 8).

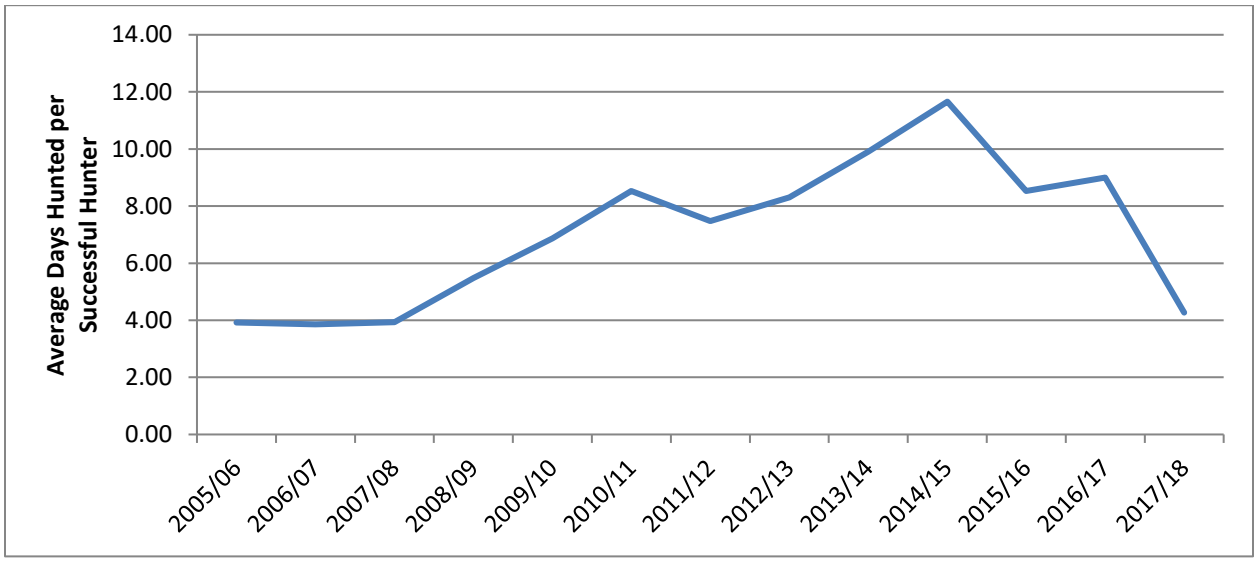

Figure 8. Average days hunted per successful mountain lion hunter within the Black Hills (excluding CSP dog hunters), 2005/06-2017/18 (April 1-March 31).

Hunting licenses for mountain lions in South Dakota were $28 in 2017/18, and each year hunter surveys conducted by SDGFP reveal that some hunters purchase licenses, but do not actually hunt (Table 6); in the 2017/18 season only about 42% of licensed hunters spent time hunting mountain lions in the BHFPD. Hunter surveys also collect hunter effort (# days hunted), which is used with active hunting participants to estimate Harvest per Unit Effort (HPUE) or Catch per Unit Effort (CPUE).

Catch per Unit Effort (CPUE) is a commonly collected harvest statistic that may be used to estimate abundance or population trend. Catch-effort methods are based on the general assumption that one unit of sampling effort will catch a fixed proportion of the population, so that if samples are permanently removed, the decline in population size will produce a decline in CPUE (Seber 1982). Five western states currently report using CPUE evaluations when setting mountain lion harvest limits or hunting license numbers (WAFWA 2019, unpublished).

In terms of mountain lion population monitoring, CPUE may be defined as the number of mountain lions brought to bay in trees per day or as the number of mountain lions harvested per day. Some states use multiple CPUE indices in evaluation of mountain lion populations; e.g., South Dakota monitors mountain lions treed per 100 hours of effort in DNA sampling surveys, as well as boot hunter harvest of mountain lions per 1,000 days hunted (HPUE) (Lindbloom and Griffin 2017).

The relationship between CPUE and mountain lion abundance may or may not be apparent. Catch effort data and trends could potentially be impacted by variables other than mountain lion density, such as snow conditions, road closures, and harvest regulations. Choate et al. (2006) found that CPUE was a poor predictor of abundance of mountain lions in Utah, although some data suggested the relationship between CPUE and abundance was worth further investigation. Further evaluations of the same area over a longer time span by Wolfe et al. (2016) showed a strong positive relationship between the number of mountain lions treed per day during pursuit only seasons and an index to minimum annual mountain lion abundance. CPUE estimators, however, require stringent assumptions that are likely violated at times (see discussion by Whittaker and Wolfe 2011) including demographic and geographic independence and constant catchability throughout the period of data collection. Regardless, the high correlation between mountain lions treed per day and mountain lion density found by Wolfe et al. (2016) suggest CPUE indices may be informative metrics in state management programs. For the 2017/18 South Dakota mountain lion season, Harvest per Unit Effort was approximately 2.5 mountain lions per 1,000 hunted days and has trended downward since the 2009/10 season (Table 6; Figure 9).

Table 6. Harvest per unit effort for Black Hills mountain lion hunting seasons, 2008/09 – 2017/18 (April 1 – March 31).

Year	Season length	Harvest	# BH lics	# hunters that hunted	Average # days per hunter	Total hunter days hunted	Harvest per 1000 hunter days hunted	Difference in Harvest per 1000 days from prev year %
2008/09	45	26	2,428	1,646 (1,594, 1,698)	6.5	10,699 (10.003, 11,404)	2.43 (2.28, 2.60)	
2009/10	41	40	2,082	1,468 (1,423, 1,513)	6.2	9,102 (8,535, 9,678)	4.39 (4.13, 4.69)	81%
2010/11	52	47	2,325	1,790 (1,749, 1,831)	6.6	11,814 (11,128, 12,508)	3.98 (3.76, 4.22)	-9%
2011/12	61	69	3,482	2,646 (2,591, 2,701)	7.1	18,787 (17,831, 19,749)	3.67 (3.49, 3.87)	-8%
2012/13	96	54	4,351	2,872 (2,804, 2,940)	7.3	20,966 (19,799, 22,143)	2.58 (2.44, 2.73)	-30%
2013/14	96	44	3,293	1,861 (1,796, 1,925)	6.9	12,841 (11,920, 13,775)	3.43 (3.19, 3.69)	33%
2014/15	96	38	3,210	1,689 (1,620, 1,758)	7.1	11,992 (11,053, 12,953)	3.17 (2.93, 3.44)	-8%
2015/16	97	35	3,102	1,529 (1,462, 1,596)	7.1	10,856 (9,972, 11,759)	3.22 (2.98, 3.51)	2%
2016/17	96	23	2,561	1,153 (1,093, 1,213)	6.9	7,956 (7,204, 8,727)	2.89 (2.63, 3.19)	-10%
2017/18	96	22	2,878	1,199 (1,137, 1,261)	7.3	8,743 (7,973, 9,555)	2.52 (2.30, 2.76)	-13%

*95% confidence intervals listed below values.

*Harvest and effort excludes CSP hunters, but CSP hunters that boot hunted in the BH after the CSP season closed are included.

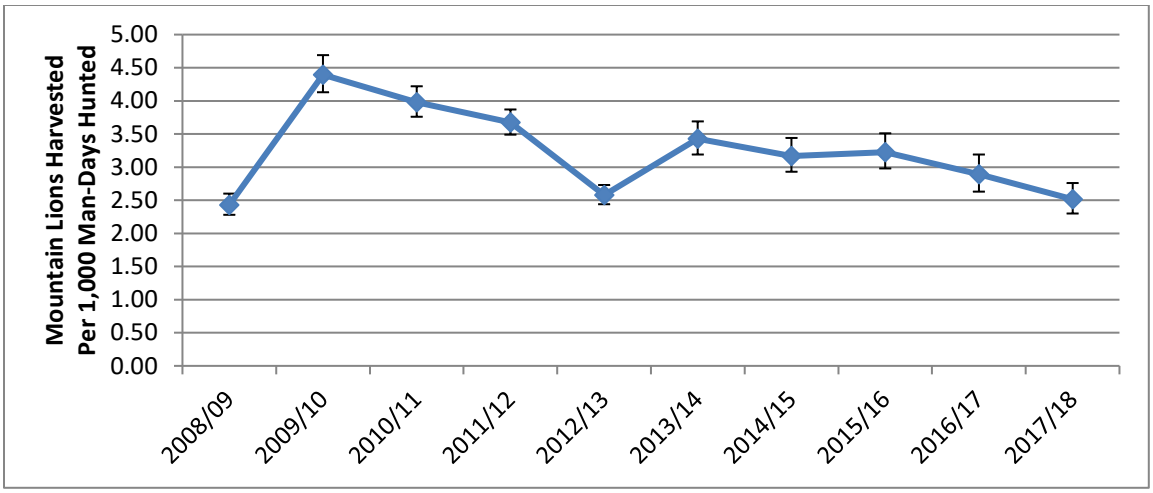

Figure 9. Mountain lion harvest per unit effort (HPUE) for the BHFPD seasons, 2008/09 – 2017/18 (April 1 – March 31). Error bars represent 95% confidence intervals.

Documented Mortalities

A total of 1,044 mortality events were documented in South Dakota from 1996/97 - 2017/18. Documented mortalities were similar between males (519) and females (510); sex was unknown for 15 mortalities. Mortalities were categorized as hunter harvest (545), SDGFP removal (135), vehicular accidents (115), unknown causes (58), public removal (43), mountain lion interaction (31), incidental (24), research related (21), sick (19), infanticide (17) emaciated mountain lions (13), illegal kills (12), and other (11; Figure 10). Variation in recovery or detection probability among cause-specific mortalities prevents comparison among categories. For example, vehicle mortalities have higher detection probabilities than illegal killing. Mortality due to interactions or infanticide amongst mountain lions is difficult to detect but has been shown to occur through research of radio-collared mountain lions (Jansen 2011) and documentation of facial scarring in resident males. Thompson (2009) documented 89% (10 of 11) of captured resident male mountain lions had moderate to severe scarring primarily across the face and skull along with scarring of the forelimbs. The number of total annual mortality events increased from 1996/97 – 2010/11 and have been on a decreasing trend thereafter.

A total of 933 mortality events were documented in the BHFPD from 1996/97 - 2017/18. Mortalities were categorized as: hunter harvest (490), followed by SDGFP removal (119), vehicular accidents (107), unknown causes (55), public removal (23), mountain lion interaction (31), incidental (19), research related (21), sick (19), infanticide (17) emaciated mountain lions (13), illegal kills (9), and other (10). More females (290) were harvested than males (200) during established harvest seasons in the Black Hills. Conversely, more males (42) were harvested than females (13) during established harvest seasons on the prairie.

Within the Black Hills, more males were removed (90 total; 78 by SDGFP, 12 by the public) to address depredation or human safety concerns than females (52 total; SDGFP 41, public 11). This same trend followed on the prairie as SDGFP removed 13 male and three female mountain lions, and the public removed 16 males and four females (Figure 10).

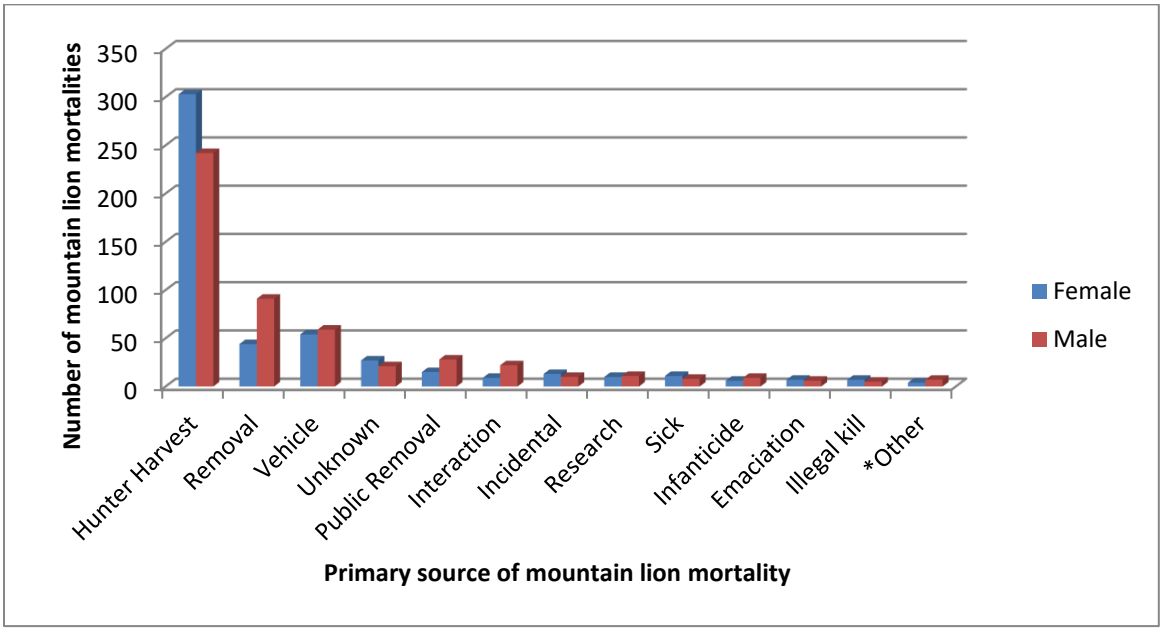

Figure 10. Comparison between male and female mountain lion mortalities in South Dakota, 1996/97 – 2017/18 (categories represent primary sources of mortality, *other includes drowning, electrocution, fire, wounding and miscellaneous events).

Harvest and Non-harvest Mortalities

All known mountain lion mortalities in South Dakota are recorded and the Black Hills mortalities are evaluated for population trend assessments. Mortalities that have been documented as a result of research and/or radio-collared animals are removed from trend datasets. Summaries and details of documented mortalities are reported biennially (Lindbloom and Griffin 2017). The highest number of mountain lion mortalities within the Black Hills was 102 in 2011/12 (Figure 11). Harvest mortalities can be influenced by hunting season regulations, weather and other factors, and have been decreasing for the past six years (Figure 11). The harvest limit in the BHFPD has not been reached in the past six hunting seasons.

Non-harvest mortalities peaked at 42 mountain lions in 2010/11, declined to six in 2016/17, and increased to 21 in 2017/18 (Figure 11). Non-harvest mortality trend may reflect increases or decreases in the mountain lion population. However, factors influencing non-harvest mortality can be variable and may influence trend assessments.

The majority of the mountain lion population in South Dakota occurs within the Black Hills.

Mountain lions are occasionally observed outside of the Black Hills area, but most are likely transient young male mountain lions. Since 2000, SDGFP has documented 111 mountain lion mortalities outside of the Black Hills Fire Protection District. Of those, 28 were female (five adults, 23 sub-adults) and 83 were male (10 adults, 71 sub-adults, two kittens).

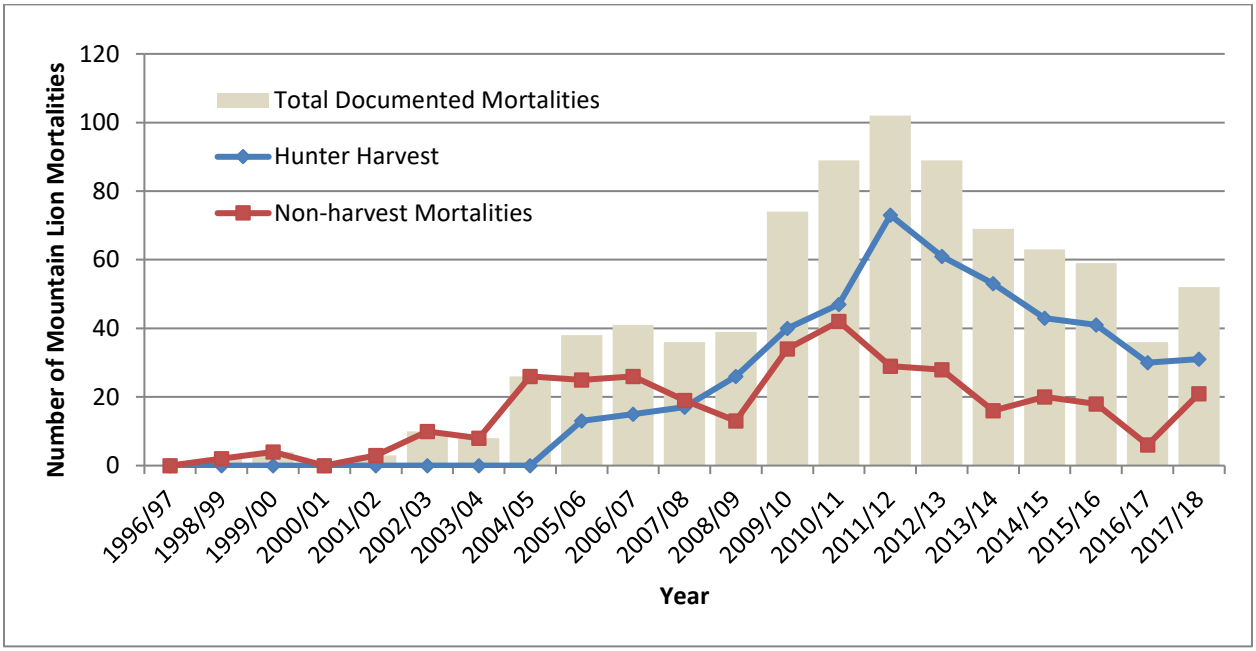

Figure 11. Harvest and non-harvest mountain lion mortalities documented in the BHFPD of South Dakota, 1996/97 – 2017/18 (April 1 – March 31).

Mountain Lion Removals

In South Dakota, mountain lions are removed by SDGFP due to concerns involving livestock depredation, attacks on pets, or mountain lions that pose a substantial threat to public safety. The most mountain lions annually removed within the BHFPD by SDGFP was 19 in 2009/10, and the number of removals decreased to zero in 2016/17 before increasing back up to four in 2017/18 (Figure 12). SDGFP will remove a mountain lion for attacking domestic animals, but may not remove a mountain lion for attacking or killing pets that are free-roaming or that provoke a mountain lion. Feeding of prey species, such as deer and turkey, in urban areas or near rural homes is discouraged as it can lead to an increased presence of mountain lions. SDGFP encourages problem prevention whenever possible when dealing with mountain lion incidents.

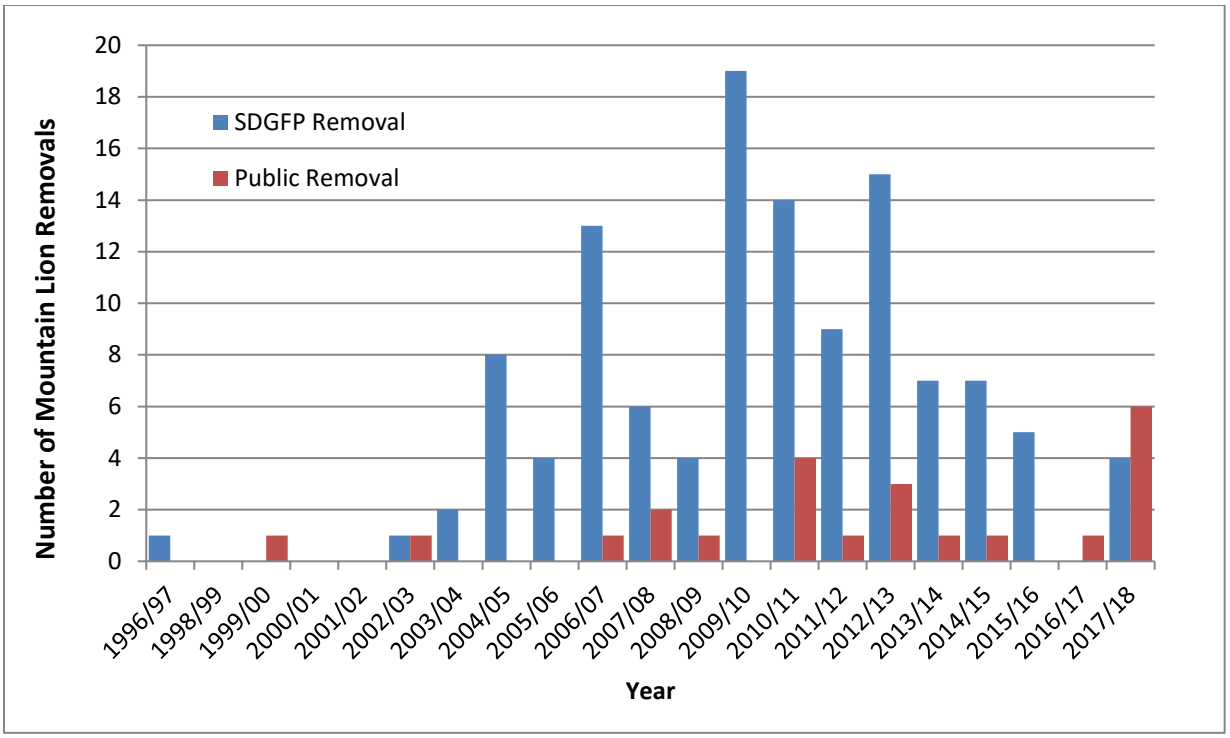

Figure 12. Mountain lion removals within the BHFPD by SDGFP and the Public, 1996/97 – 2017/18 (April 1 – March 31).

Under SDCL § 41-6-29.2, killing of a mountain lion is permitted if reasonably necessary to protect the life of a person or if a mountain lion is posing an imminent threat to a person's livestock or pets. If a person kills a mountain lion pursuant to state law, they must contact SDGFP within twenty-four hours of killing the mountain lion. Public removals of mountain lions within the BHFPD peaked at four removals in 2010/11 before declining again (Figure 12). In 2017/18, public removals were recorded at six removals, and was the highest number of removals ever recorded (Figure 12). Within the BHFPD, total mountain lion removals recorded from 1996/97 to 2017/18 include 63% males and 37% females; ages of all removals includes 21% adults (AD; 30), 56% sub-adult (SA; 80), and 23% kittens (K; 32; Table 7).

Table 7. Age and sex of mountain lions removed in the BHFPD, South Dakota, 1996/97 – 2017/18.

Removal		Age			
Type	Sex	AD	SA	K	Total
Public Removals	male	1	8	3	12
(n = 23)	female	3	6	2	11
SDGFP Removals	male	17	46	15	78
(n = 119)	female	9	20	12	41

Mortality Densities

Total mortality densities are evaluated in relation to thresholds defined for adjacent mountain lion populations in Wyoming. Based on Anderson and Lindzey (2005) and evaluations of harvest densities in Wyoming (Wyoming Game and Fish 2006), the Wyoming Game and Fish Department (WGFD) uses the following harvest densities (along with evaluation of other criteria) for establishing source-stable-sink mountain lion management (Cougar Management Guidelines Working Group 2005):

- Reduce mountain lion population: > eight mountain lions/1,000 km^2
- Maintain mountain lion population: five-eight mountain lions/1,000 km^2
- Increase mountain lion population: < five mountain lions/1,000 km^2

Human caused mountain lion mortality densities in the BHFPD are monitored by the state wildlife agencies of both South Dakota and Wyoming. Demographic rates and subsequent thresholds of mountain lion populations may vary between states, but evaluations and comparisons of mortality densities are still valuable until new research suggests alternative criteria. Using criteria established in Wyoming, mortality densities in both states have been sufficient to lower mountain lion populations in the Black Hills from approximately 2010/11 to 2015/16 (Figure 13). Mortality densities during 2016/17 and 2017/18, however, have suggested a stable or increasing mountain lion population in South Dakota.

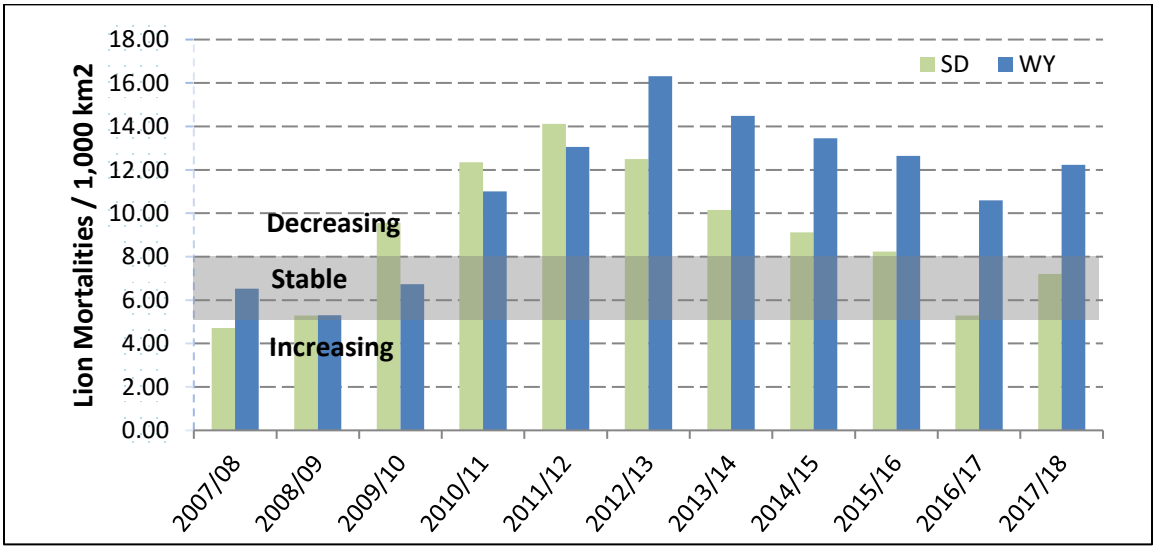

Figure 13. Human-caused mountain lion mortality densities (mountain lions per 1,000 square kilometers) in the Black Hills of South Dakota and Wyoming, 2007/08 – 2017/18 (April 1 – March 31). Potential stable population threshold (five to eight mortality density) identified by shaded horizontal bar.

Vehicle Collisions

Mountain lion-vehicle collisions are an additional source of mountain lion mortality that is documented in South Dakota. From 1996/97 to 2017/18, a total of 107 documented mountain lion-vehicle mortalities have been recorded within the BHFPD. This source of mortality accounts for 11 percent of the total documented mountain lion mortalities since 1996/97 and is the third leading cause of mountain lion mortalities following hunter harvest (490, 53% of documented mortalities) and SDGFP removals (119, 13% of documented mortalities). Figure 14 shows annual variation in the number of mountain lions that are killed within the BHFPD by vehicles each year with a high of 14 mortalities during 2010/11. Average vehicle caused mortalities since 1996/97 was approximately five mountain lions per year. A total of 55 males, 50 females, and two unknown sexes have been recorded as vehicle killed mountain lions. Younger mountain lions appear to be more susceptible to vehicles as a total of 28 kittens, 57 sub-adults and 22 adults have been recorded. SDGFP will continue to document all reported vehicle killed mountain lions as part of mountain lion management in South Dakota.

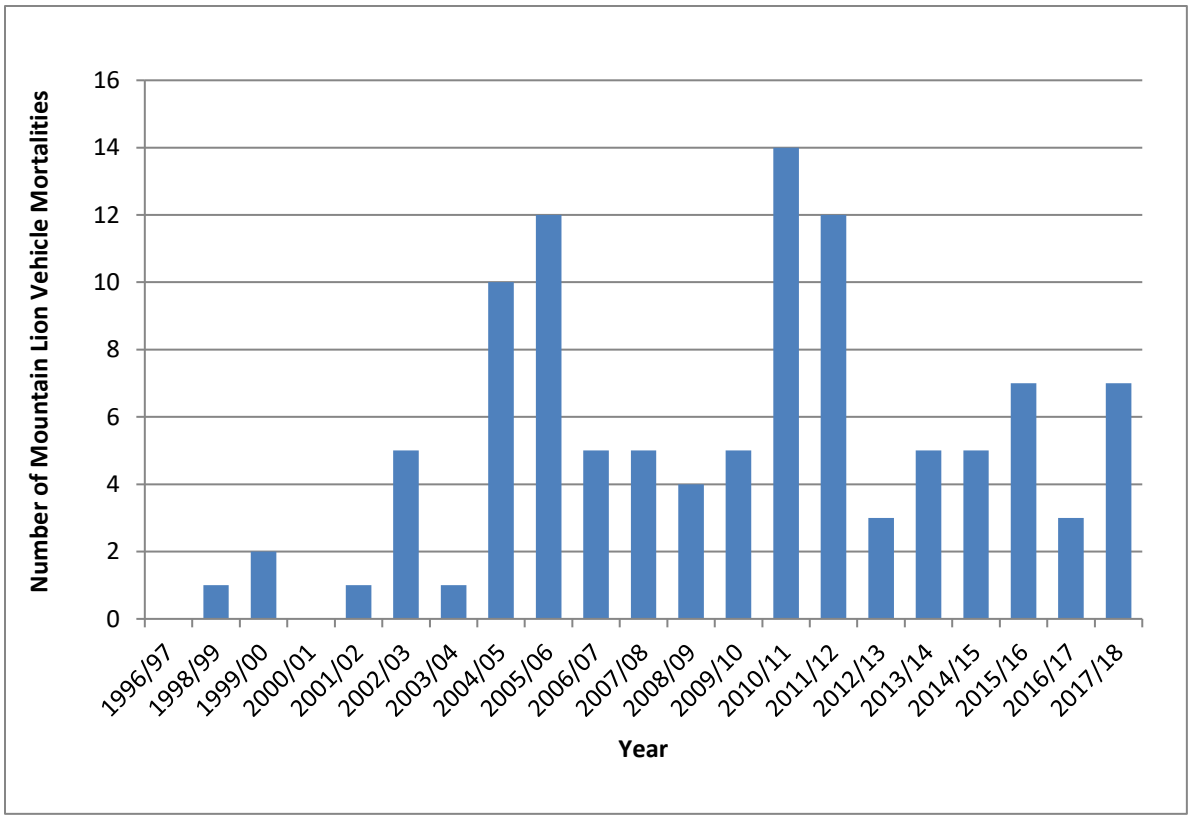

Figure 14. Annual documented mountain lion-vehicle mortalities in within the BHFPD, South Dakota, 1996/97 - 2017/18.

Population Estimation

Before harvest and survival data were available, mountain lion population sizes were estimated using population projection models. In 2007, when adequate survival and harvest data became available, reconstruction methodologies were temporarily used before switching to currently used Lincoln-Petersen models fit to DNA mark/recapture data.

Population projection estimates began with a population size of 15 in 1998 which was projected to subsequent years based on population growth. Rate of population growth was estimated using a maximum value (r = 0.28) reported by Logan and Sweanor (2000) for an un-hunted population, which was considered more conservative than the rate of 0.32 calculated from data collected on the mountain lion population in the Black Hills. Population projection provided a mean population estimate of 247 mountain lions in 2008 $\left(\widehat{N}_{2007} = 15 \times e^{0.28*10\ years}\right)$. Because nutritional condition of mountain lions had declined, consumption of domestic prey increased, home range size of females declined, and dispersal of female sub-adults from the population increased, the assumption was the population was saturated in 2005 (Thompson 2009). A completely saturated population would result in a stable population and population growth rate of 0, well below 0.28 used in the projection model. In addition an annual hunting season was initiated in 2005. As a result, a new harvest population reconstruction modeling approach was developed to evaluate the population.

During 2007-2009 when sufficient radio-collared mountain lions were available to estimate the female harvest rate, a pre-hunt female population (excluding kittens) was reconstructed by dividing the female harvest by the harvest rate (hereafter harvest reconstruction model). Harvest rate was estimated using number of radio-collared mountain lions harvested divided by total number of radio-collared mountain lions available to be harvested (Skalski et al. 2005). Estimates from pre-hunt 2007/08 harvest reconstruction model were compared to those generated via original population projection.

Estimates of the 2007/08 pre-hunt population were reconstructed for only the female segment of the population because only one radio-collared male was harvested. Harvest rate for the female segment of the population was estimated at 0.143 where five radio-collared female mountain lions were harvested of a total of 35 available radio-collared female mountain lions. Total number of females in the pre-hunt population was estimated by dividing total number of females harvested (15) by harvest rate (0.143), which resulted in 105 female mountain lions in 2007/08, excluding kittens. The proportion of males in the sub-adult and adult population was estimated at 30%, based on observed data and those from other populations (Logan and Sweanor 2000), which provided a 2007/08 pre-hunt estimate of 45 males.

The following assumptions were used to estimate the 2007/08 pre-hunt kitten population: 1) 50% of females were with kittens at the beginning of the hunting season, 2) litter size was 3.0 kittens/litter at birth (Thompson 2009), and 3) 6-month survival of kittens was 0.67 (assuming on average kittens were born close to the middle of the previous year [Jansen and Jenks 2012]). Thus, 53 females had kittens at the beginning of the 2007/08 hunting season, and the average

kittens surviving per female was assumed to be 2, resulting in an estimate of 106 kittens.

The total 2007/08 pre-hunt mountain lion population estimate was 256 (106 females, 45 males, 106 kittens). Because the hunting season occurred towards the end of the year in 2007, the population estimate of 256 is most comparable to the 2008 population projection estimate of 247. Although agreement of both estimates may improve confidence in model results, the true population was not known, and estimates could be scaled higher or lower based on input parameters. For example, increasing the starting population in 1998 to 30 would increase the 2008 projection to 493.

From 2010/11 to 2012/13, SDGFP continued to utilize radio-collared mountain lions to estimate the population in the BHFPD. Because previous research (Thompson 2009) documented very high dispersal of sub-adult mountain lions, radio-collared sub-adult samples were limiting and the availability of animals for recapture compromised. Therefore, only radio-collared adult mountain lions were used in modified Lincoln-Petersen mark/recapture estimations (described below), and sub-adults were estimated based on harvest proportions observed in previous years (3-year average) hunting seasons. Kitten estimates were modified based on the following assumptions: 1) 57% of adult females gave birth within the past year, 2) litter size was 2.9 kittens/litter at birth (Jansen 2011), and 3) 6-month survival of kittens was 0.60 (assuming on average kittens were born close to the middle of the previous year [Jansen 2011, Jansen and Jenks 2012]).

Beginning in 2013/14, after completion and evaluation of research conducted by Juarez (2014), the SDGFP began using biopsy-darting as the primary method to mark mountain lions immediately prior to the season; radio-collared mountain lions from previous research were also utilized to assess availability. In December of 2017, SDGFP used three houndsmen teams (SDGFP, WGFD, private contractor) to collect 63 samples. After DNA analyses were conducted by the USFS National Genomics Center for Wildlife and Fish Conservation, Bozeman, MT and data were further reviewed, there were DNA samples from 54 individual adult and sub-adult mountain lions that were considered available for harvest for the first day of the 2017/18 hunting season. The 96-day hunting season is considered the recapture event, and during that time 29 adult and sub-adult mountain lions were harvested; three were either previously DNA sampled or had a functioning radio-collar. The inputs for the 2017/18 Lincoln-Petersen mark-recapture estimate are as follows; $M = 54$, $C = 29$, $R = 3$.

Lincoln-Petersen mark-recapture Chapman estimates are derived using:

$$N = \frac{(M+1)\,(C+1)}{R+1} - 1$$

Where:
N = Estimate of adult/sub-adult population size
M = Total number of adults captured and marked on the first visit
C = Total number of adults captured on the second visit
R = Number of adults captured on the first visit that are then recaptured on the second visit

95% confidence intervals are then formulated using the variance estimator below:

$$var\,(N) = \frac{(M+1)\,(C+1)\,(M-R)\,(C-R)}{(R+1)(R+1)(R+2)}$$

Vital rates from radio-collared individuals and recruitment data from previous research studies in the Black Hills (e.g., Thompson 2009, Jansen 2011) were used as input variables to calculate the total mountain lion population. Age and sex composition of starting populations was based on the 3-year average composition of harvested mountain lions. The 2017/18 preseason population estimate for the Black Hills was approximately 532 total mountain lions (95% CI: 111-970), of which 413 were adults/sub-adults. Population estimates have low precision, but appear to be near management objective the past few years (Figure 15). Catch per unit effort data from houndsmen teams are also recorded during DNA collection efforts, and are evaluated annually (Table 8). During 2015-2017, catch per 100 hours has been very consistent (Table 8).

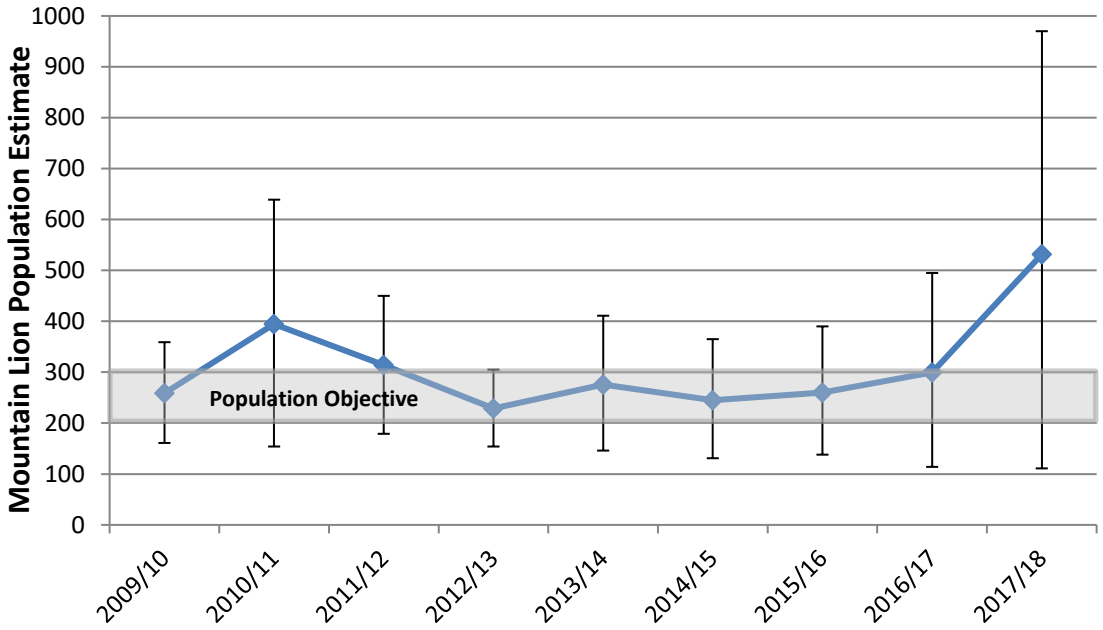

Figure 15. Mark/recapture estimates of the mountain lion population in the Black Hills of South Dakota, 2009/10 – 2016/17 (April 1 – March 31). Current population objective (200-300) identified by shaded horizontal bar.

Table 8. Catch per unit effort data collected during annual biopsy surveys of mountain lions in the Black Hills of South Dakota, 2013 – 2017.

Year	hours	lions	hrs/lion	catch/100 hrs
2013	319	26.0	12.3	8.2
2014	615	31	19.8	5.0
2015	508	56	9.1	11.0
2016	578	63	9.2	10.9
2017	551	63	8.7	11.4

Population trajectories are an important management tool that enables a better understanding of 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 mountain lion populations are primarily dependent on female survival and kitten recruitment. Evaluating a range of female and kitten survival rates allows managers to apply appropriate harvest rates in order to meet unit objectives (Table 9).

Table 9. Predicted mountain lion population growth rates[a] (decrease [↓], stable [●], increase [↑]) based on recruitment, survival, and harvest rate. Recruitment rates were fixed using 57% birth rate of ≥3 year old females within the past year and litter size of 2.9.

Birth-prehunt Survival[b]		Low			Average			High		
Annual Female Survival[c]		Low	Ave	High	Low	Ave	High	Low	Ave	High
Population Change[a] Based on Subadult and Adult Female Harvest Rate	20 %	↓↓	↓	↓	↓↓	↓	●	↓	●	●
	15 %	↓↓	↓	●	↓	●	●	↓	●	↑
	10 %	↓	↓	●	↓	●	↑	●	●	↑
	5%	↓	●	↑	●	●	↑	●	↑	↑↑
	0%	↓	●	↑	●	↑	↑	●	↑	↑↑

[a] Growth rates based on modeled values where 1.0 is a stable population, less than 1.0 decreasing, and greater than 1.0 increasing (↓↓: <.85 ↓: .85 - .94 ●: .95 – 1.05 ↑: 1.06 - 1.15 ↑↑: >1.15)

[b] Birth to the hunting season survival rates are: Low = 40%, Average = 60%, High = 80%

[c] Annual female survival rates in the absence of harvest are categorized as follows:

1) Low = 0.5-2.5 yrs old 55%, >2.5 yrs old 85%
2) Ave = 0.5-2.5 yrs old 65%, >2.5 yrs old 90%
3) High = 0.5-2.5 yrs old 75%, >2.5 yrs old 95%

Observation Reports

All mountain lion observations and incidents that are reported by the public are documented and evaluated for trend assessments along with other mountain lion population data. A "Mountain Lion Observation Report" (Appendix D) is used by all department staff to record information which is later entered into a centralized database. Observation reports have been on a decreasing trend since they peaked in 2004/05 at approximately 406 total reports (Figure 16). Because SDGFP encourages the public to report any observations of mountain lions and documents all such observations, it is important to report these data. Interpretation of observational data is challenging, however, because reporting rates from the public are unknown and likely variable, which impacts data trend evaluations. It is likely that only significant increases or decreases to the mountain lion population would be documented with observation report data.

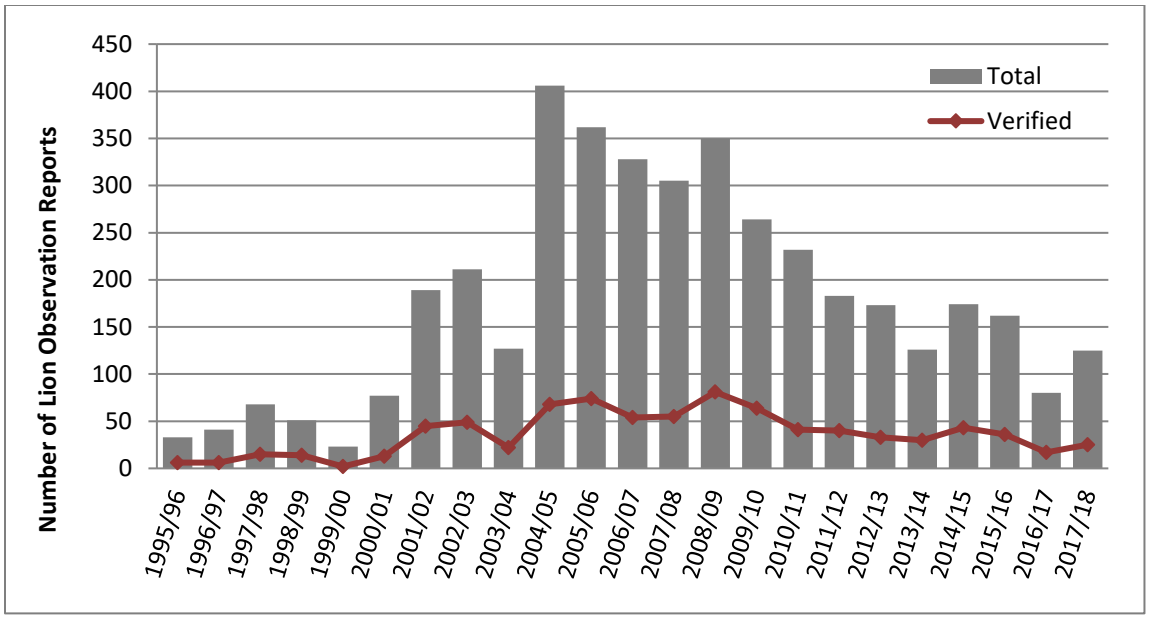

Figure 16. Mountain lion observation reports in South Dakota, including total number of reports and those verified by SDGFP, 1995/96 – 2017/18 (April 1 – March 31).

HISTORICAL MOUNTAIN LION SURVEYS

Mountain Lion Track Surveys

SDGFP has utilized various surveys over the years to assess changes in the mountain lion population. A mountain lion track survey was conducted from 2006/07 to 2011/12 and evaluated as a tool that could be used to determine annual population trends of mountain lions in the Black Hills.

The mountain lion track survey monitored presence or absence of mountain lion tracks on established roads in the Black Hills. Fecske (2003) found that mountain lion tracks were most prevalent on Class three and Class four roads in the Black Hills, therefore many of the routes were completed on these secondary types of roads. This methodology seemed like a feasible survey approach because the Black Hills has one of the highest road densities of any National Forest (Appendix E, Fecske 2003, USFS 2019).

Mountain lion track surveys were conducted in winter months during morning hours after fresh snowfall. A total of 10 transects with a total length of 170.4 road miles were distributed throughout the Black Hills and surveyed as often as favorable weather conditions and personnel availability allowed during the months of November–April (Figure 17). Data summaries included total tracks of all surveys, high count per route, presence of tracks, and average number of tracks per route. Trend comparisons primarily included the number of

tracks per 100 miles of surveys and the proportion of surveys with tracks present (Figure 18, Figure 19).

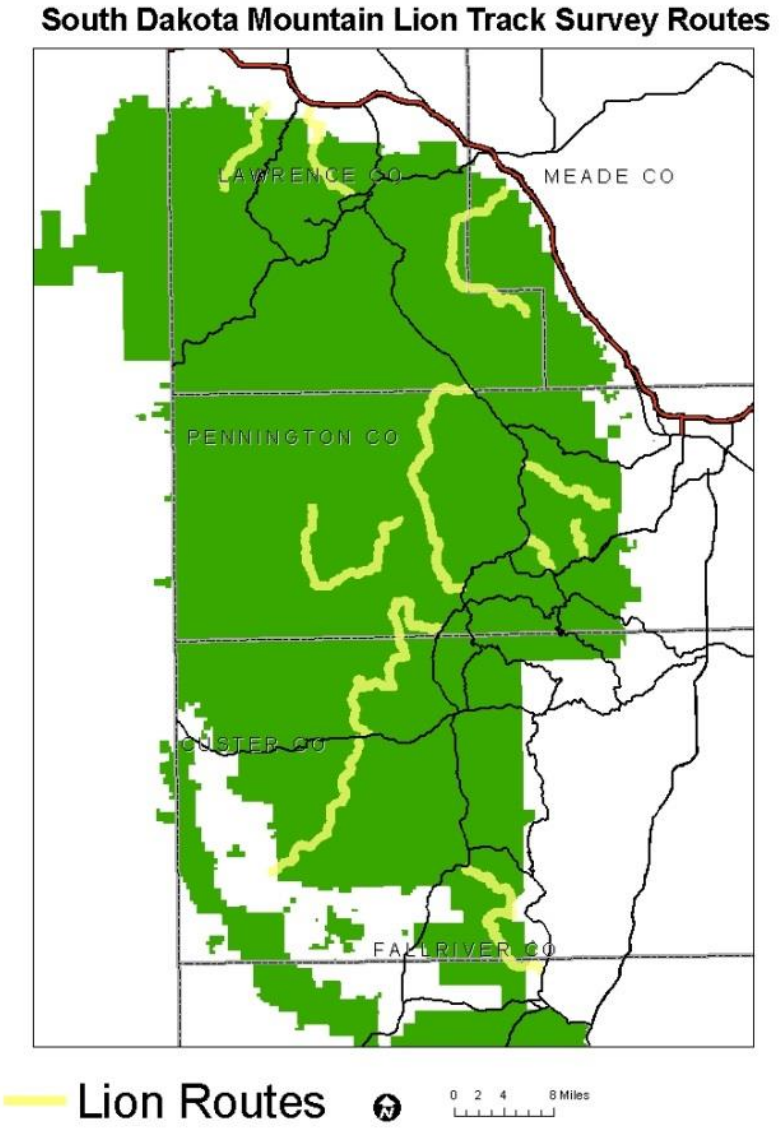

Figure 17. Mountain lion track survey routes within the Black Hills, South Dakota, 2006/07 – 2011/12.

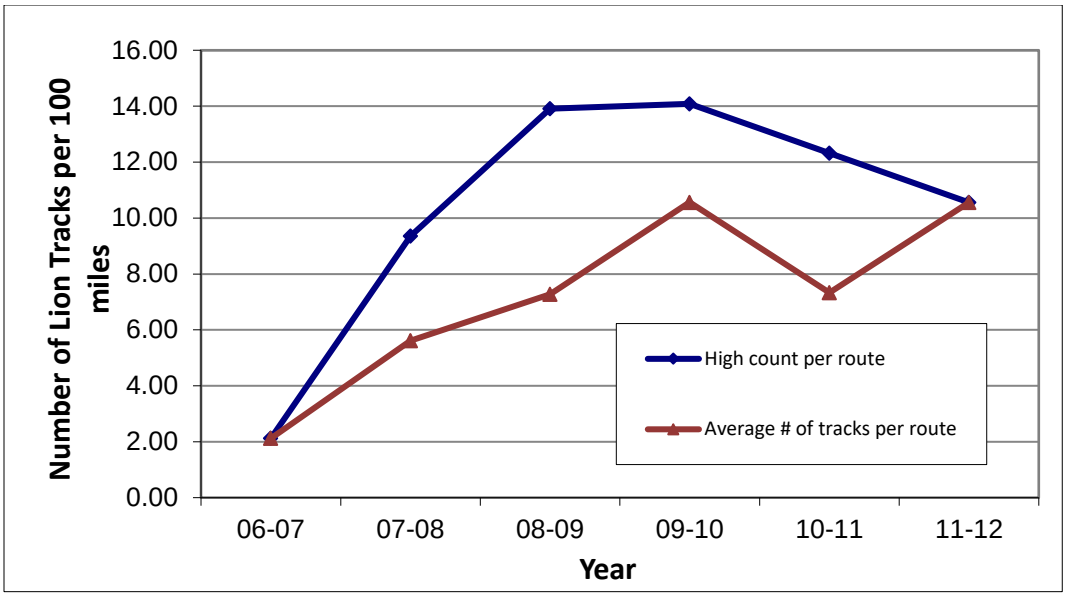

Figure 18. Number of mountain lion tracks per 100 miles of surveys in the Black Hills, South Dakota, 2006-2011.

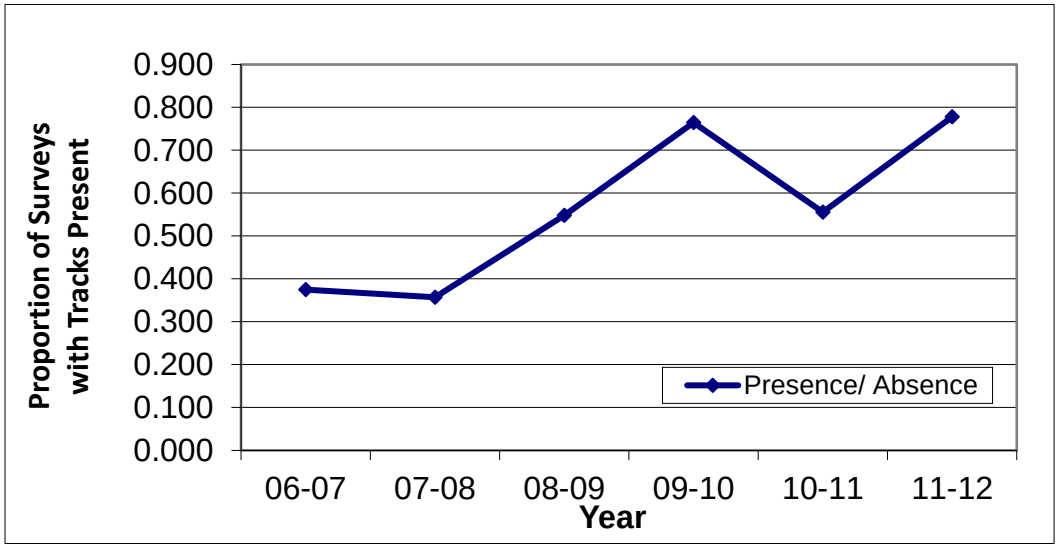

Figure 19. Proportion of surveys with tracks in the Black Hills, South Dakota, 2006/07 - 2011/12.

The relationship between mountain lion tracks and population densities, while potentially direct and linear under ideal tracking conditions, is not easily estimated, but may be a reliable estimator of relative abundance (Beier and Cunningham 1996). Track data were analyzed annually to determine if an increase or decrease in mountain lion population trends in the Black Hills of South Dakota could be determined. Due to the difficulty in having consistent and

adequate survey conditions (i.e., snow conditions) throughout all the mountain lion range in the Black Hills, inaccessibility to survey routes due to weather, and small sample sizes, SDGFP determined this survey was not robust nor reliable, and thus discontinued conducting the survey after the 2011/12 winter.

MOUNTAIN LION RESEARCH

In the Black Hills of South Dakota, five research studies on mountain lions have been conducted and completed by SDSU in conjunction with SDGFP. These studies have increased our knowledge of mountain lions in South Dakota and data collected have been used in establishing scientific based management of this species. An overview of South Dakota and other relevant research is herein provided to educate and provide background information used for mountain lion management in South Dakota.

Capture

Mountain lions were captured from 1998-2014 throughout the Black Hills study area (Fecske 2003, Thompson 2009, Jansen 2011, Smith 2014, Juarez 2014): methods of capture included dogs, opportunistic use of walk-in live traps, foot-hold snares (Logan et al. 1999), and leg-hold traps with offset jaws. Research animals were immobilized using telazol and xylazine (Kreeger 1996). Captured mountain lions were aged by tooth wear and pelage description (Anderson and Lindzey 2000), and animals >10 months old were fitted with VHF radio transmitters (Telonics, Inc., Mesa, Arizona, USA). Immobilized mountain lions were released on site and observed until recovered from immobilization. Kittens (<two months of age at capture) of marked female mountain lions were captured to determine age of independence and dispersal; kittens were fitted with expandable VHF radio-collars (Thompson 2009, Jansen 2011).

Approximately 380 mountain lions have been captured and individually marked during sixteen years of research in the Black Hills of South Dakota. Data from monitored mountain lions were utilized to address numerous objectives from various research and management projects (Fecske 2003, Thompson 2009, Jansen 2011, Juarez 2014, Smith 2014, Lindbloom and Griffin 2017).

Movements and Home Range

<u>Home Range</u>

The term “home range” is often used to refer to an area that an individual or herd of animals occupy for a defined period of time. Sanderson (1966) suggested that the home range for a given species is only as large as the area needed to meet all of its biological requirements. Powell and Mitchell (2012) proposed that an animal’s home range is the part of its cognitive map of its environment that it chooses to keep updated based on environmental conditions including favorable climate, available resources, desirable habitat, population density, and other factors.

Home range analysis on mountain lions was conducted from 1999-2001 in the Black Hills of South Dakota and results suggested home ranges of adult males were significantly larger than adult females (Fecske 2003; Table 10). Percent home range overlap for three established mountain lions averaged 33% (range 18.0 – 52.0%; Fecske 2003). Additionally, Thompson (2009) calculated home ranges for mountain lions from 2003-2005 in the Black Hills and observed smaller home range sizes compared to Fecske (2003; Table 10), and similarly found male home ranges were larger than female home ranges. Jansen (2011) looked at regional variation of home range sizes for adult males and females in the Black Hills utilizing data from mountain lions from 2002-2009 and noted that both males and female mountain lion home ranges varied by regions of the Black Hills (four quarters NW, NE, SW, SE). Home range size for adult females and males was largest in the SW quarter of the Black Hills (Jansen 2011; Table 10).

Home range analysis in western North Dakota also found large differences in the size of adult male and female home range size with the males averaging 1.8 times larger than females (Wilckens 2014; Table 10). Home range overlap was documented in North Dakota mountain lions and averaged 13.7%. Johnson (2017) reported mountain lion home ranges in western North Dakota and showed that males averaged 295.4 km^2 (95% CI = 226.6 – 364.3) and females averaged 127.5 km^2 (95% CI = 83.3 – 171.7; Table 10). Johnson (2017) used a 95% Brownian bridge movement model (BBMM) with package BBMM (Nielson et al. 2013) in Program R (R Development Core Team 2013) to develop home ranges. In the Black Hills, home range sizes have been shown to decrease over time as the mountain lion populations were increasing. This is believed to be a function of the increasing mountain lion population size and increasing competition for available habitat within the Black Hills.

Dispersal

Dispersal has been defined as the permanent movement away from an animal's natal home range/area (Greenwood 1980). Howard (1960) further differentiated dispersal into innate and environmental dispersal. Innate dispersal is considered a birth predisposition to move beyond the confines of a parental home range, whereas environmental dispersal is in response to "crowded situations" and density dependence.

Mountain lion research in the Black Hills of South Dakota was initiated in 1998 in response to increasing mountain lion sightings and dispersal movements were documented by Thompson (2009) and Jansen (2011). Dispersal distances were calculated from capture point to site of death, last known location, or home range center-point if the animal dispersed and successfully established a home range. In instances where kittens were captured at a den, the natal home range center-point versus the site of capture was used.

Table 10. Home range sizes calculated from research in South Dakota and North Dakota from 1999 - 2016.

Location	Female Home Range	Male Home Range	Time Period
Black Hills[a]	237.3 km^2 (s.d. = 131.5)	809.2 km^2 (s.d. = 336.1)	1999-01
Black Hills[b]	147.6 km^2 (S.E. = 49.1)	684.7 km^2 (S.E. = 152.4)	2003
Black Hills[b]	105.2 km^2 (S.E. = 27.3)	397.3 km^2 (S.E. = 54.4)	2004
Black Hills[b]	123.4 km^2 (S.E. = 32.9)	457.1 km^2 (S.E. = 60.4)	2005
Black Hills[c]	Range 66 km^2 - 198 km^2	Range 314 km^2 to 804 km^2	2002-09
NW Black Hills[c]	80.6 km^2 (S.E. = 1.6)	314.2 km^2 (S.E. = 1.4)	2002-09
NE Black Hills[c]	66.0 km^2 (S.E. = 1.5)	533.8 km^2 (S.E. = 1.4)	2002-09
SW Black Hills[c]	198.3 km^2 (S.E. = 1.6)	804.3 km^2 (S.E. = 1.5)	2002-09
SE Black Hills[c]	102.5 km^2 S.E. = 1.5)	317.3 km^2 (S.E. = 1.4)	2002-09
Western ND[d]	194.16 ± 28.03 km^2 (n=4)	348.75 ± 36.66 km^2 (n=5)	2012-13
Western ND[e]	127.5 km^2 (95% CI = 83.3 – 171.7)	295.4 km^2 (95% CI = 226.6 – 364.3)	2012-16

[a]Fecske 2003: Home range analysis using 90% Adaptive Kernel
[c]Jansen 2011: Home range analysis using 95% Fixed Kernel
[b]Thompson 2009: Home range analysis using 95% Adaptive Kernel
[d]Wilckens 2014: Home range analysis using 95% MCP
[e]Johnson 2017: Home range analysis using 95% mean Brownian bridge movement model home range estimates

Dispersal of sub-adult female mountain lions in the Black Hills of South Dakota averaged 48.0 km (S.E. = 10.9, range 12.3 - 100.0 km, *n* = 10) (Thompson 2009). Female mountain lions that dispersed from natal ranges showed a movement towards the periphery of the Black Hills. Three females were documented leaving the study area and either establishing home ranges or died in other habitats (Thompson 2009). Thompson (2009) also noted that dispersal of 14 sub-adult male mountain lions averaged 274.7 km (S.E. = 88.3, range 13.3 - 1,067.0 km). No collared sub-adult male mountain lions were recruited into the Black Hills mountain lion population during the course of the study. All male mountain lions (*n* = 14) dispersed from their natal area, however, several animals (*n* = 6) died before establishing residency (Thompson 2009). When animals that sustained mortality while dispersing were censored, average dispersal rate increased to 450 km (S.E. = 123).

Jansen (2011) compared sub-adult male and female mountain lion dispersal rates from a non-hunted period of 2002-2005 with dispersal rates from a period with hunting from 2005-2009 and found that there was no difference between periods. Furthermore, Jansen (2011) compared male and female dispersal rates in hunted and protected areas within the Black Hills. Results showed that sub-adult males dispersed at similar rates among areas, while females dispersed from protected areas at a rate 45% less than females in hunted areas. Jansen (2011) also noted that sub-adult male dispersal from the study area was consistently high (>88%) regardless of period or areas.

Large dispersal movements have been documented from the Black Hills of South Dakota. Thompson and Jenks (2005) documented the longest dispersal movement by a radio-collared

male mountain lion (1,067 km) from the Black Hills of South Dakota to Oklahoma, and subsequently recorded at least five additional radio-collared sub-adult males that made movements in excess of 250 km. In addition, five sub-adult female mountain lions dispersed > 50 km from natal ranges. Jansen (2011) documented an adult female mountain lion leaving the Black Hills area after losing a litter of kittens. This adult female dispersed a total of 250 km from her last known location in the Black Hills of South Dakota to Montana. In 2011, an unmarked male mountain lion with genetics most closely related to mountain lions from the Black Hills of South Dakota or associated subpopulations from Nebraska or North Dakota was killed on a highway in Connecticut; dispersal distance of this mountain lion was at minimum of 2,450 km (Hawley et al. 2016). The documented dispersal distances suggest the potential for large movements by male mountain lions to new areas.

Other large movements of mountain lions have been documented for both male and female mountain lions across the country. Morrison et al. (2015) documented a dispersal movement of 749 km by a sub-adult male in Saskatchewan. Stoner et al. (2008) documented a straight line movement of 357 km by a sub-adult female mountain lion from Utah to Colorado over a one year period. Data from the GPS collar on this mountain lion showed a total movement distance of 1,341 km. Wilckens (2014) recorded an average sub-adult male dispersal within the western regions of North Dakota at 45.13 km (S.E. = 11.7). Two long-range dispersals were documented from mountain lions immigrating into North Dakota from Montana (376 km and 378 km). Using genetic analysis, Juarez (2014) was able to successfully determine that South Dakota and North Dakota were separate populations and confirmed immigration of two North Dakota mountain lions into the Black Hills of South Dakota.

Female dispersal movements within the Black Hills generally consisted of a movement towards the periphery of the ecosystem. Male mountain lions tended to follow the edge of the forested regions of the ecosystem before leaving the Black Hills to traverse prairie/agricultural habitats (Thompson 2009). As documented in other mountain lion populations, Black Hills sub-adult male mountain lions dispersed farther than females. Although female mountain lion dispersal rates were within ranges documented by Sweanor et al. (2000), average dispersal distances of both males and females were greater than documented in previous research (Hemker et al. 1984, Logan et al. 1986, Beier 1995, Spreadbury et al. 1996, Sweanor et al. 2000, Logan and Sweanor 2001).

Age of independence and dispersal of mountain lions was similar to those of other populations in western North America (Beier 1995, Sweanor et al. 2000, Logan and Sweanor 2001, Pierce and Bleich 2003). Age of independence averaged 13.5 months (range 10 - 16 months) with dispersal occurring one - three months after independence from the adult female. No difference was documented in age of independence or age of dispersal between sexes. However, the sex ratio (5:1) of kittens was highly skewed to males (Thompson 2009). Upon reaching independence, same sex littermates commingled for a period of one - three months before disbanding and making solitary dispersal movements (Thompson 2009).

Mountain lions captured in the Black Hills made farther long-distance movements (both males

and females) than previously documented with many of these animals leaving the Black Hills and crossing regions characterized by prairie habitats. Dispersal movements of sub-adult mountain lions indicate prairie habitats and associated topographic characteristics do not act as barriers to movements. This finding contrasts with those of research in other regions (McRae et al. 2005). Additionally, movements of females in the Black Hills indicated that density dependent factors, such as resource limitation and intraspecific competition (Howard 1960) were displacing individuals (Thompson 2009). These factors resulted in movement out of the Black Hills or to the edge of available forested habitat within the study area prior to establishing a home range. Although inbreeding avoidance has been suggested as a causal factor for male dispersal, in fully occupied habitats it also may motivate female dispersal (Thompson 2009). Biek et al. (2006a) found that intra-population female movements were beneficial in maintaining population genetic viability.

The textbook driving factors of dispersal (inbreeding avoidance, lack of resources/density dependence) would still not account for sub-adult males traveling in excess of 300 km upon leaving the Black Hills (Thompson and Jenks 2010). Once a mountain lion left the study area, it was traversing areas that had been devoid of breeding mountain lion populations for at least 100 years, effectively removing intraspecific competition. With naïve prey readily available there would generally not be competition for resources (Berger et al. 2001). Unless an animal was successful in reaching regions where bears and wolves occur, the largest source of interspecific competition would come from coyotes and quite possibly humans. Information collected on dispersal of mountain lions suggests that a lack of available females with which to breed caused the male mountain lions to continue dispersing until coming into contact with other populations with available territories (Hornocker 2010) or the animal died prior to finding a mate (Thompson 2009). Three long distance dispersers from South Dakota (Male 17, Male 19, and Male 51) successfully reached breeding mountain lion populations in Montana (Male 17 and Male 19) and Wyoming (Male 51) and established home ranges. All three mountain lions were harvested after remaining within their respective home ranges for at least one year (based on estimated date of departure from the Black Hills). Other radio-collared mountain lions dispersing >200 km were not known to establish home ranges possibly because they were unable to find unoccupied breeding populations throughout the terrain traveled. Based on these results, for sub-adult male mountain lions it seems that in some instances the importance of finding an available mate (not accounted for by resident males) may supersede the effects of habitat and prey availability.

Resource Selection

Mountain lions in the Black Hills of South Dakota have been found to utilize all areas of the Black Hills (Fecske 2003). Habitat in the Black Hills is characterized as a ponderosa pine dominated landscape that is characterized by steep ridges, canyons, and gulches with large rock outcrops (Froiland 1990). Mountain lions are known to select habitats that have topography and or vegetation that make prey more vulnerable (Logan and Irwin 1985). While hunting, mountain lions seek habitat conditions that enable an approach within attack distance of prey (Hornocker 1970). The land area of the Black Hills was estimated at 8,400 km^2 and that high-

quality mountain lion habitat (6,703 km^2) occurred throughout the Black Hills (Fecske 2003). In the Bighorn Mountains of Wyoming, Logan and Irwin (1985) found a high occurrence of mountain lion caches in the vegetation of canyons, draws, and on steeper ridges. This was attributed to the available cover for hunting and food consumption. Logan and Irwin (1985) determined that mountain lions selected habitat with steep rugged topography and slopes >50%, avoided gentle slopes <20%, and used other slopes of 20 - 40% in proportion to availability. Mountain lions in North Dakota, showed positive selection for landscape ruggedness, edge habitat, and forest, while displaying negative responses to disturbance and anthropogenic land cover (Johnson 2017).

Female mountain lions use habitats to raise kittens that are similar to concealment and stalking cover. Logan and Sweanor (2000) noted these areas provide lateral and overhead cover and are comprised of thick vegetation, steep slopes, boulder piles, rocky outcrops, and undercut cliffs. Additionally, these elements provide mountain lions with security cover while feeding and as nursery sites for kittens. In the Black Hills, documented litters of female mountain lions have been found in these same types of habitats including thick vegetation, rock piles, slash piles, and in the root balls of uprooted pine trees. The Black Hills not only provide an adequate number of prey species for mountain lions, but also provide cover (e.g., thick spruce) and a variety of geographic terrain (e.g., rocky outcroppings) necessary for a sustainable population of mountain lions.

Diet

Mountain lions in North America consume a large variety of prey species (Logan and Sweanor 2000). However, ungulates such as white-tailed deer and mule deer make up the majority of mountain lion diets in almost any habitat occupied by this species. Regional differences in mountain lion diets can occur based on availability of food sources, the most prevalent large ungulate, and the presence of other large predator populations. Estimates of the number and species of prey removed by mountain lions are critical for evaluating the effects of mountain lion predation on prey species.

Mountain lion diets in the Black Hills of South Dakota consist mainly of large ungulates. Smith (2014) documented a total of 26 unique prey species at mountain lion feeding sites based on 1,506 documented feeding events from 41 mountain lions. Ungulates including white-tailed deer, mule deer, elk, bighorn sheep, and pronghorn (*Antilocapra americana*) comprised 89.4 % of identified prey items with deer species being consumed the most (83%; Smith 2014) (Table 11). Smith (2014) documented white–tailed deer made up 63% of the identifiable deer species. Other ungulates found in the diets of mountain lions in the Black Hills included elk (5.5%), mule deer (3.7%), bighorn sheep (0.6%), and pronghorn (0.2%). Ungulates dominated diets of mountain lions in all months (Smith 2014). While some research suggests mountain lions pose a significant threat to bighorn sheep populations due to ease of capture of this prey species (Festa-Bianchet et al. 2006, Rominger et al. 2004), Smith (2014) only documented 0.6% bighorn sheep in the diet of lions in the Black Hills. Smith (2014) also noted that other diet items included wild turkey (3.1%), coyote (1.1%), and domestic cattle (1.0%) with the remainder of

species occurring at <1% each.

Knopff and Boyce (2007) found similar dietary results in west–central Alberta, Canada with wild ungulates making up 85% of prey identified (Table 11). Deer were the most prevalent ungulate species comprising 68% of ungulates in the diet. Other large ungulates in the diet included moose (*Alces alces*) (7%), elk (6%) and feral horse (*Equus caballus*) (4%). In another report (Knopff et al. 2010b) reported that white-tailed deer was the most prevalent deer species in the mountain lion diet in Canada.

Wilckens (2014) documented 12 unique species of prey items at mountain lion feeding sites in the Badlands of North Dakota. Ungulates such as white-tailed deer, mule deer, elk, and bighorn sheep comprised the majority (81%) of identified prey items found (Table 11). This is very similar to the 89% found in the Black Hills by Smith (2014). Deer species were the most prevalent (76.9%) prey item, with mule deer being the most common deer species at 85.7% (Wilckens 2014). This is in contrast to white-tailed deer being the most common deer species in the diets of mountain lions in the Black Hills of South Dakota (Smith 2014) and in Alberta (Knopff et al. 2010b). In North Dakota, white-tailed deer (9.0%), bighorn sheep (2.7%), and elk (1.3%) occurred at lower frequencies in the diets of mountain lions (Wilckens 2014). Other prey items found in the diets of North Dakota mountain lions included beaver (*Castor spp.*; 6.7%), porcupine (5.0%), coyote (1.7%), raccoon (1%), turkey (1%), and domestic cattle (1%) with the remainder of species (mountain lion, cottontail [*Sylvilagus* spp.]) occurring at <1%.

Table 11. Frequency of occurrence (%) of ungulate species comprising mountain lion diets in South Dakota, Canada, and North Dakota.

Prey Species	Smith (2014) Black Hills of South Dakota		Knopff and Boyce (2007) Alberta, Canada		Wilckens (2014) Badlands of North Dakota	
	% of diet	Ungulate % of diet	% of diet	Ungulate % of diet	% of diet	Ungulate % of diet
Deer species *	83.0%	89%	68.0%	85%	77.0%	81%
Elk	5.5%		6.0%		1.3%	
Bighorn Sheep	0.6%		-		2.7%	
Pronghorn	0.2%		-		-	
Moose	-		7.0%		-	
Feral Horse	-		4.0%		-	
Other	11.0%		15.0%		19.0%	

* white-tailed and mule deer combined

Scavenging by mountain lions has also been documented in various research studies. Scavenged prey in South Dakota made up 17.3% of mountain lion diets in terms of relative frequency with higher rates observed in winter ($\bar{x}$ = 0.21 events/week) than in summer ($\bar{x}$ = 0.08 events/week) (Smith 2014). Similar to mountain lions in the Black Hills of South Dakota,

Knopff et al. (2010a) found mountain lions were also scavengers in Canada, and that scavenging rates were higher in winter (0.12 events/week) than in summer (0.04 events/week), reflecting seasonal variation in carrion availability. Wilckens (2014) also documented scavenging occurring in western North Dakota at 6.7% based on relative frequency of prey items and although scavenging occurred throughout the year, higher rates were observed in winter (11.9%) than summer (3.7%). Higher scavenging rate in winter than summer in North Dakota is consistent with results from both Knopff et al. (2010a) in Alberta, Canada, and Smith (2014) in South Dakota.

Knopff et al. (2010b) noted that management of predator-prey systems depends on estimates of kill rates and prey composition. Knopff et al. (2010b) reported on the variety of kill rates reported based on methodology and study areas (Knopff et al. 2010b; Appendix F). Reasons for these discrepancies have received substantial attention (Knopff et al. 2010b, Ruth et al. 2010). As Knopff et al. (2010b) reported in Appendix F, different methods for estimating kill rate relied on snow tracking (Connolly 1949, Hornocker 1970), energetic models (Ackerman et al. 1986, Laundré 2005), or intensely monitoring radio-collared individuals (Beier et al. 1995). Anderson and Lindzey (2003) conducted research on mountain lion kill rates and predation based on GPS data, which allowed monitoring of a greater number of individuals for longer continuous periods across seasons, resulting in increased precision and decreased bias (Knopff et al. 2010b, Ruth et al. 2010). Prey species vary amongst different regions, and some multi-carnivore systems may influence kill rate estimates (Ruth et al. 2010). In addition to regional variation, ecological factors, and demographics of mountain lion populations also have been shown to influence variability in kill rates within a population (Smith 2014). Thus, even the most in-depth assessments of mountain lion kill rates may not be applicable to all populations.

In the Black Hills of South Dakota, Smith (2014) noted that mountain lion kill rate (not accounting for seasonal or demographic effects) averaged 0.79 ungulates/week (95% CI = 0.70 – 0.88), but was highly variable among individuals (range = 0.13 – 1.75 ungulates/week) and varied significantly from summer ($\bar{x}$ = 0.92; 95% CI = 0.81 – 1.03) to winter ($\bar{x}$ = 0.62; 95% CI = 0.51 – 0.74) (Table 12). Knopff et al. (2010b) noted that mountain lion kill rate (not accounting for the influence of season or demography) averaged 0.8 ungulates/week (95% CI = 0.7 - 0.9), and that kill rates were also variable among individuals (range = 0.24 - 1.38 ungulates/week). Additionally, mountain lions in west-central Alberta killed 1.49 times as many ungulates/week in summer ($\bar{x}$ = 0.951 ungulates/week, 95% CI = 0.797 - 1.105) as in winter ($\bar{x}$ = 0.639 ungulates/week, 95% CI = 0.497 - 0.782) (Table 12). In North Dakota, Wilckens (2014) found that overall ungulate kill rate (not accounting for seasonal or demographic effects) was 1.01 ungulates/week (95% CI = 0.76 – 1.27). Summer ungulate kill rates (1.09 ungulates/week, 95% CI = 0.83 – 1.36) were similar to winter rates (0.90 ungulates/week, 95% CI = 0.69 – 1.12) and were also similar to what was found in the Black Hills (Smith 2014) and Alberta, Canada (Knopff et al. 2010b) (Table 12).

Table 12. Weekly ungulate kill rates by mountain lions in South Dakota, Canada, and North Dakota.

		Ungulates/week	95% CI	Summer	Winter
Smith (2014)	Black Hills of SD	0.79	0.70-0.88	0.92	0.62
Knopff et al. (2010b)	Alberta, Canada	0.8	0.70-0.90	0.95	0.64
Wilckens (2014)	Badlands of ND	1.01	0.76-1.27	1.09	0.9

Additionally, Smith (2014) found that ungulate kill rate increased as reliance upon juvenile prey increased, and that the interval between feeding events varied substantially by month, but decreased rapidly during the ungulate birth pulse (June) before increasing after a low in July. This was similar to results found by Knopff et al. (2010b) in Canada. Wilckens (2014) also documented an increase in ungulate kill rates during the fawning period (June–August) compared with the remainder of the year. Ungulate kill rate was 1.61 times higher during the fawning period (1.41 ungulates/week, 95% CI = 1.12 – 1.71) than during the remainder of the year (0.88 ungulates/week, 95% CI = 0.62 – 1.13) (Wilckens 2014). North Dakota also analyzed data with the removal of the August ungulate fawning period and found an even greater difference in ungulate kill rate. Ungulate kill rate was 1.68 times higher during June and July (1.52 ungulates/week, 95% CI = 1.26 – 1.78) than the remainder of the year (0.90 ungulates/week, 95% CI = 0.65 – 1.16; Wilckens 2014). An increase in ungulate kill rate during the fawning period occurred simultaneously to an increase in reliance on juvenile prey; fawning period = 60.67%, 95% CI = 43.01 – 78.33; non-fawning period = 37.21%, 95% CI = 30.76 – 43.65). Despite increase in ungulate kill rate, total biomass consumed did not vary; fawning period = 6.73 kg/week, 95% CI = 4.20 – 9.25; non-fawning period = 6.90 kg/week, 95% CI = 4.41 – 9.39; Wilckens 2014).

Smith (2014) determined that annual live-weight biomass consumed by mountain lions averaged 3,336 kg for females with kittens >six months, 2,383 kg for females with kittens <six months, 2,101 kg for adult females, 2,162 kg for sub-adult males, 3,483 kg for adult males, and 1,882 kg for sub-adult females (Table 13). In comparison, Knopff et al. (2010b) found annual live-weight biomass consumed by mountain lions averaged 4,280 kg for females with kittens >six months, 2,794 kg for females with kittens <six months, 2,423 kg for adult females, 2,051 kg for sub-adult males, 4,708 kg for adult males, and 1,441 kg for sub-adult females (Table 13). Additionally, the average number of ungulates killed in the Black Hills of South Dakota, was 52 for females with kittens >six months, 42 for females with kittens <six months, 39 for adult females, 38 for sub-adult males, 35 for adult males, and 33 for sub-adult females (Smith 2014, Table 13). Knopff et al. (2010b) in Alberta, Canada, found the average number of ungulates killed was 67 for females with kittens >six months, 47 for females with kittens <six months, 42 for adult females, 31 for sub-adult males, 35 for adult males, and 24 for sub-adult females (Table 13).

Table 13. Average number of ungulates killed annually, and annual biomass consumed by mountain lions in South Dakota and Canada.

	Smith (2014). South Dakota		Knopff et al. (2010b). Canda	
	Average # of Ungulates killed by Mountain Lions	Biomass Consumed (kg)	Average # of Ungulates killed by Mountain Lions	Biomass Consumed (kg)
Female with > 6 Month Old Kittens	52	3,336	67	4,280
Male Adult	35	3,483	35	4,708
Female with < 6 Month Old Kittens	42	2,383	47	2,794
Male Subadult	38	2,162	31	2,051
Female Adult	39	2,101	42	2,423
Female Subadult	33	1,882	24	1,441

The use of GPS radio-collar technology has improved the ability to determine more accurate prey consumption and prey kill rates throughout the established range of mountain lions. In the Black Hills of South Dakota, Smith (2014) concluded that females with kittens averaged more ungulate kills than sub-adult and male mountain lions. This was also determined in Alberta, Canada (Knopff et al. 2010b). Smith (2014) also noted that in the Black Hills, prey composition and scavenging rates can influence the variability of ungulate kill rates. Therefore, Smith (2014) noted that as estimates of kill rates are contingent on accurate estimates of scavenging rates and prey composition, other researchers must look at timely investigations of mountain lion feeding events, especially in modified landscapes as an important part of reducing biases in estimating mountain lion kill rates.

Thompson et al. (2009) documented food habits of mountain lions on the prairies of North and South Dakota, and indicated that mountain lions obtained prey opportunistically when hunting in grassland habitats. Diets of mountain lions on the prairie had a lower frequency of occurrence of deer species (Table 14) than diets of mountain lions inhabiting western states (Robinette et al. 1959, Spalding and Lesoski 1971, Ackerman et al. 1984, Koehler and Hornocker 1991).

Survival

Survival Rates

The Black Hills mountain lion population naturally recolonized the Black Hills area and is within a region that is heavily used by humans (Thompson et al. 2014). Data on mountain lion survival has been collected for many years, and survival for mountain lions in the Black Hills has been estimated during pre-hunting and post-hunting time periods.

Table 14. Frequency of occurrence (%) of prey species in diet of Dakota prairie mountain lions, 2003-2007 (From Thompson et al. 2009).

Prey Species	N	Frequency of Occurrence (%)
Odocoileus spp.	7	50.0
Medium size mammals[a]	4	28.6
Small mammals[b]	2	14.3
Rodentia spp.	2	14.3
Domestic Cat	2	14.3
Empty	3	21.4
Vegetation	3	21.4

[a] Porcupine (n=32), badger (*n* = 1), and beaver (*n* = 1)
[b] Mink (n=1) and jackrabbit (*n* = 1)

Thompson et al. (2014) reported survival rates of mountain lions during pre-hunting period in the Black Hills from 1998 to 2005. Annual survival from 31 radio-collared individuals was 0.89 for adult males, 0.63 for sub-adult males, 0.86 for adult females, 1.0 for sub-adult females, and 0.67 for dependent young (kittens). Although there was no hunting in this population during this time period, 62% of all radio-collared mountain lion mortalities were classified as human caused. Additionally, a total of 85 mountain lion mortalities were documented from 1998 - 2005 in the Black Hills region, and 82.5% of all documented mortalities were considered human caused (Thompson et al. 2014).

Jansen (2011) compared survival of kittens, sub-adults, and adult mountain lions during a period when no hunting occurred (period 1) and then when an annual hunting season was initiated (period 2) in the Black Hills. Jansen (2011) also included information about survival in small protected (non-hunted) areas of Custer State Park and Wind Cave National Park during the hunting period. Pre-hunting, period 1, was from 2002-2005, and the hunting period two was from 2005-2009. Kitten survival was variable between time and areas. During period 1, kitten (*n* = 8) survival was 0.50, and 0.54 (*n* = 70) during period 2, and 0.83 (*n* = 12) in protected areas (Jansen 2011).

Sub-adult mountain lion survival was variable for males and females for both periods and areas. Sub-adult males had survival rates of 0.32, 0.24, and 0.53 in un-hunted (*n* = 8), hunted (n=28), and protected (*n* = 8) areas, respectively (Jansen 2011). Sub-adult females had survival rates of 0.60, 0.52, and 0.76 in un-hunted (*n* = 8), hunted (*n* = 22), and protected (*n* = 5) areas, respectively (Jansen 2011). Adult male survival was 0.70 (*n* = 5) during the un-hunted period, 0.40 (*n* = 27) during the hunted period, and 0.80 (*n* = 5) during the hunted period in a protected area. Adult females had survival rates of 0.90, 0.79, and 0.94 in un-hunted (*n* = 11), hunted (*n* = 59), and hunted protected (*n* = 10) areas, respectively (Jansen 2011).

Increased harvest of mountain lions resulted in an overall decrease in survival rate of both sexes of mountain lions; survival rate was reduced to 0.37 and 0.72, respectively, for male and female mountain lions. Litter size averaged 2.9 kittens with a 1:1 (male = 42: female = 42) sex ratio and kitten survival from 2005-2009 averaged 0.59 (Jansen 2011). Survival rates utilized in SDGFP population estimates are based on data from Jansen (2011) and are as follows: 0.60 for kittens less than six months, 0.52 for annual kitten survival, male survival is 0.47 and female survival is 0.72. These most recent survival rates are used to model the mountain lion population.

Jansen (2011) also noted that from 2002-2005, 90% of radio-collared mountain lion (*n* = 10) mortality was human caused. From 2005-2009, Jansen (2011) documented 82 mortalities of radio-collared animals; 65% of mortality was human-caused. Even with the hunting season being added in late 2005, the percentage of human-caused mortalities of radio-collared mountain lions decreased during 2005-2009. As noted earlier in this section, human-caused mortalities of all documented mortalities of mountain lions from 1996/97 to 2017/2018 account for 92% of mountain lion mortalities. Hunter harvest accounts for 60% of the human-caused mortality, followed by SDGFP and public removals at 20% and vehicle kills at 13%.

Survival rates have changed in the Black Hills with the initiation of a hunting season. Although there are very few protected areas in the Black Hills, it has been shown that survival does increase in areas where hunting of mountain lions is not permitted (Jansen 2011). Since Jansen (2011) reported mountain lion survival rates in protected areas, which included Custer State Park, this area now has an established hunting season on mountain lions. The only protected areas that exist in the Black Hills would include National Parks, National Monuments, or private lands where hunting is not allowed.

Compensatory Mortality

A cause of mortality is considered additive when it results in an increase in overall mortality of a population (i.e., causes a decrease in survival). An increase in compensatory mortality (up to a threshold number of mortalities), however, results in no change in overall mortality because mortalities are compensated by reductions in non-harvest mortality, increases in reproduction, or immigration (Williams et al. 2002, Turgeon and Kramer 2012).

Research has suggested that harvest mortality may be additive in certain mountain lion populations (Cougar Management Guidelines Working Group 2005). Cooley et al. (2009) found no compensation between hunting and natural mortality in a localized mountain lion population in Washington. In Montana, Robinson et al. (2014) reported that hunting had an additive effect on mountain lion mortality and found no evidence for compensation between hunted and unhunted mountain lion populations when monitoring litter size, birth intervals, maternity, age of dispersal, and age of first reproduction. Wolfe et al. (2015) in Utah found support for additive mortality in one study area with a heavily harvested population, but partial compensation may have been evident in another semi-protected population.

Peek (1986) argues that each wildlife population responds to exploitation according to its characteristics; to the nature, timing, and duration of the exploitation; and to the effect on other organisms that it interacts with. It might be inappropriate to apply inferences from data collected on one population to another population of the same species, especially if the 2 populations had different demographic characteristics, or were affected by different environmental factors. Study area sizes and proximity to other mountain lion populations (i.e., source populations or meta-population theory), hunting schemes or harvest methods, and other human causes of mortality can affect mountain lion populations in many ways, and may influence whether mortality is additive or compensatory, or whether results are comparable among studies.

In South Dakota, as the overall percentage of mountain lion mortalities from harvest increased from 2005/06 to 2017/18, the overall percentage of mortalities from vehicles and removals during this same time period subsequently decreased (Figure 20). This is suggestive of some compensation of harvest mortality occurring in South Dakota, however, cautious interpretation is warranted because all sources of mortality are not fully understood during this entire time period. Also, Jansen (2011) documented that increased harvest of mountain lions resulted in an overall decrease in annual survival rate of both sexes of mountain lions, suggesting at least some harvest mortality is additive.

Understanding the impacts of hunting mortality on mountain lion populations is important, but to fully evaluate this managers must have long term data on many population parameters such as survival, reproduction, and movements. It is unlikely that any cause of mortality is completely compensatory or completely additive, rather somewhere in between. Exactly where hunting mortality falls on this continuum is less important than understanding how hunting mortality relates to population growth rate objectives. For example, if the objective is to decrease a population, and the tool used to reduce population is hunter harvest, the management goal would be to increase the extent of which harvest is additive. Alternatively, if the objective is to increase a population, management would simply reduce the overall harvest until the population objective is achieved. Ultimately, responsible population management requires an understanding of where the population is at relative to goal, and ensuring management actions effectively move the population towards the goal.

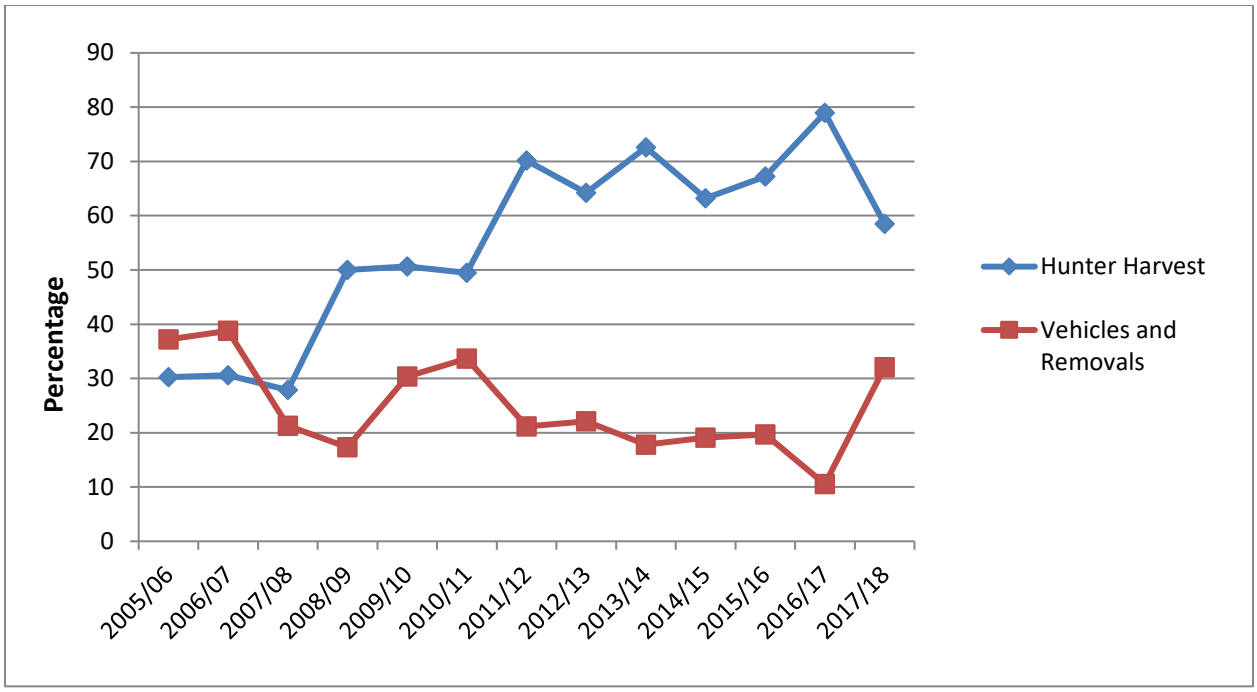

Figure 20. Percentages of mountain lion mortalities in the Black Hills Fire Protection District in South Dakota from hunter harvest vs removals and vehicles, 2005/06 – 2017/18.

Genetics

Mountain lion populations across the western United States have shown interrelatedness and movement between populations (Culver et al. 2000, Sweanor et al. 2000, Anderson et al. 2004); a pattern necessary to the definition of a metapopulation. Recent genetic analyses classified mountain lions ranging north of Argentina as one interrelated subspecies (*P. concolor cougaur*; Culver et al. 2000), and it was found that across the Wyoming Basin geographically separate populations were considered one population (Anderson et al. 2004). Dispersal between mountain lion populations allows for genetic material to be introduced and intermixed between otherwise geographically isolated regions (Logan and Sweanor 2001, Sweanor et al. 2000). As habitat fragmentation increases throughout the range of mountain lions, movement between populations remains critical to maintain genetic population viability (Beier 1995, Sinclair et al. 2001).

The Black Hills of South Dakota are an eastern extension of the Rocky Mountains and are surrounded by the Northern Great Plains. The isolation of the Black Hills had fostered concern that there may be genetic isolation of mountain lions that have repopulated the area in the last 25 years. Thompson (2009), Juarez (2014) and Juarez et al. (2016) investigated the genetic structure of mountain lions in the Black Hills Region, along with the relationships with other mountain lion populations in Wyoming, and North Dakota.

Thompson (2009) conducted genetic analysis on 134 mountain lions from the Black Hills of South Dakota using 20 microsatellite loci and found an average expected heterozygosity (H_E) of 0.542 and observed heterozygosity (H_O) of 0.547. Genetic analysis was also conducted on Black Hills (*n* = 675), North Dakota (*n* = 113), and eastern Wyoming (*n* = 62) mountain lions using 20 microsatellite loci (Juarez et al. 2016). DNA extraction was conducted at the National Genomics Center for Wildlife and Fish Conservation, United States Forest Service, Rocky Mountain Research Station (Missoula, Montana, USA). Juarez et al. (2016) compared genetic variation and number of effective breeders in the Black Hills of South Dakota during three harvest regimes to determine if harvest impacted genetic variation. These harvest regimes were pre-harvest (2003-2006; *n* = 288), moderate harvest (2007-2010; *n* = 289), and heavy harvest (2011-2013; *n* = 98). Pre-harvest strategies showed an expected heterozygosity (H_E) between 0.55 - 0.56 and observed heterozygosity (H_O) between 0.56 - 0.57. Similarly, moderate harvest and heavy harvest showed expected heterozygosity (H_E) between 0.55 – 0.56 and observed heterozygosity (H_O) between 0.54 and 0.57, and expected heterozygosity (H_E) between 0.55 – 0.56 and observed heterozygosity (H_O) between 0.54 and 0.55, respectively. Additionally, Juarez (2014) documented that mountain lions in the Black Hills had both expected (H_E) and observed heterozygosities (H_O) of 0.56. Results reported by Juarez et al. (2016) showed no significant difference in observed or expected heterozygosity levels under different harvest strategies and were similar to what was noted by Thompson (2009).

Juarez et al. (2016) also compared the Black Hills mountain lion genetic structure with that of mountain lion populations in North Dakota and eastern Wyoming. Wyoming mountain lions had expected heterozygosity (H_E) of 0.57 and observed heterozygosity (H_O) of 0.56 and North Dakota had H_E and H_O of 0.52, making genetic variation between South Dakota and Wyoming mountain lions more comparable.

Mountain lions in the Black Hills have a relatively high level of genetic diversity based on genetic analyses at 20 loci. Observed and expected heterozygosity levels were similar to other mountain lion populations in western and southern North American (Walker et al. 2000, Anderson et al. 2004, Biek et al. 2006a, McRae et al. 2005). During the late 1990's, South Dakota Game, Fish and Parks estimated the mountain lion population inhabiting the Black Hills at 25-35 individuals. Despite such a low population level at that time, no clinical signs of inbreeding (e.g., crooked tail, cryptorchidism) were noted in Black Hills mountain lions. Results support conclusions by Anderson et al. (2004) suggesting dispersal occurs between Black Hills and other Wyoming mountain lion populations, allowing sufficient genetic movement between populations and negating the otherwise deleterious alleles encountered from inbreeding. In addition to immigration, female dispersal movements within the Black Hills population contribute to increased heterozygosity for Black Hills mountain lions. Biek et al. (2006a) observed similar findings in the Yellowstone Ecosystem and suggested that female mountain lions made adequate dispersal movements within populations to negate instances of inbreeding (i.e., sibling and offspring mating).

Effective population size (N_e), can be defined as the size of an idealized population that would give rise to the variance of change in gene frequency, or rate of inbreeding that may be

observed in an actual population under consideration (Caballero 1994). Thompson (2009) estimated an N_e of Black Hills mountain lions at 28 individuals (23-39; 95% CI). Juarez (2014) reported an N_e of 25 (21-33; 95% CI) for the pre-harvest period in the Black Hills (2003-2006), and 28 (23-37; 95% CI) for the heavy harvest period in the Black Hills (2011-2013). Generally, N_e is much smaller and somewhat proportional to the total population size, and has been estimated at 10 to 20% of local census population size (Frankham 1995). Assessment of effective population size as it relates to overall population size may assist in detecting deleterious population effects associated with a decrease in N_e through time (Schwartz et al. 2006).

Thompson (2009), Thompson and Jenks (2010) and Juarez et al. (2016) noted that genetic exchange has occurred between South Dakota and North Dakota mountain lions. Thompson (2009) stated that mountain lions from the Black Hills of South Dakota had higher genetic variation than the North Dakota population and similar to Juarez et al. (2016) were more closely related to Wyoming mountain lions than to the North Dakota population. Juarez et al. (2016) reported that the Black Hills mountain lions may have recolonized the North Dakota Badlands area, but there appears to be a genetic differentiation between these populations due to possible immigration from other populations. Wilckens (2014) has documented immigration of mountain lions from Montana into the North Dakota population, suggesting genetic exchange between these populations.

Results from Juarez et al. (2016) have indicated that mountain lions from the Black Hills have maintained genetic viability most likely due to emigration and immigration despite harvest in both South Dakota and Wyoming. Additionally, genetic viability has been maintained despite the fact that the Black Hills are classified as a semi-isolated region. Thompson (2009), Thompson and Jenks (2010), and SDGFP (unpublished data) have recorded dispersals of mountain lions from the Black Hills population to other states with mountain lions (North Dakota, Montana, Wyoming, Colorado, Nebraska). These recorded dispersals indicate genetic interchange and genetic analysis indicates that immigration into South Dakota also exists from surrounding populations.

Consequently, a population size above that level with adequate immigration of individuals from outside the Black Hills region (e.g., one male per generation; one female per two generations [Anderson et al. 2004]) would be necessary to maintain a genetically healthy population. Therefore, when considering the documented immigration into this population from surrounding populations, the identified population objective of 200-300 individuals are within the range to provide for sufficient genetic diversity amongst this Black Hills mountain lion population.

Disease

Mountain lions have the potential to acquire and transmit diseases that may impact other wildlife, domestic animals, humans, or mountain lions. Diseases can affect mountain lion populations, and with the expansion of mountain lions into areas with humans, there is an

increased chance of exposure to diseases commonly affecting domestic cats (Fecske et al. 2011). Despite mountain lions' wide distribution, increasing abundance, and important ecological roles in the environment, information about pathogen dynamics in mountain lions is limited and virtually absent for the Rocky Mountain region (Biek et al. 2006b).

Disease monitoring in South Dakota conducted by SDGFP and other agencies has occurred through research projects (Jansen 2011), and opportunistic events. Jansen (2011) noted that disease was a potential cause of death in 16% of sub-adult (one–three years) old) and adult (>three years old) mountain lion mortalities and 10% in kittens (<one-year-old) from 2006-2009. Detecting cause of death due to disease is difficult due to the delay in laboratory examination during field research, and conclusive evidence was not always available to determine causative agents of mountain lion mortalities. Furthermore, seroprevalence techniques only show exposure to various diseases and do not indicate mortality from these diseases. Ultimately, mountain lions in the Black Hills have been, and will most likely continue to be, exposed to various disease agents. Although there is no evidence that population effects have occurred due to disease exposure in South Dakota mountain lions, SDGFP must continue to monitor for diseases in the population.

This section will address pertinent diseases, testing results, and the current knowledge of particular diseases that may emerge and cause concern for mountain lion management in South Dakota. Monitoring for any potentially new disease or evaluating current disease issues in South Dakota will continue.

Canine distemper virus (CDV)

Canine distemper virus is caused by a virus in the genus *Morbillivirus* (Davidson 2006). Although this virus is usually found in carnivores, Biek et al. (2006b) suggested that CDV persists in carnivores other than mountain lions and was found in mountain lion populations for short, sporadic periods of time. Symptoms of this virus may include respiratory distress, coughing, sneezing, watery or purulent ocular and nasal discharge, and diarrhea (Davidson 2006). Jansen (2011) found positive status in 18% of mountain lions in the Black Hills of South Dakota during 2007 to 2009. This prevalence was slightly higher than what was found by Biek et al. (2006b) in Wyoming (1-13%).

Feline calicivirus (FCV)

Feline calicivirus (FCV) is a member of the genus *Vesivirus* and is found in domestic cats worldwide and mountain lions are susceptible (Lenghaus et al. 2001). Jansen (2011) noted that from 2006 - 2009, FCV was found in mountain lions in the Black Hills of South Dakota and was the second most common virus found at 27% exposure rate. This rate was slightly higher than was reported by Biek et al. (2006b) in Wyoming/Montana (9%-17% average), and Paul-Murphy et al. (1994) (17%), but lower than the 67% reported by Nicholson et al. (2012) in Arizona. Jansen (2011) reported that FCV is the primary agent that causes respiratory disease and, although not fatal in adult mountain lions, can be fatal in kittens.

Feline immunodeficiency virus (FIV)

Feline immunodeficiency virus a member of the genus *Lentivirus* (Worley 2001). Jansen (2011) found an overall prevalence of 12% in Black Hills mountain lions. Carpenter et al. (1996) reported prevalence of FIV exposure in wild mountain lions of 67% in Colorado, and 17% in Wyoming, with 22% of 434 samples showing the presence of antibodies for FIV found in samples throughout the geographic range of mountain lions. Biek et al. (2006b) reported prevalence from 19% to 50% in Wyoming/Montana mountain lions. Jansen (2011) reported that no mountain lions in the Black Hills showed any clinical symptoms of FIV.

Feline parvovirus (FPV)

Feline parvovirus is a synonym for many infections such as feline panleukopenia virus (FPLV) and is closely related to canine parvovirus (Barker and Parrish 2001). Jansen (2011) reported exposure rates as feline/canine parvovirus (F/CPV) and reported an 81% rate in the Black Hills. Biek et al. (2006b) reported FPV rates of 58-69% in Wyoming/Montana mountain lion populations. Paul-Murphy et al. 1994 noted rates for Feline panleukopenia virus of 89-100% in California. Wilckens (2014) reported a carnivore parvovirus prevalence of 70% in North Dakota mountain lions. In the Black Hills, Jansen (2011) reported that disease was implicated in 10% of kitten mortalities, which might be related to high prevalence of F/CPV in adult mountain lions. Kittens >four months old were sampled and 31% were found to be positive for F/CPV (Jansen 2011). These results do not totally implicate that feline/canine parvovirus can be attributed to the cause of death of the kittens, but that future research may need to be considered with disease testing of kittens.

Plague

Plague is caused by a bacterium *Yersinia pestis* that is normally maintained through a flea/rodent cycle (Davidson 2006). Plague has been documented in prairie dogs in southwestern South Dakota and thus there is the opportunity for mountain lions to become infected. Jansen (2011) did not find evidence of plague in a total of 68 mountain lions that were tested from the Black Hills. In California, Paul-Murphy et al. (1994) found 40% of mountain lions tested positive for *Y. pestis* antibodies, indicating that mountain lions had been at least exposed to the disease. Biek et al. (2006b) noted that *Yersinia pestis* exposure was greater than 25% in the Snowy Range in southeastern Wyoming. In South Dakota, there is the opportunity for mountain lions to be exposed to plague, and biologist and the public must be aware that human exposure is always a possibility.

Ocular disease

In 2004-2005, agency personnel and researchers became aware of adult mountain lions that exhibited extreme cloudiness of the eyes. Jansen (2011) ultimately noted one acute and four chronic cases resulting in corneal opacity due to neutrophil infiltration of the corneal tissues. Diagnoses were keratitis (one acute case) and uveitis (one chronic case; Jansen 2011). Prevalence of potential ocular disease inducing agents was low with feline calicivirus (FCV) RNA being amplified most frequently from prevalent ocular swabs (4.7%). Jansen (2011) also noted that causative agents of these cases were not determined; the investigation was hindered by

the low occurrence of clinically-affected animals exhibiting active disease. This syndrome has not been documented in South Dakota mountain lions recently.

Toxoplasmosis

Toxoplasmosis is caused by a protozoan parasite *Toxoplasma gondii* (Davidson 2006). Bobcats and other felines can be definitive hosts of this parasite but may not develop disease or clinical signs when infected (Davidson 2006). Jansen (2011) noted that *Toxoplasma gondii* was detected in 53% of sampled mountain lions in South Dakota. Paul-Murphy et al. (1994) noted a 58% infection of this parasite in California. In South Dakota, Jansen (2011) also noted that adult females had a high prevalence (62%), but the role that this organism might play in kitten mortality requires more research. Of additional importance, toxoplasmosis is a zoonotic disease that can cause clinical disease in humans (Davidson 2006).

Trichinosis

Trichinosis is caused by nematode parasites in the genus *Trichinella* (Lockhart 2006). Trichinosis or trichinellosis is a disease of carnivores with behaviors that include consuming raw meat. The spread of this parasite is through the ingestion of larvae located in the muscle tissue, and all warm blooded animals can be infected (Dick and Pozio 2001). Mountain lions can be infected by *trichinella* spp., and therefore humans that consume undercooked tissue from an infected mountain lion have the potential to get trichinosis. Although research has not been conducted in South Dakota on the percentage of mountain lions that may carry *trichinella* spp., Reichard et al. (2015) found that 21.4% of Florida panthers were infected with *trichinella* spp., and Reichard et al. (2017) found that 43.6% of mountain lions from Colorado showed detection of the *trichinella* spp. larvae. Symptoms of trichinosis in humans may include nausea, diarrhea, vomiting, fever, fatigue and abdominal discomfort. Cooking meat from harvested mountain lions to a temperature of 165° F will kill the parasite and thus the risk of infection.

DEPREDATION MANAGEMENT

Mountain lion 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 public and private lands throughout the year and the management of mountain lions is a controversial topic across the state. During the 2016/17 hunting season, there were 3,067 licensed hunters for all mountain lion seasons in South Dakota (Lindbloom and Griffin 2017). Mountain lion populations in South Dakota have changed dramatically over the past 15 years and harvest peaked during the 2011/12 hunting season. When mountain lion populations are high, decreased social tolerance is experienced by some landowners and livestock producers in areas of South Dakota due to the potential damage to private property or loss of livestock. Other areas of the United States have also reported that as the estimated mountain lion density increased, the number of mountain lion removals associated with livestock conflicts increased as well (Hiller et al. 2015). The social tolerance of mountain lions can also be impacted by different stakeholders. Big game hunters have

demonstrated lower tolerances for high mountain lion populations (Knopff et al. 2016). Deer and elk hunters tend to view mountain lions as direct competitors for their resource. Longmire (2013) found that 64% of the 2012/13 South Dakota mountain lion hunters wanted to see a decrease in the mountain lion population within the next five years. Huxoll (2018) noted that approximately 35% of the 2017/18 South Dakota mountain lion hunters wanted to see a decrease within the next five years. Other research in North America has reported that the social tolerance for mountain lions is a management challenge, and the increased publicity of human-mountain lion conflicts has magnified the public's perceived risk of living with mountain lions (Knopff et al. 2016, Riley and Decker 2000).

Successful wildlife management programs must target private landowners and work cooperatively with farmers and ranchers to be effective (Bookhout 1996). SDGFP works diligently to maintain a balance between viable mountain lion populations, social tolerances, and the desires of a variety of stakeholders. At times, this balance is difficult to achieve as some stakeholders want less mountain lions and other want to see more mountain lions on the landscape. SDGFP understands that cooperative partnerships with private landowners are an essential component of mountain lion management and that private lands serve an important role regarding all wildlife management (Fisk 2017). Without this cooperative partnership, it would not be possible to meet the agency's responsibility of successfully managing South Dakota's mountain lion population. In addition, mountain lions that pose a safety risk to the public, pets, or livestock are always the highest priority for SDGFP. It is because of these important considerations that SDGFP operates an active and comprehensive wildlife damage management program regarding mountain lion depredation events. Hunters in South Dakota have shown strong support for programs that assist landowners with livestock loss events and damage to private property from wildlife (Longmire 2012b). The public also supports management of wildlife that is causing damage to personal property when non-lethal techniques are employed (Reiter et al. 1999) as well as lethal techniques (Riley and Decker 2000).

As wildlife 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 go to hunter access programs. The establishment of this funding was the financial foundation for which SDGFP's wildlife damage abatement program was initiated. A component of this program provides assistance to landowners that experience mountain lion-caused depredation events and addresses public safety concerns regarding mountain lions. From 2010 to 2017, SDGFP spent over $300,000 addressing mountain lion depredation events on private lands or dealing with mountain lions that posed a threat to public safety. In comparison, SDGFP expends well over $300,000 annually to address depredation events from ungulate species like deer or elk.

Overall, the demand for mountain lion depredation services from SDGFP is low and fluctuates annually due to mountain lion population levels and dynamics, seasonal variations, prey

populations, and changes to habitat (i.e., habitat loss and human encroachment). Factors such as decreasing mountain lion populations, increasing mountain lion harvest density in specific problem areas, decreasing the proportion of juvenile male mountain lions in a problem area, and balancing the density of livestock in relation to available densities of prey populations have been suggested to decrease livestock depredation events by mountain lions (Hiller et al. 2015). However, the most significant factor that likely affects social tolerance and the demand for mountain lion depredation services in South Dakota are population levels and landowners' financial dependency on livestock or other personal property. Lacey et al. (1993) also found that tolerance for other wildlife species depredation quickly diminished as landowners' economic dependency on their land increased. Fortunately, a small number of landowners and livestock producers have interactions with mountain lions because of their relatively low densities in South Dakota and the animal's secretive nature.

In South Dakota, conflicts with mountain lions occur throughout the year, primarily in the Black Hills, or areas directly adjacent to this small mountain range. The highest annual number of mountain lions removed by the SDGFP or the public because of attacks on pets, and livestock loss events was 12 mountain lions in 2010-2011. Since 2001, a total of 92 mountain lions have been removed statewide in response to pet attacks, livestock loss events or threat of livestock loss (Figure 21). Mountain lions have been documented moving large distances across the state (Thompson and Jenks 2005). Over the past 17 years, SDGFP has confirmed a total of 3 livestock loss events from mountain lions on the prairies of western South Dakota in which the mountain lion was removed. These depredation events occurred with sheep and captive pheasants. Most times, these few events took place on ranches near rugged terrain with thick cover along riparian or wooded areas. Overall, from 2001/02 to 2017/18, the number of conflicts on the prairie between livestock producers and mountain lions was seven. Conflicts with livestock operations outside the Black Hills may be avoided by mountain lions because of husbandry techniques and the high levels of human presence around these operations (Thompson et al. 2009). Within the BHFPD, mountain lion removals occurred a total of 85 times due to depredation or threat events on livestock or pets. These events include 46 livestock kills, 23 pet kills, 7 livestock threats, and 9 pet threats. Mountain lions have the ability to kill many types of livestock and pets (e.g., cattle, sheep, llamas, goats, cats and dogs) with ease, but compared to other states where mountain lions occur, South Dakota has a relatively low number of confirmed attacks on pets and livestock loss events.

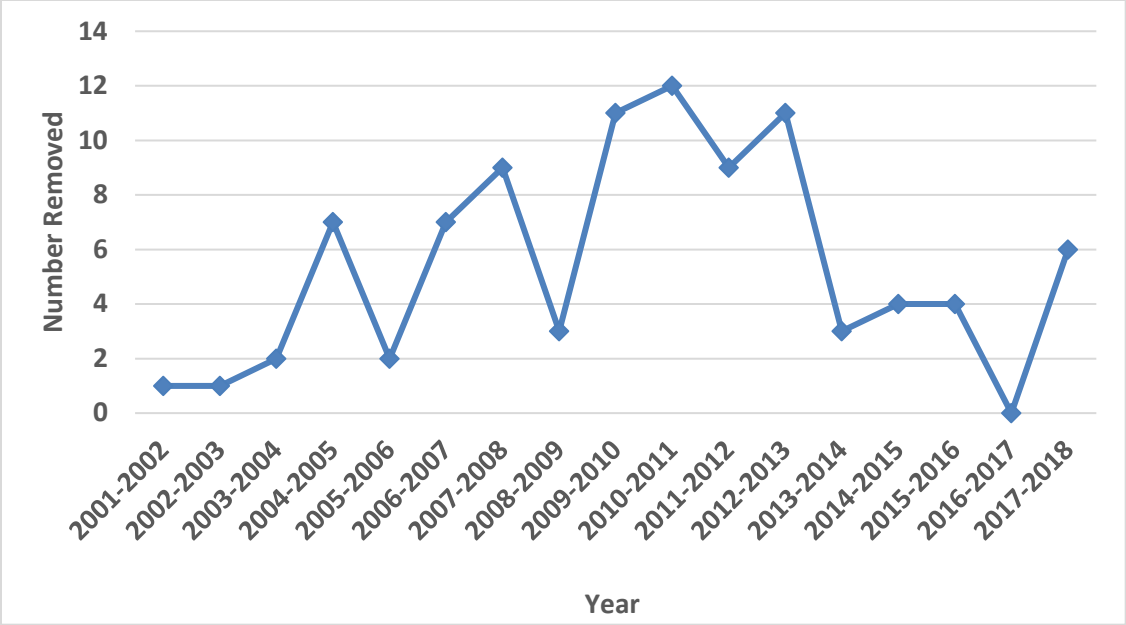

Figure 21. Statewide mountain lion removals due to livestock and pet attacks and threat to livestock or pets, 2001/02 – 2017/18.

SDGFP implements lethal management techniques in most situations that deal with conflicts with mountain lions (e.g., public safety concerns, attacks on pets and livestock loss events). These management techniques include trapping, snaring, shooting, and the use of dogs to pursue mountain lions. During the early stages of mountain lion management in South Dakota, SDGFP did utilize trap and relocation on several occasions but those efforts were deemed ineffective. In one situation, the relocated mountain lion moved back to the place of origin (over 60 miles) within two days. SDGFP will not relocate a mountain lion that previously attacked livestock to another area, because it may impact another livestock producer. In New Mexico, researchers found that mountain lions over 27 months old may likely move large distances and may prey on livestock or pets again and translocation is an unreliable management tool to deal with mountain lions that have caused conflicts (Ruth et al. 1998). In these situations, it is SDGFP's current position to utilize lethal removal as the most appropriate management technique. However, SDGFP does provide technical advice to livestock producers and homeowners regarding non-lethal techniques (e.g., protective fencing and additional livestock husbandry practices) to be proactive and hopefully minimize mountain lion conflicts with livestock and pets.

SDGFP may utilize lethal control to address mountain lion conflicts or depredation events:

> ***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.

Lethal control is conducted exclusively by SDGFP staff when deemed appropriate. However, in certain circumstances citizens may kill a mountain lion if necessary.

> ***SDCL § 41-6-29.2 – Killing of mountain lion permitted under certain circumstances***— *Notification of conservation officer. Any person, licensed or unlicensed, may kill a mountain lion if reasonably necessary to protect the life of that person of some other person. Any person, licensed or unlicensed, who owns or cares for livestock or pets, may kill any mountain lion posing an imminent threat to such person's livestock or pets. If any mountain lion is killed pursuant to this section, the person who killed the mountain lion shall notify a conservation officer within twenty-four hours of killing the mountain lion.*

Ultimately, mountain lion management is challenging in a human-dominated landscape and humans and mountain lions must adapt for management to be successful. Nevertheless, mountain lions are remarkably adaptable to modified landscapes and maintaining their population does not require vast areas of wilderness (Knopff et al. 2014). SDGFP has worked hard over the years to manage mountain lions and the associated conflicts that occur with livestock producers and pet owners. These interactions (i.e., humans and mountain lions) will continue to challenge wildlife managers (Hiller et al. 2015, Knopff et al. 2016, Riley and Decker 2000). While management techniques and strategies have proven successful over the past 20 years, mountain lion depredation and the associated conflicts will continue to challenge SDGFP. These matters not only involve the management of mountain lions but also include socio-economic and political dynamics that must be considered as well. To help minimize these conflicts when possible, SDGFP must ensure that mountain lion populations are managed proactively and that management goals are being met. Defined wildlife population objectives, management goals, and stakeholder opinions are critical to effectively manage wildlife populations (Leopold 1933, Riley and Decker 2000). SDGFP also acknowledges that its wildlife damage management programs will not be able to completely resolve all issues regarding mountain lion depredation events in all situations. However, SDGFP has a proven history of working with private landowners, homeowners, pet owners, and livestock producers and is committed to cooperatively working with these constituents into the future to implement reasonable solutions to address most situations.

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 22). Each is managed by a respective Native American tribe under tribal

sovereignty and their respective tribal councils. Most tribes have a wildlife department that conducts various wildlife 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, many wildlife species thrive on these tribal lands, benefiting both wildlife watchers and hunters. Mountain lion populations are primarily limited to the Black Hills in South Dakota, but occasional dispersers are possible on any of the Reservations. The Oglala Sioux Tribe (Pine Ridge Reservation) and Standing Rock Sioux Tribes (Standing Rock Reservation) are currently the only tribes that have an established mountain lion season in South Dakota.

Figure 22. Tribal lands found in South Dakota. Source: South Dakota Department of Tribal Relations (SDDTR 2019).

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 wildlife and other natural resources management is important. In developing recommendations for upcoming mountain lion hunting seasons, regional SDGFP staff discuss management options for hunting units within tribal lands. Since hunter harvest is occurring from both state and tribal hunting seasons, these discussions are important to ensure that all management agency objectives are considered. Cooperative mountain lion research and surveys have been limited; however, coordinated efforts occur with harvest and removals.

SDGFP and some tribes are currently in the process of developing Memorandum of Understandings (MOU). The purpose of these MOU's is to formalize cooperative efforts between tribes and SDGFP where mutual interest exists to conduct collaborative operations. Collaborative operations between the parties may include, but not be limited to the following:

conducting and sharing wildlife surveys, developing big game and small game harvest season recommendations, communicating wildlife and fisheries resource management concerns, and conducting predator/nuisance animal control activities in an effort to safeguard domestic livestock operations.

Opportunities exist to increase collaboration between SDGFP and tribal agencies regarding mountain lion management. State mountain lion licenses are not valid on tribal-deeded land within a reservation and tribal licenses are not valid between tribes. Hunting rules and regulations vary by tribe and hunters are encouraged to contact or visit the website of their tribal interest (Table 15). In summary, tribal lands provide substantial wildlife habitat and hunting opportunities, with a few in western South Dakota offering some limited mountain lion hunting.

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.santeesioux.com
Lower Brule Sioux Tribe	Lower Brule Reservation	Lower Brule, SD	132,601	605-473-5561	http://www.lbst.org
Oglala Sioux Tribe	Pine Ridge Reservation	Pine Ridge, SD	Approx. 1,700,000	605-867-1449	http://www.oglalasiouxparksandrec.net
Rosebud Sioux Tribe	Rosebud Reservation	Rosebud, SD	882,416	605-747-2381	http://www.rosebudsiouxtribe-nsn.gov
Sisseton Wahpeton Oyate	Former Lake Traverse	Agency Village, SD	106,153	605-698-3708	http://www.swo-nsn.gov
Standing Rock Sioux Tribe	Standing Rock Reservation	Ft. Yates, ND	562,366 in SD	701-854-8500	http://standingrock.org
Yankton Sioux Tribe	Yankton Reservation	Wagner, SD	Approx. 40,000	605-384-5687	http://www.yanktonsiouxtribe.net

INTER-STATE COORDINATION

There are currently several gatherings and events with other surrounding state wildlife agencies to coordinate mountain lion management efforts. SDGFP meets annually with the Wyoming Game and Fish Department to discuss mountain lions and other species management in the shared Black Hills ecoregion. In addition, SDGFP meets approximately every third year with Nebraska, North Dakota, and Wyoming biologists to discuss and coordinate mountain lion management and research. There has been a long history of reciprocating assistance amongst states in mountain lion research and management that continues to this day.

Furthermore, SDGFP biologists meet and discuss mountain lion management issues, strategies, and research with other state biologists and managers at the Western States Association of Fish and Wildlife Agencies triennial Mountain Lion Workshop (https://www.wafwa.org/workshops/mountain_lion_workshop/).

PUBLIC INVOLVEMENT AND OUTREACH

Effective decision-making by wildlife agencies necessitates the need to consider public perceptions and opinions, as well as potential responses to management policies. Along with hunter harvest and biological data collected, public involvement is an important component in developing and implementing wildlife management plans. 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 wildlife 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. 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. No single citizen or group of citizens can represent the views of all citizens. Multiple avenues for public involvement and outreach, therefore, are used in the development of the Mountain Lion Management Plan. These approaches are designed to involve the public at various stages of plan development and to ensure opportunities for participation are accessible to all citizens.

South Dakota Game, Fish and Parks first began collecting public opinion information related to mountain lion management in 2002, at which time mountain lions were listed as a state threatened species (Gigliotti et al. 2002). Since that time SDGFP has administered multiple surveys regarding mountain lions in South Dakota: five state resident surveys (Longmire 2019, Gigliotti 2012, Gigliotti et al. 2009, Gigliotti 2002, and Gigliotti et al. 2002); three Black Hills deer hunter surveys (Gigliotti 2007a, 2006a, and 2005a); one elk hunter survey (Gigliotti 2006b); and 13 mountain lion hunter surveys (Huxoll 2018, Longmire 2017, 2016, 2015, 2014, 2013, 2012a, Gigliotti 2011, 2010a, 2009, 2008, 2007b, and 2006c). In addition to surveys, SDGFP has held

multiple public meetings/open houses in 2005, 2010, and 2012 designed to provide information to the public and gather public input about mountain lion management in South Dakota. Additional public comment has been collected over the years in conjunction with management plan revisions; SDGFP Commission public hearings, open forums, and petitions processes; and via informal avenues such as emails and phone calls to the Department. A stakeholder group was established in conjunction with the 2018 management plan revision process as an additional means for gathering input related to mountain lion management. A SDGFP webpage was also set up to provide the public information about the mountain lion management plan revision process and how to provide public input. Furthermore, in the summer of 2019 SDGFP hosted an open house to present and discussion information relevant to the draft revision of the statewide mountain lion plan.

Attitudes toward Mountain Lion Hunting Season

Over the years South Dakota residents have been supportive of a mountain lion hunting season (Longmire 2019, Gigliotti 2012, Gigliotti et al. 2009, Gigliotti 2002 and Gigliotti et al. 2002). Prior to the establishment of a mountain lion hunting season in South Dakota, a survey of South Dakota residents in 2002 found that 71 percent would support a change in status from a state threatened species to a game animal if the State acquired data that the mountain lion population was healthy and could sustain a prescribed level of harvest; only 14 percent would oppose this (Gigliotti 2002). Additionally, results from the same survey showed that only 59 percent of residents would support a change in status if the reason were to protect deer populations from declining, and even fewer South Dakota residents (17%) would support a change in status if the reason were to eliminate as many mountain lions from the state as possible. Together these results indicate the support for the mountain lion season is not the result of negatively held attitudes towards mountain lions in South Dakota, but rather a belief that a healthy mountain lion population could support a regulated hunting season and would help maintain a healthy, stable population of mountain lions in the Black Hills. Less than one-quarter (21%) of South Dakota residents did not support a mountain lion hunting season under any circumstance (Gigliotti 2002). Three years after South Dakota's mountain lion hunting season was implemented Black Hills residents were asked how strongly they favored or opposed the season. Nearly two-thirds (63%) favored a mountain lion season in South Dakota, and 24 percent opposed the season (Gigliotti et al. 2009). In 2012, 71 percent of South Dakota residents indicated they favored a regulated hunting season for mountain lions and nine percent opposed the season (Gigliotti 2012). In a 2018, survey of South Dakota residents, 60 percent indicated they would like SDGFP to manage for a self-sustaining population of mountain lions at a level that included an annual hunting season, and 16 percent disagreed with this (Longmire 2019). In 2018, residents were specifically asked about the current season structure for the Black Hills mountain lion season and the statewide mountain lion season. Sixty one percent of residents supported the current Black Hills season structure and 60 percent supported the current statewide season structure. Approximately, 12 percent of residents opposed the Black Hills season structure and 13 percent opposed the current statewide season structure (Longmire 2019).

While the majority of state residents support the current mountain lion season structures, there is less support for the current regulations surrounding the use of dogs to hunt mountain lions. Less than half (45%) of residents indicated support for the current dog hunting regulations in Custer State Park and 28 percent opposed these regulations. Similarly, 46 percent of residents supported the current regulations for the use of dogs to hunt mountain lions on the prairie (outside of the Black Hills Fire Protection District), and 27 percent opposed these regulations (Longmire 2019). When asked about the potential to allow the use of dogs during the general Black Hills season, 40 percent of residents were in support and 33 percent opposed this. Black Hills residents were more likely to oppose the use of dogs during the general Black Hills mountain lion hunting season than residents on the prairie (46% versus 30%). Black Hills residents were defined as residing in the 5-county area which comprises the Black Hills Fire Protection District (Custer, Fall River, Lawrence, Meade, and Pennington Counties). Residents on the prairie were defined as residing in a county other than Custer, Fall River, Lawrence, Meade or Pennington Counties.

Currently, state law and administrative rule do not allow the taking of any big game animal (including mountain lions) with traps or snares. When asked how strongly they would support or oppose the use of traps and snares when hunting mountain lions, the majority of SD residents (59%) were opposed to this. Black Hills residents were more likely (71%) than residents on the prairie (55%) to oppose the use of traps and snares for hunting mountain lions (Longmire 2019).

Social Tolerance

Research into the acceptance of wildlife indicates both objective and subjective factors shape beliefs about wildlife populations (Zinn et al. 2000; Decker and Purdy 1988). In addition to objectively measured population levels, risks, and benefits factors such as value orientations and perceptions of population levels, risks, and benefits have been found to be important in determining stakeholder acceptance capacity for wildlife (Zinn et al. 2000). Understanding attitudes is important since they can influence and predict behavior, and the more specific the attitude is toward a certain behavior the stronger the relationship between attitude and behavior (Vaske 2008, Fishbein and Manfredo 2003, Ajzen and Fishbein 1980).

The attitudes and beliefs about mountain lions held by SD residents are complex. Over the past 16 years surveys have consistently shown the full range of attitudes towards mountain lions is present among South Dakota residents, ranging from strong support to strong opposition toward mountain lions. Attitudinal statements have been used to measure SD residents' beliefs regarding mountain lions, four of which were asked consistently on the 2002, 2012, and 2018 surveys (Longmire 2019, Gigliotti 2012 and Gigliotti et al. 2002): 1) having a healthy, viable population of mountain lions in South Dakota is important to me; 2) the presence of mountain lions is a sign of a healthy environment (this statement was not included on the 2012 survey of SD residents); 3) having mountain lions in South Dakota is too dangerous of a risk to people; and 4) I am concerned about mountain lions killing too many game animals.

In 2002, the majority of SD residents (47%) agreed with the statement "having a healthy, viable population of mountain lions in South Dakota is important to me", while 25 percent disagreed with the statement (Gigliotti et al. 2002). In 2012 residents reported similar levels of agreement (48%) and disagreement (27%) with this statement as reported in 2002 (Gigliotti 2012). Residents were asked to indicate their level of agreement or disagreement with this statement again in 2018; 41 percent agreed this was important to them, 26 percent disagreed, and 33 percent neither agreed nor disagreed (Longmire 2019). The proportion of residents who neither agreed nor disagreed with the statement in 2018 increased from the levels in 2012 (25%) and 2002 (28%). Black Hills residents were more likely than residents on the prairie to agree (55% compared with 36%) that a healthy, viable population of mountain lions in SD is important to them (Longmire 2019). The majority of residents in 2002 (72%) agreed that the presence of mountain lions was a sign of a healthy environment, while 12 percent disagreed and 16 percent neither agreed nor disagreed with it (Gigliotti et al. 2002). In 2018, a smaller majority (57%) agreed that the presence of mountain lions was sign of a healthy environment, 20 percent disagreed, and 23 percent neither agreed nor disagreed with it. Black Hills residents were more likely than residents on the prairie to agree (67% compared to 54%) that mountain lions' presence was a sign of a healthy environment (Longmire 2019).

The majority of SD residents disagreed that having mountain lions in SD is too dangerous a risk to people. In 2002, 62 percent of SD residents disagreed with this statement, 25 percent agreed with it and 13 percent neither agreed not disagreed (Gigliotti et al. 2002). Similarly in 2012, 57 percent disagreed that mountain lions were too dangerous a risk to people, 27 percent agreed and 16 percent neither agreed nor disagreed (Gigliotti 2012). More recently, in 2018, 53 percent disagreed with this statement, 28 percent agreed and 19 percent neither agreed nor disagreed. Black Hills residents were more likely to disagree than residents on the prairie (67% compared to 50%) with the statement that having mountain lions in SD was too dangerous a risk to people (Longmire 2019).

SD residents' concerns for mountain lions killing too many game animals have fluctuated over the years. This fluctuation is likely due, in part, to fluctuations in mountain lion, deer, and elk populations in the Black Hills over the last 16 years. In 2002, a slight majority of SD residents (52%) disagreed with the statement that they were concerned about mountain lions killing too many game animals. One-quarter (25%) were concerned about this and 24 percent neither agreed nor disagreed with this statement (Gigliotti et al. 2002). The proportion of SD residents who indicated they were concerned about mountain lions killing too many game animals jumped to nearly half (45%) in 2012, while one-third (33%) were unconcerned and 22 percent neither agreed nor disagreed with the statement (Gigliotti 2012). In 2018, the proportion of residents who were concerned about this dropped to 33 percent, 42 percent indicated they were unconcerned, and one-quarter (25%) neither agreed nor disagreed that they were concerned about mountain lions killing too many game animals. Black Hills residents were more likely than residents on the prairie (52% compared to 39%) to disagree with this statement (Longmire 2019).

SD residents were also asked to indicate their desired population goals for mountain lions in 2002 and again in 2018. In 2002, when mountain lions were still listed as a state threatened species, one-quarter (25%) of residents wanted the mountain lion population to increase to some degree, less than one-third (30%) wanted it to stay about the same, and 17 percent indicated they would like to see the population decrease to some degree. Over one-quarter (28%) were unsure about what the population goal should be (Gigliotti et al. 2002). In 2018 (13 years after the first mountain lion hunting season) residents were asked the direction they would prefer to see mountain lion populations go over the next five years within the Black Hills Fire Protection District and statewide (outside the fire protection district). Over one-third (39%) of residents preferred to see the population in the Black Hills Fire Protection District stay about the same, and 35 percent of residents would like to see the population statewide stay about the same (Longmire 2019). Over one-quarter (29%) of residents would like to see the population decrease to some extent over the next five years statewide, and 21 percent would like to see the population in the Black Hills decrease. A similarly proportion of residents would like to see the population in the Black Hills and statewide increase (20% and 17%, respectively). About 20 percent of residents indicated they were unsure about mountain lion population goals over the next five years (Longmire 2019). Black Hills residents were more likely than residents on the prairie to indicate they would prefer the mountain lion population in the Black Hills Fire Protection District remain about the same over the next five years (44% compared to 38%). In addition, residents on the prairie were more likely than Black Hills residents (31% compared to 22%) to prefer to see the mountain lion population statewide (outside the fire protection district) decrease to some extent (Longmire 2019).

In 2018, SD residents were presented three scenarios and asked about the acceptability of six management actions that SDGFP could take: 1) leave the mountain lion alone (take no action); 2) use techniques to frighten the mountain lion away; 3) capture and relocate the mountain lion to another area; 4) lethally remove the mountain lion; 5) educate the public on how to safely live in areas with mountain lions; and 6) prohibit deer and elk feeding in the local area to reduce prey availability. Under the first scenario, where a mountain lion was frequenting a neighborhood but not causing any problems or exhibiting any threatening behaviors, the most acceptable management actions were: to educate the public on how to safely live in areas with mountain lions (73% found acceptable); to capture and relocate the mountain lion to another area (73% found acceptable); and to use techniques to frighten the mountain lion away (66% found acceptable). The least acceptable management actions under this scenario (53% found both actions unacceptable) were: to lethally remove the mountain lion; and to leave the mountain lion alone, (Longmire 2019). Under the second scenario, where a mountain lion was killing livestock, the most acceptable management actions were: to capture and relocate the mountain lion to another area (76% found acceptable); educating the public on how to safely live in areas with mountain lions (63% found acceptable); and using techniques to frighten the mountain lion away (62% found acceptable). Just over half of residents (55%) indicated lethally removing the mountain lion would be acceptable, while 37 percent indicated it was unacceptable. Leaving the mountain lion alone, taking no action was the least acceptable management action, with 83 percent indicating this was unacceptable (Longmire 2019). The third and final scenario, where a mountain lion was killing domestic pets, had a similar level of

acceptability for the six management actions as the second scenario. The most acceptable management actions were: to capture and relocate the mountain lion to another area (76% found acceptable); educating the public on how to safely live in areas with mountain lions (68% found acceptable); and using techniques to frighten the mountain lion away (63% found acceptable). The least acceptable management action was to leave the mountain lion alone, with 81 percent of residents indicating this was unacceptable. The acceptability of prohibiting deer and elk feeding in the local area to reduce prey availability was similar across all three scenarios. Roughly one-third of residents found this unacceptable, about one-quarter indicated it was neither acceptable nor unacceptable, and around 42 percent of residents found this acceptable (Longmire 2019).

Survey results over the past 16 years have consistently shown that the full range of attitudes toward mountain lions exist in South Dakota. This finding is significant in it means managing mountain lions can be controversial, and mountain lion incidents have the potential to become contentious depending on how they are addressed. Understanding how various stakeholders perceive mountain lions in South Dakota is an important component of overall mountain lion management that is responsive to public values.

Communications for Plan Development

Information on the development of the South Dakota Mountain Lion Management Plan has been available online at https://gfp.sd.gov/management-plans/since the beginning of the planning process; outlining the plan's contents, timeline and how staffs, customers and stakeholders can get involved.

Individuals and stakeholder groups were invited to participate in a mountain lion stakeholder group meeting (held on October 3, 2018 in Rapid City). Information presented at these meetings and minutes of discussions are available for review at the previously mentioned link above. The mountain lion stakeholder group was provided a draft of the revised management plan for review and comment. Further, in the summer of 2019 SDGFP hosted an open house public meeting in Rapid City to present and discuss information relevant to the draft revision of the statewide mountain lion plan.

The plan and any updates were provided to the public through Facebook, Twitter and targeted email messaging (specifically to resident and nonresident deer/big game hunters). Scheduled Facebook and Twitter posts were made after the release date of the plan as reminders to let followers know this information is available. However, if users made comments via social networking, they were directed to provide those comments in writing to Wildinfo@state.sd.us or mail them to 523 E. Capitol Ave., Pierre, S.D. 57501 and include a full name and city of residence in order for them to be a part of the official public record. Once the plan was available for public review and comment, in July 2019, a PDF version was posted online. All email comments from the public pertaining to the draft plan were sent to LionPlan@state.sd.us and were available in public folder for all staff to review.

Media outlets were informed of the plan through the standard press release distribution process. Press releases were sent via email to a group of over 5,000 recipients (media and customers alike) who have opted in to receive all SDGFP News (or press releases). In addition, availability of the draft plan and deadline for public comments was shared via email to all mountain lion hunting applicants from 2017 and 2018 and a postcard was mailed to all landowners who subscribe to the SDGFP Landowner's Matter Newsletter. Press release information was also shared internally with over 600 SDGFP employees and posted to all SDGFP digital platforms mentioned above as well as online at: http://gfp.sd.gov/news/default.aspx and http://news.sd.gov/.

EDUCATION AND OUTREACH

Mountain lions are a topic of interest and conversation throughout the state. SDGFP staff provide education and information in both formal and informal settings. This includes, but is not limited to, the Outdoor Campuses (Rapid City & Sioux Falls), SDGFP offices and parks, teacher trainings, and other staff presentations (e.g., a Conservation Officer presentation to a community group). While presentations occur throughout the state, they are more frequent in the western portion of the state, especially in and around the Black Hills.

In 2017, SDGFP Outdoor Campus-West staff conducted seven mountain lion class presentations for 200 people. Audiences included youth as well as college students studying at the Wheaton College Field Station. SDGFP will continue to be active in educating area residents, schools, and visitors about mountain lions. Mountain lion biology, ecology, management, behavior, and human safety/interactions will be common themes regardless of audience.

The SD-specific Project WILD mountain lion educator's guide and activities created by SDGFP in 2006 may be used to train area educators. When mountain lion sightings and/or removals occur near area schools, SDGFP will contact those schools and offer in-school education programs for the students and staff. Strategies and themes may include, but will not be limited to, those described above.

Additional education materials are provided in the form of a SDGFP brochure entitled "Living with Mountain Lions" (Appendix H). This brochure has information about mountain lions in South Dakota along with general information about the species. A hunter educational brochure entitled "Mountain Lion Identification and Methods of Determining sex and Age" has also been created to inform hunters in South Dakota about mountain lions, and to assist with field identification on sex and age (Appendix I). Both of these brochures add to the available information that SDGFP provides to the citizens and visitors of the state.

CHALLENGES AND OPPORTUNITIES

Hunting Regulations

In most western states, hunting for mountain lions is conducted by a general season method, a limited entry season, or a harvest quota system (Cougar Management Guidelines Working Group 2005). Within the Black Hills unit of South Dakota, the current mountain lion hunting season regulations follow both a general season and harvest quota system (hereafter referred to as harvest limit) to meet population objectives and maximize hunter opportunity. Mountain lion hunting licenses for residents are unlimited, and the season is currently open for approximately three months (December 26 – March 31) or until the harvest limit has been met (total harvest limit with female sub-limit). The season dates combined with the use of a total harvest limit season structure allows for maximum hunting opportunity, while the female sub-limit reduces the potential effects of harvest on the mountain lion population to ensure management objectives are being met. In South Dakota, hunters are required to monitor the hunting season status by calling a harvest limit hotline or checking the SDGFP website for current harvest numbers. Residents of South Dakota are allowed to harvest one mountain lion (either sex) per year; nonresidents are currently ineligible to hunt mountain lions in the state.

Harvest methods used for mountain lion hunting within the Black Hills unit are limited to boot hunting only (dogs are not allowed) with unlimited license availability. The primary methods used by boot hunters in the Black Hills include predator calling, tracking, and hunting over a kill site (Table 4). Although overall hunter success for boot hunters is relatively low (1.9% for active hunters in 2017/18; Huxoll 2018), mountain lion hunting is popular with 2,878 licenses sold in 2017/18. Season regulations that restrict methods to boot hunting and result in subsequent low success, have traditionally allowed SDGFP to provide unlimited hunting license opportunities while still meeting population objectives.

Custer State Park is within the Black Hills unit but has different mountain lion hunting regulations. CSP is closed to mountain lion hunting except during established hunting intervals for mountain lion licensees who possess a valid statewide mountain lion license and a temporary access permit issued free of cost. Individuals interested in hunting mountain lions within CSP must enter their name into a random drawing to obtain a free access permit to hunt mountain lions within CSP. During the period of 2012/13 - 2017/18, a yearly maximum of 162 access permits (150 boot and 12 dog) have been issued in CSP (Table 16). For the past three years, 45 access permits that do not allow the use of dogs, and 12 that do, have been issued annually in CSP. The use of dogs in CSP allows a limited number of hunters the opportunity to utilize the sport of dog hunting for mountain lions and also increases the mountain lion harvest within CSP. Although boot hunting is allowed in CSP, the majority of mountain lions harvested within CSP are with the use of dogs. In 2017/18, hunter success for those hunters using dogs in CSP was 75%, providing a limited but unique mountain lion hunting opportunity in South Dakota.

Table 16. Mountain lion hunting season information for access permits in Custer State Park, 2012/13 – 2017/18.

CSP lion Season	Total # Permits	Boot Hunting Access Permits		Dog Hunting Access Permits	
		# permits	# harvested	# permits	# harvested
2012/13	162	150	1	12	6
2013/14	136	120	1	16	8
2014/15	136	120	0	16	5
2015/16	57	45	0	12	6
2016/17	57	45	0	12	7
2017/18	57	45	0	12	9

The current hunting season structure for mountain lions on the prairie includes a general hunting season structure with unlimited license numbers, year-round season dates, and no harvest limits. Although SDGFP does not quantify the number of hunters that specifically hunt in the prairie unit, the opportunity is being utilized by hunters as reflected by the reported harvest of mountain lions on the prairie (Table 3). The current prairie season structure maximizes hunter opportunity and allows for harvest using boot hunters and hunting with dogs. Boot hunters on the prairie are comprised of opportunistic hunters that carry a mountain lion license during deer or other hunting seasons, or those that carry a license for a harvest opportunity that may arise at any time of the year. The use of dogs is also allowed year-round outside of the BHFPD on private land with the permission of the landowner or leasee. A pursuit of a mountain lion by dogs that originates on private land may cross over or culminate on property owned by the Office of School and Public Lands or the United State Bureau of Land Management other than the Fort Meade Recreation Area. Licensed hunters must accompany the dog handler when the dogs are released and must continuously participate in the hunt thereafter until the hunt is completed.

SDGFP will continue to strive to maximize hunter opportunity and meet population objectives in the Black Hills unit of the state. CSP will be managed to provide limited but unique mountain lion hunting opportunities using dogs. Harvest opportunities will be maximized in the rest of the state by allowing a more liberalized season structure. SDGFP will continue to monitor mountain lion populations in South Dakota and will continue to explore harvest options needed to manage mountain lion populations at objective levels.

Orphaned Kittens

Mountain lions can breed any time of the year. This provides the potential opportunity for a female, with kittens that are too young to accompany her when she is away from the den, to be harvested during the season. Since young mountain lions may become independent as early as 10 months old (Thompson 2009) and average dispersal age is 14-15 months (Anderson et al. 1992, Sweanor et al. 2000), yearling survival should not be influenced by the death of the adult female. Survival of orphaned young 6-12 months of age has been documented at 71% (Lindzey

et al. 1988, Logan and Sweanor 2001, Anderson and Lindzey 2003). On average 50% of adult females reproduce annually and 75% are with dependent young each year (Logan and Sweanor 2001). Therefore, 25% of adult females are without young and 25% are with yearlings. Because the number of females with kittens younger than three months of age would be a small fraction of the harvestable animals available, the loss of the kittens from hunting seasons does not affect the sustainability of mountain lion populations. In addition, survival of kittens in the Black Hills from birth to independence was documented at 67% (Thompson 2009), and at 59% (Jansen 2011) indicating that not all kittens born are recruited into the population due to natural caused mortality.

Since all mountain lions harvested during the season are subject to a mandatory check, it can be determined if a harvested female has previously lactated and/or has kittens based on nipple characteristics (Anderson and Lindzey 2000). In the Black Hills of South Dakota, 155 adult females have been harvested from 2005/06 through 2017/18, of which 22 (14%) had evidence of current lactation and thus possible kittens less than three months of age. A total of 16 kittens (six litters) were found by SDGFP staff and placed in licensed zoological parks throughout the United States.

In an attempt to even further reduce potential abandonment of kittens during the hunting season, SDGFP modified the season dates during the 2008/09 hunting season (Table 3) to the months of January – March 2009. This change appears to have decreased the percentage of harvested lactating females. During the fall hunting seasons from 2005/06 to 2007/08, 16 total adult females were harvested with six showing evidence of lactation (38%). A total of 13 kittens were recovered by SDGFP during this period. After the hunting season start dates were modified to early January or late December (2008/09 to 2017/18), only 16 of 139 (12%) adult females harvested showed evidence of lactation (12%). A total of three kittens were recovered during these seasons.

Research in the Black Hills found that although mountain lions may give birth at any time of the year, 74% of parturition occurs during the months of May through September (Jansen and Jenks 2012) (Figure 23). Data shows that of the 42 litters documented by Jansen and Jenks (2012), 14% (n=6) of the dependent young less than three months of age in the Black Hills might be affected by the current hunting season. Additionally, there was no difference detected in the survival of kittens due to the time of the year they were born.

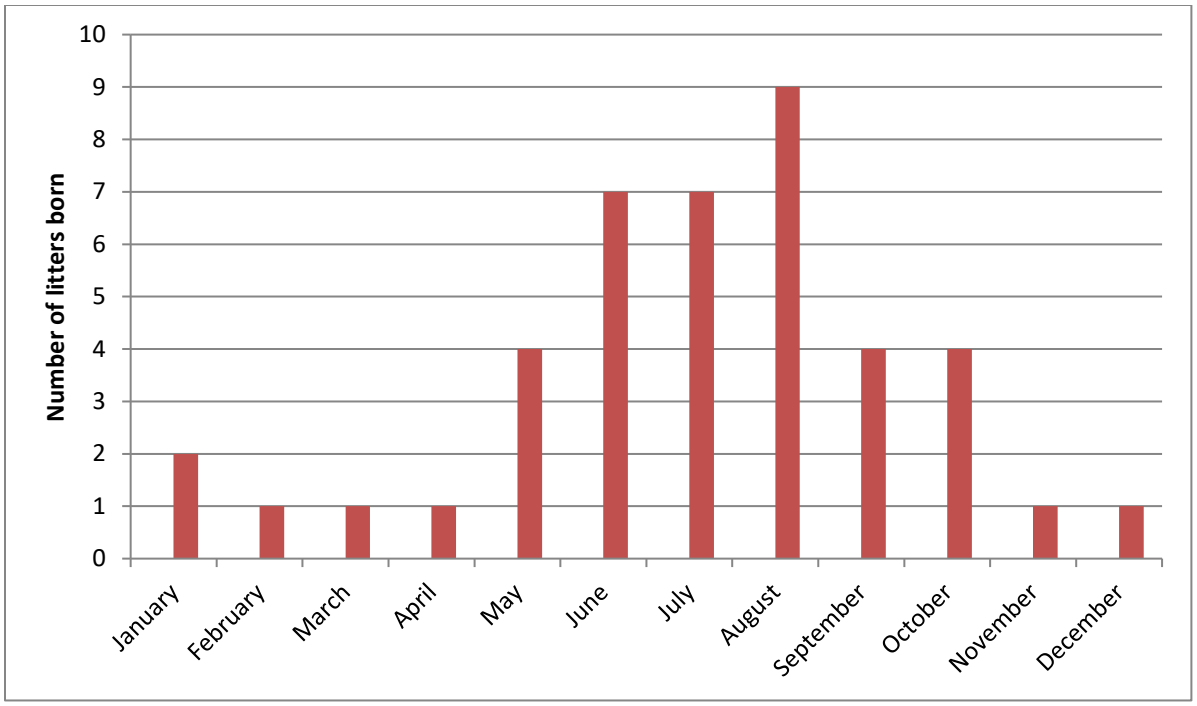

Figure 23. Number of litters born during each month from 2005 to 2009 for mountain lions in the Black Hills, South Dakota, USA (Jansen and Jenks 2012).

Protocol for Radio-Collared Mountain Lions

SDGFP has a well-established Mountain Lion Response Protocol for dealing with mountain lion sightings, encounters, incidents, and attacks (see Appendix G). Mountain lion populations are viable and productive in South Dakota and SDGFP manages mountain lion conflicts with an emphasis to minimize human safety concerns and property loss (primarily livestock/pets).

At times, SDGFP and/or collaborating Universities may capture and radio-collar mountain lions to conduct scientific research. Mountain lions are wild animals and radio-collared animals likely retain all wild and unpredictable behavior of uncollared animals. SDGFP will address human wildlife conflict situations with radio-collared and non-collared animals similarly. Radio-collars on mountain lions, however, may provide immediate or near real-time data (e.g., location data) from VHF or GPS signals which presents additional considerations and potential responsibilities. In addition to using the criteria found in the response protocol, SDGFP and cooperating university research staff, along with SDGFP management staff, will collaborate closely to evaluate any location data obtained from radio-collared mountain lions.

In situations where telemetry data suggest a potential conflict may occur with a radio-collared mountain lion, research and management staff will discuss and evaluate the situation daily or as needed. Potential conflict areas may include but are not limited to residential areas, human recreation areas, and areas where children are regularly concentrated. If telemetry data suggest that the radio-collared mountain lion is a potential threat to human safety,

management and research staff will discuss the disposition on the animal. Efforts may be made to notify the appropriate publics of the mountain lion's proximity and/or provide them with educational information such as the brochure "Living with Mountain Lions" (Appendix H).

Lethal removal will occur if deemed necessary to address human safety concerns. In situations involving potential or realized livestock/pet depredations, research and management staff will discuss lethal and nonlethal options. If cause of livestock/pet depredation has been verified as mountain lion (radio-collared), research and/or management staff will contact the landowner to discuss the situation and determine if some resolution short of lethal removal of the mountain lion is acceptable to the landowner.

Opposing Viewpoints

With the management of charismatic predatory species such as mountain lions comes a substantially heightened interest from certain stakeholders with substantially different and opposing viewpoints. Lethal control and management of wildlife is a philosophical debate with opposing and polarizing viewpoints (Rowlands 1998, Taylor 2009, Laverty 2018). For example, one group may oppose all lethal control of non-human animals and value animal rights similar to those of human beings (Rowlands 1998, Taylor 2009). An opposing viewpoint may support any lethal means necessary for mitigating threats posed by wildlife to human safety, pets, or livestock, regardless of the risk to population viability of the species. Extreme viewpoints can result in organized efforts to hinder science-based, objective management of wildlife, with a goal to move policy decisions away from governmental agencies tasked with managing wildlife as a public trust, and into the hands of the courts (Laverty 2018). Conflict over wildlife policies and management decisions has included adversarial tactics such as demonstrations, protests, appeals, and litigation (Laverty 2018). Mountain lion management is subject to this conflict, which is why SDGFP emphasizes the need for reliable research and information used to effectively manage wildlife populations and understand stakeholder opinions, in addition to engaging stakeholder groups.

Support for lethal control of mountain lions in the Black Hills of South Dakota is based on research supporting the use of regulated hunting seasons to maintain a healthy, stable population of mountain lions while providing recreational opportunity. Further, based on stakeholder opinion surveys, there was general support for hunting as a tool to manage mountain lions in South Dakota and provide recreational opportunity (Gigliotti 2005b, Gigliotti 2010b). In spite of general stakeholder support for mountain lion hunting in South Dakota, the implementation of a hunting season was controversial, and involved extensive public input and a court challenge shortly before the modern hunting season was initiated (Leif 2006; Gigliotti 2005b). As a result of this challenge, SDGFP Division of Wildlife conducted an e-mail survey of citizens' attitude towards the mountain lion season. Results indicated most residents (69%) supported the current season or were neutral (5%), and 26% were opposed (Gigliotti and Teel 2008). Further, SDGFP strives to engage the public through collaboration and partnerships, which can have significant positive impacts on wildlife policy and management decision making processes (Cubbage et al. 2017).

Human Safety and Conflict Management

With increasing human populations and encroachment of residential areas into mountain lion habitat within the Black Hills, the probability of humans encountering a mountain lion in an urban setting has increased. The Department does not encourage mountain lions inhabiting urban areas. There are a number of recommendations that will reduce the risk of problems with mountain lions in urban areas and help humans coexist with these large carnivores. Some examples of these recommendations are: do not feed wildlife, closely supervise children when they are outdoors, and keep pets under control. The Department offers a brochure titled "Living with Mountain Lions" (Appendix H) that provides a complete list of recommendations and other information about mountain lions in South Dakota.

People who encounter mountain lions are encouraged to report the events to Department staff. Reports range from mistaken identification (e.g., domestic dogs or cats), to verified mountain lion sign (e.g., tracks or kills), to sightings of mountain lions, to attacks on pets or livestock or close human encounters with mountain lions. There has been one reported attack on a human by a mountain lion in South Dakota that was classified as probable but unverified by SDGFP. The probability does exist in South Dakota for an attack on a human causing serious injury or death, however, the probability is extremely low. Under SDCL § 41-6-29, game animals may be removed to alleviate damage to property or to protect human health.

In 1995, SDGFP developed and adopted response goals for dealing with mountain lion/human encounters. Over the years, this response plan (Appendix G) has been revised to include experience and techniques learned from previous responses and results from research. All reports of mountain lions will be documented by Department personnel.

Predation/Conflicts with Ungulate Management

Understanding the relationship predators have on ungulate populations is essential to proper game management. Predator-prey dynamics are impacted by a multitude of variables such as changes in habitat quality and quantity, stochastic weather events, foraging competition with other ungulates, predator species and densities, abundance of alternate prey and harvest strategies. Managing predators to increase ungulate populations is a complex issue and encompasses many factors that must be evaluated to determine the effects of predation on ungulate recruitment and population growth.

There are multiple predators in South Dakota that may affect ungulate populations. Coyotes, mountain lions, and to a lesser extent, bobcats and domestic dogs (*Canis lupus familiaris*), are the primary predators of deer (Gerads et al. 2001, Schmitz 2006, Thompson et al. 2009). Within the Black Hills of South Dakota, mountain lions, coyotes and bobcats prey on adult and calf elk (Lehman 2015).

Mountain lions are native to South Dakota and primarily occupy areas in and around the Black Hills but may occasionally travel through other parts of the state. Mountain lions are obligate carnivores that consume deer-sized prey throughout their range in the western hemisphere (Sweanor et al. 2000), and deer are the major prey source of mountain lions in North America (Anderson 1983). In an effort to better understand the feeding habits of mountain lions occupying the Black Hills, along with quantifying prey selection and kill rates, 41 mountain lions (29 female; 12 males) were captured and collared throughout the Black Hills with GPS technology from 2009-2012. Over 5,500 cluster locations (i.e., potential feeding sites) were investigated, of which 1,506 were feeding sites (kills = 1,246; scavenge = 260). Results indicated that deer comprised the majority of mountain lion diets (83%; Smith 2014) in the Black Hills of South Dakota. The most common prey species, when identifiable, was white-tailed deer (62.9%), elk (5.5%), mule deer (3.7%), and bighorn sheep (0.6%). Ungulates dominated diets of mountain lions in all months (Smith 2014). Scavenged prey made up 17.3% of mountain lion diets in terms of relative frequency with higher rates observed in winter ($\bar{x}$ = 0.21 events/week) than in summer ($\bar{x}$ = 0.08 events/week) (Smith 2014).

From 1998-2003, 81 adult white-tailed deer were collared in the Black Hills (66 females; 15 males). Natural causes of mortality among white tailed deer accounted for 72% of all mortalities. Coyotes were among the top predators of white-tailed deer totaling half of all natural mortality cases (36%, n=18), while mountain lions accounted for two mortalities of white tailed deer in the southern Black Hills (4%, n=2). The majority of female white-tailed deer mortality events (50%, n=25) occurred in the spring when breeding age females were in late gestational stages of pregnancy (Griffin et al. 1994, Griffin et al. 1999). From 1999-2001, 21 adult female mule deer were collared in the southern Black Hills. Predation accounted for 69% (n=11) of the total mortalities. Of the 11 mortalities, evidence suggested mountain lions were responsible for nine mortalities and canid species accounted for the other two mortalities. Smith (2014) determined that kill rates of mountain lions averaged 0.79 ungulates/week (95% CI = 0.70-0.88) and varied significantly among individuals (range = 0.13-1.75 ungulates/week) and season (e.g., summer, $\dot{x}$=0.92 ungulates/week; winter, $\dot{x}$=0.62 ungulates/week). Annual kill rates averaged 52 ungulates killed for females with kittens >six months, 42 for females with kittens <six months, 39 for adult females, 38 for sub-adult males, 35 for adult males and 33 for sub-adult females (Smith 2014). Juvenile animals made up >55% of a mountain lion diet. Mountain lions selected for neonates in June (75%) and July (82%) and into August (51%). Mountain lions may kill more juvenile ungulates to keep up with the biomass loss from lack of consuming adult ungulates.

Many studies (Hornocker 1970, Logan et al. 1996, Kunkel et al. 1999) have found that mountain lions target the most vulnerable individuals in a population (e.g., old, young, or malnourished), suggesting mountain lion predation may not always be an additive source of mortality (Bishop et al. 2009). Logan et al. (1996) suggested that the mountain lion birth pulse in the spring coincides with the fawning season, conferring survival advantages through the abundance of vulnerable prey. Furthermore, Knopff (2010) observed that mountain lions shifted prey composition seasonally as predicted by the juvenile and reproductive vulnerability hypotheses. Surprisingly, several studies (Robinette et al. 1959, Hornocker 1970) have reported mountain

lions targeting bucks relatively more than does, regardless of age or physical condition, attributing the difference to an increased vulnerability of bucks as a result of sexual segregation in resource selection, especially after the rut; however, Logan et al. (1996) suggested that these results may be the result of inherent biases in the way deer populations and mountain lion kills were sampled.

Even though predation rates may not be high enough in a particular area to significantly affect deer population performance by itself, when added to the other sources of mortality caused by hunting, weather, accidents, drowning, etc., predation may have a significant impact (Mech 1984). Because predator management may or may not increase deer population abundance, managers must consider all factors in determining whether predator management is appropriate and prescribe an effective predator management plan if justified.

In assessing the total amount of mortality due to predators, coyotes have the greatest potential impact on deer populations within South Dakota (Young and Goldman 1946). Predation occurs across all age classes of deer and throughout all seasons (Compton 1980, MacCracken and Hansen 1982, Turner et al. 2011), although fawns and aging deer are more vulnerable to predation than healthy young adult deer (Nelson and Mech 1990, Grovenburg et al. 2012).

Understanding the relationship predators have on elk populations is essential to proper management. Numerous studies throughout the elk range in North America have investigated predator interactions with elk and their impacts on elk recruitment and population growth. For example, Griffin et al. (2011) investigated 3-month calf survival across 12 elk populations in the north-western United States encompassing three, four and five predator systems (e.g., mountain lions, coyotes, black bears, grizzly bears and wolves). A total of 1,999 radio-marked calves were included in the analysis and results indicated that average 3-month survival decreased as the number of predator species in the system increased (i.e., 65% (SE = 0.01) three predators, 55% (SE = 0.03) four predators, 50% (SE = 0.03) five predator systems). Of the 671 mortalities documented throughout the study, 70% occurred in the first 30 days. Another collaborative analysis including 2,746 radio-collared adult female elk occupying western North America documented 1,058 mortalities, of which the largest mortality factors were hunter harvest (54.8% of all mortalities) and predation (wolf and mountain lion, 12.8%; Brodie et al. 2013).

Mountain lion predation occurs on all age classes and throughout the year, while coyote and bobcat predation occur on newborn calves in early spring (Griffin et al. 2011). Numerous research projects investigating the impacts predators, especially mountain lions, have on elk occupying the Black Hills have been conducted. From 1 January 2007 - 1 May 2010, 105 adult elk (76 females, 29 males) were monitored throughout the Black Hills of South Dakota. Sixty-seven mortalities were documented throughout the duration of the study, of which eight were determined to be caused by mountain lions (11.9%). Hunters accounted for 77% of total mortality during this study (Schmitz 2011). From 2005 - 2009, 202 elk (83 sub-adult males and 119 sub-adult/adult females) were fitted with global positioning system (GPS) collars within Wind Cave National Park (WICA). Twenty-eight mortality events were documented involving

collared individuals throughout the course of the study and six (21.4%) were attributed to mountain lion predation (Sargeant et al. 2011). In addition, Smith (2014) noted that CWD infected elk potentially have an increased risk to predation. From December 2011 to April 2012, elk kills (*n*=14) from two GPS collared mountain lions (one male; one female) occupying WICA were tested for CWD. Nine of the 14 (64%; 95% CI = 50.3 - 78.3%) elk were positive for CWD.

From 2011 - 2013, Lehman (2015) captured and radio-collared 58 female elk ≥ two years of age and 125 calves during the parturition season in the southeastern Black Hills. Throughout the study, 18 adult mortality events were documented, of which five (27.8%) were attributed to mountain lion predation. It was estimated that 4% (95% CI; 0.01 – 0.08) of all radio-collared adult female elk occupying the study area were predated by mountain lions. Mountain lion predation accounted for 81% (*n* = 59) of all documented calf mortalities and coyote and bobcat predation accounted for 10% (n =7) and 1.4 % (n = 1), respectively. Overall predation accounted for 93% of all documented calf mortalities throughout the three years. In summary, 63% (95% CI; 0.51 – 0.76) of all radio-collared calves occupying the southeastern Black Hills were predated by mountain lions (Lehman 2015).

In a similar study conducted in the west-central Black Hills, Simpson (2015) radio-collared 40 female elk ≥ two years of age and 37 calves in 2012, and nine additional female elk ≥ two years of age and 34 calves in 2013. Throughout the duration of the study, 13 adult cow elk mortalities were documented; 15.4% (*n* = 2) were caused by mountain lions, 54% (*n* =7) were caused by hunter harvest. It was estimated that 2.3% (95% CI; 0.00 – 0.06) of all radio-collared adult female elk occupying the west-central portion of the Black Hills were predated by mountain lions. Furthermore, 16 calf mortalities were documented throughout the two years and mountain lion caused mortality was 75% (*n* =12). In summary, 17% (95% CI; 0.08 – 0.26) of all radio-collared calves occupying the west-central Black Hills were predated by mountain lions. This study did not document any confirmed mortality events caused by coyote or bobcat (Simpson 2015).

Significant differences in average annual calf survival were documented between the Lehman (2015) (i.e., 21%; SE = 0.04) and Simpson (2015) (i.e., 75%; SE = 0.03) study areas. Mortality rates caused by mountain lions were also significantly different (southeastern Black Hills-63%; west-central Black Hills-17%). In summary, research findings indicate that mountain lion predation is not a limiting factor on cow elk survival; however, mountain lion predation does appear to be a limiting factor on calf survival in specific geographic areas within the Black Hills. Ballard et al. (2001) explains when ungulate populations are well below carrying capacity, additional mortality sources are likely additive. As a result, liberal mountain lion hunting season structure and methods were implemented in the southeastern Black Hills as an effort to potentially increase elk calf survival.

Coyote and bobcat predation on elk calves within the Black Hills appears to be limited, typically occurring in the first 30-days of life (Lehman 2015, Simpson 2015). In the southeastern Black Hills collared calf (*n*=125) mortality rates caused by coyotes and bobcats were 6% (*n* = 7; 95%

CI: 0.0 – 0.13) and 1.5% (*n*=1; 95% CI: 0.0 – 0.06), respectively (Lehman 2015). No mortality events caused by coyotes or bobcats involving adult elk have been documented within the Black Hills (Simpson 2015). Thus, research findings suggest coyote and bobcat populations have minimal impacts on elk populations.

In summary, determining if predation is a limiting factor can be extremely difficult because predator-prey dynamics are complex situations and recruitment and adult survival of primarily deer and elk is likely dependent on a combination of multiple factors. If predation is discovered to be a limiting factor, developing solutions to benefit ungulate populations requires adaptive management strategies, where effective monitoring allows managers to learn and adjust management through time.

Ballard et al. (2003) emphasizes the following guidelines for determining if a more aggressive approach in predator management would likely increase deer and or elk populations:

- Deer or elk populations are below the habitat's carrying capacity
- Predation identified as a major cause of mortality
- Populations of alternative prey species are limited
- Predator management efforts must be targeted and result in a significant decline in predator numbers
- Predator management efforts are focused within a geographic area (e.g., <400 mi.2)
- Predator management efforts are timed just prior to predator and/or prey reproductive periods

The Black Hills of South Dakota are not occupied by breeding populations of wolves and/or bears, resulting in the potential to manage the impacts of predation on deer and elk populations more effectively. In the Black Hills of South Dakota, the primary non-human predators of deer are coyotes and mountain lions and the amount to which they influence deer population growth rates remains largely unknown. The primary non-human predator of elk (mainly calves) are mountain lions and continued monitoring is necessary to ensure predation does not become a limiting factor and predator management strategies need to be adjusted accordingly.

Population Objectives

During the development of the first South Dakota Mountain Lion Management Plan (SDGFP 2013), many decision-making alternatives were taken into consideration to determine that a population objective of 150-200 mountain lions would be reasonable goal. This original objective has served a meaningful purpose from which to evaluate management strategies and hunting season regulations. Over time, and since the development of the first South Dakota Mountain Lion Management Plan (SDGFP 2013), SDGFP has evaluated this goal in relation to mountain lion abundance estimates, livestock depredation issues, human safety and conflict issues, mountain lion removals, mountain lion vehicle strikes, mountain lion observations, multiple population trend indices, prey species abundance and growth rates, and substantial

input from a wide variety of publics with an interest in mountain lion management in South Dakota. Upon further consideration of all biological and social data available, the population objective for mountain lions has been adjusted during the revision of the mountain lion management plan.

The adjusted population objective of 200-300 mountain lions in the Black Hills ecosystem of South Dakota will be used and evaluated over the next 10 years (Figure 15). Managing the population at this level will allow for the continuation of an annual harvest on mountain lions. This population level will maintain a genetically and nutritionally healthy population of mountain lions and fulfills a broad range of public input and desires. According to a recent survey conducted by Longmire (2019), 39% of South Dakota residents would like to see the Black Hills mountain lion population remain at the current level and 10% thought it should decrease slightly. Adjusting the population objective to 200-300 mountain lions will better align population management and public opinion with actual mountain lion abundance and trend assessments. This new mountain lion objective range will also be evaluated alongside established population objectives for ungulates in the Black Hills (e.g., deer and elk), but current abundance and trend evaluations suggest both mountain lion and ungulate goals can be obtained in the Black Hills.

Prairie Mountain Lion Management

Dispersal of mountain lions onto the prairies of South Dakota is well documented with both male and female mountain lions leaving the Black Hills (Thompson 2009, SDGFP unpublished). However, to date there has been no documentation of any radio-collared mountain lion from the Black Hills of South Dakota establishing a home range on the prairie in South Dakota, indicating the prairies South Dakota have a limited capacity to support mountain lions. Marked and/or unmarked sub-adult mountain lions have generally traversed these prairies traveling to the north (North Dakota to Saskatchewan), south (Nebraska and Oklahoma), west (Wyoming and Montana), and east (Minnesota and Wisconsin).

SDGFP has documented 111 mountain lion mortalities outside of the Black Hills through hunter harvest (55), public removals (20), SDGFP removals (16), vehicle kills (8), incidental (5), and other mortalities (7) (Figure 24). Additionally, SDGFP has verified 132 sightings outside of the Black Hills (Figure 25). The majority of mountain lions that have been documented outside of the Black Hills were young male mountain lions dispersing to new areas. Documentation of reproduction on the prairie was confirmed by SDGFP in December of 2014 when a female mountain lion harvested in Mellette County showed evidence of lactation. Since 2014, three more adult females showing evidence of lactation have been confirmed by SDGFP outside of the Black Hills (two in Bennett County, one in Oglala Lakota County). This indicates that there is limited breeding activity in areas outside of the Black Hills of South Dakota. Incidentally, an additional lactating adult female was harvested in 2005 on the prairie, but this animal had been previously declawed and thus determined to be an escaped captive animal.

Population objectives for mountain lions on the prairie habitats of South Dakota have not been

established as these areas are managed primarily to abate potential livestock losses on private property, minimize human conflicts, and maximize hunter opportunity. The current hunting season structure for mountain lions on the prairie includes unlimited license numbers, year-round season dates, and no harvest limits. This season structure maximizes hunter opportunity and allows for harvest using boot hunters and hunting with dogs.

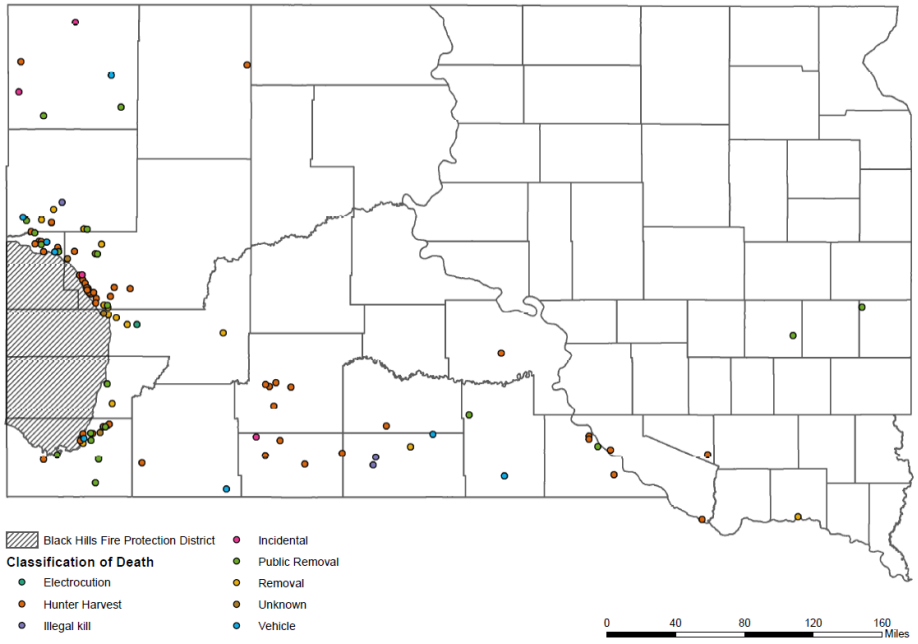

Figure 24. SDGFP documented mountain lion mortalities (N = 111), outside of the Black Hills, 2000/01 to 2017/18.

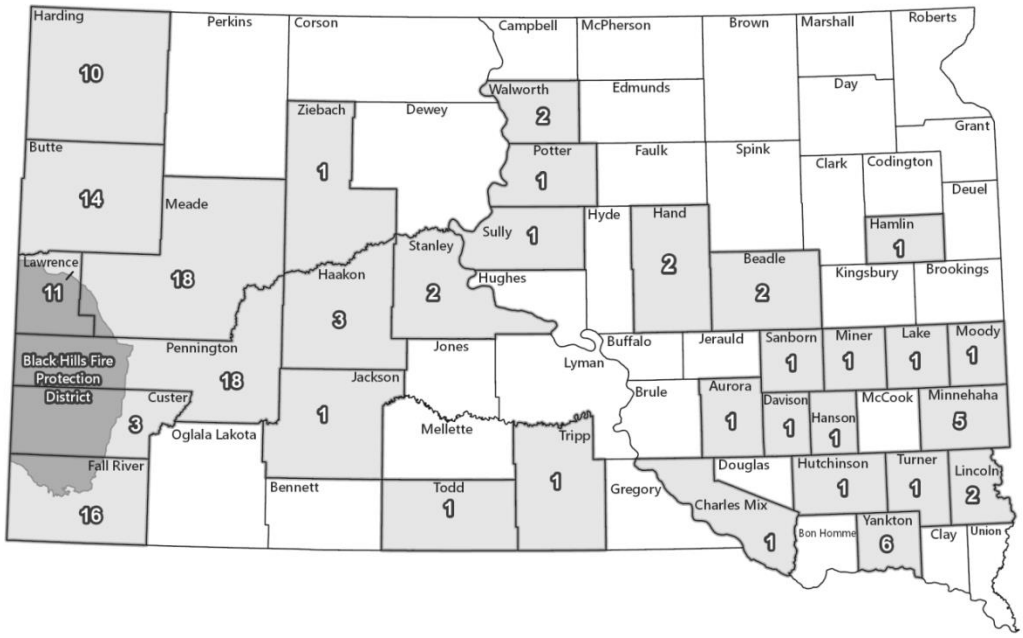

Figure 25. SDGFP verified mountain lion sightings in each South Dakota county (N = 132), outside of the Black Hills, 2005/06 to 2017/18.

GOALS, OBJECTIVES & STRATEGIES

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

- that wildlife, including mountain lions, contributes significantly to the quality of life in South Dakota and therefore must be sustained for future generations.
- that mountain lions play an important role in the ecosystem.
- in providing for and sustaining the diversity of our wildlife heritage for present and future generations.
- in management of mountain lions in accordance with biologically sound principles while considering social tolerances.
- that having mountain lions in South Dakota requires SDGFP to implement education and public involvement strategies related to safely living with mountain lions.
- in providing accurate and timely information to the public concerning mountain lions and associated recreational opportunities in South Dakota.
- that the future of mountain lions in South Dakota depends on a public that appreciates, understands and supports mountain lions and their habitats.

Population Goals

The SDGFP will manage mountain lion 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 Black Hills population objective is 200-300 total mountain lions, but actual population abundance may range depending on a multitude of factors such as mountain lion vital rates, prey species population densities, mortality factors, public input, and the precision and accuracy of biological monitoring. This population objective range was developed and updated after thorough analyses of mountain lion population data, prey availability, recreational opportunities, livestock depredation issues, human safety and conflict issues, and substantial input from a wide variety of publics with an interest in mountain lion management in South Dakota. SDGFP will adopt harvest strategies that will allow the mountain lion population to stay within the objective range.

Population objectives for mountain lions on the prairie habitats of South Dakota have not been established. Survey data are lacking for mountain lions on the prairie and these areas are managed primarily to abate potential livestock losses on private property while at the same time to provide recreational hunting opportunity.

The SDGFP will manage mountain lion populations and habitats by fostering partnerships and stewardship and applying biological and social sciences.

Objectives and Strategies

<u>Objective 1:</u> Monitor and assess mountain lion populations by conducting scientifically based biological surveys within South Dakota.

Strategy 1A. Annually survey licensed mountain lion hunters to estimate hunter success, hunter satisfaction, harvest, and percentage of active hunters.

Strategy 1B. Annually conduct mandatory checks for all harvested mountain lions to collect and assess harvest distribution, sex and age of harvested animals, hunting methods, and other biological data as needed.

Strategy 1C. Annually collect data on all documented mountain lion mortalities to assess mortality densities and trends.

1. Work with Native American Tribes to collect and share mortality data across jurisdictional boundaries.

Strategy 1D. Complete surveys to estimate abundance of mountain lion population in the Black Hills.
1. Evaluate need to estimate population abundance in managing mountain lions in South Dakota.
2. Evaluate frequency needed to conduct abundance surveys.

Strategy 1E. Annually collect mountain lion observations to assess trends and potential conflict situations.

Strategy 1F. Annually complete mountain lion population modeling.
1. Develop integrated population modeling program for mountain lions.

Strategy 1G. Continue to evaluate alternative population abundance and trend indices.

<u>Objective 2:</u> Manage mountain lion populations for both maximum and quality recreational hunting opportunities, considering all social and biological inputs.

Strategy 2A. Manage for a sustainable population of mountain lions within the Black Hills of South Dakota.
1. Hunting seasons will be structured primarily to allow for maximum hunting opportunities using boot hunters.
2. The winter population objective will be 200-300 total mountain lions.
   a. Develop alternative population threshold (s) as necessary.

Strategy 2B. Manage mountain lions in Custer State Park (CSP) primarily for hunting opportunities using dogs.

Strategy 2C. Collect scientific-based public input from hunters, landowners, and the general public during every management plan revision to assess public perceptions regarding mountain lion management, better define social tolerance levels, and re-evaluate objectives and strategies.

Strategy 2D. Mountain lions outside the BHFPD will be regulated with a year-round season, with an emphasis of maximizing hunter opportunity and minimizing potential mountain lion conflicts.

Strategy 2E. Provide the public with access to public land for quality mountain lion hunting opportunities.

Strategy 2F. Collaborate with interested individuals, non-governmental organizations, academic institutions, local sportsman's groups, livestock and agriculture organizations, private landowners, Tribal and other government agencies within South Dakota, and surrounding State agencies of Iowa, Minnesota, Montana, Nebraska, North Dakota, and Wyoming on mountain lion management.

<u>Objective 3:</u> Cooperatively work with private landowners, municipalities, and the general public to resolve mountain lion depredation to livestock, human safety concerns, and urban mountain lion conflicts.

Strategy 3A. Continue to document and respond to all mountain lion depredation and human safety concerns in a timely manner.

Strategy 3B. Educate the public on the potential for increased mountain lion human safety issues from feeding deer and other wildlife.

Strategy 3C. Explore new management techniques whenever possible that could minimize depredation on livestock and human safety issues caused by mountain lions.

Strategy 3D. Utilize mountain lion kill permit authority (see *Depredation Management* section) when warranted, to address mountain lion depredation and human safety concerns.

Strategy 3E. Expand hunting opportunities where/when possible to address mountain lion depredation on private lands.

Strategy 3F. Meet with interested municipalities to discuss urban mountain lion management and related issues such as urban deer management.

Strategy 3G. Provide technical advice and assistance to municipalities regarding mountain lion-human conflicts.

Strategy 3H. Continue to provide resources and support necessary to address mountain lion depredation and human safety issues.

<u>Objective 4:</u> Monitor and evaluate risk and impact of disease in mountain lions in South Dakota.

Strategy 4A. Investigate and collect biological samples from reported or observed sick and/or dead mountain lions demonstrating symptoms of concern and document in the SDGFP Wildlife Disease Database.

Strategy 4B. Monitor mountain lion disease by collecting and sampling voluntary hunter submissions as needed.

<u>Objective 5:</u> Evaluate mountain lion research and management needs.

Strategy 5A. Annually collaborate with public and agency stakeholders to collect and assess research and management needs.

Strategy 5B. Periodically review mountain lion survey protocols and discuss changes that could improve data collection efficiency and quality.

1. Complete a cost:benefit analysis on additional sampling or surveying techniques that could improve the precision and/or accuracy of mountain lion population modeling.

Strategy 5C. Formally evaluate the mountain lion Management Plan at least every ten

years. Plan updates and changes, however, may occur more frequently as needed.

Strategy 5D. Meet and discuss mountain lion management issues and strategies with other mid-western and western states' biologists by attending the Western States Mountain Lion Workshop.

<u>Objective 6:</u> Promote public, landowner, and conservation agency awareness of mountain lion management needs and challenges.

Strategy 6A. By October of 2019, make available paper and electronic copies of "Mountain lion Management Plan for South Dakota, 2019-2029" to all interested conservation partners and the public.

Strategy 6B. Periodically include articles about mountain lions and associated information in the South Dakota Conservation Digest and other popular magazines, journals, and media outlets.

Strategy 6C. Periodically review and evaluate the South Dakota mountain lion brochure "Living with Mountain Lions" and update as needed.

Strategy 6D. Continue to provide mountain lion programs and presentations through the school systems and to other public and civic groups.

Strategy 6E. Continue to educate the public on mountain lions through the Project Wild and other education programs.

Strategy 6F. Maintain and update as necessary the SDGFP web page with a mountain lion section.

Strategy 6G. Continue to provide mountain lion hunters with informational document to assist in the correct identification of mountain lions ("Mountain Lion Identification and Methods of Determining Sex and Age").

Strategy 6H. Produce a biennial report on the status of mountain lions in South Dakota.

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APPENDIX

Appendix A. Harvested mountain lion inspection form.

MOUNTAIN LION INSPECTION FORM

Harvest ID #: _____ Date: _____ Personnel: _____

Hunter Name: _____ Tag #: _____

Weapon: _____ Date of Harvest: _____

Location of Harvest: _____

Hunting Method: _____

Hounds used: [y] [n] Houndsman name: _____

Days Hunted: _____ # Mountain Lions Observed: _____

Sex: _____ Estimated Age: _____ Weight (lbs): _____

Female: Lactating [ ] Has Lactated [ ] Has Not Lactated [ ]

Pelage Description:_____

Teeth Description: _____

Samples Collected: Tissue Standard [ ] Tissue Large Vial [ ]

Marked: [y] [n] ID/Ear Tag/Tattoos: _____

Collar Frequency: _____

Comments: _____

_____

_____

Appendix B. Black Hills Mountain Lion Survey, 2018.

2018 BLACK HILLS MOUNTAIN LION SURVEY

Dear Hunter:

Our records indicate you purchased a South Dakota mountain lion hunting license for 2018. The 2018 season within the Black Hills Fire Protection District closed March 31st. The purpose of this survey is to collect information about your hunting experiences and general opinions about mountain lion management in South Dakota. This information is collected every year as an evaluation of the mountain lion season from the hunters' perspectives, and is important in making future decisions about the Black Hills mountain lion season.

PLEASE RESPOND at your earliest convenience. Our goal is to receive a response from each survey recipient. Thanks to you, we believe we have one of the most accurate harvest surveys in the nation.

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

2018 BLACK HILLS MOUNTAIN LION SURVEY

This survey only pertains to the 2018 mountain lion hunting season within the Black Hills Fire Protection District (December 26 to March 31), excluding Custer State Park

1. Did you hunt the 2018 South Dakota Black Hills mountain lion season, excluding Custer State Park (December 26 to March 31, 2018)?
   - ☐ NO – Skip to Q4
   - ☐ YES
2. How many days did you hunt mountain lions in the Black Hills during the 2018 season: _____ days
3. Did you harvest a mountain lion in the Black Hills during the 2018 season?
   - ☐ NO
   - ☐ YES
4. How satisfied/dissatisfied were you with the Black Hills mountain lion season as conducted in 2018? *Please circle one:*

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

5. Over the next 5 years, would you prefer to see the mountain lion population in South Dakota... *Please circle one:*

Decrease A Lot	Decrease A Little	Stay About The Same	Increase A Little	Increase A Lot	Not Sure
1	2	3	4	5	6

SOUTH DAKOTA Game, Fish & Parks

gfp.sd.gov/hunt-surveys

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

Appendix C. Custer State Park mountain lion hunting access permit survey, 2018.

Dear Hunter,

Our records indicate you purchased a South Dakota mountain lion hunting license for 2018, and received a Custer State Park mountain lion hunting access permit. The 2018 season within the Black Hills Fire Protection District and Custer State Park closed March 31st. The purpose of this survey is to collect information about your hunting experiences and general opinions about mountain lion management in South Dakota. This information is collected every year as an evaluation of the mountain lion season from the hunters' perspectives. The information you provide is important in making future decisions about the Black Hills and Custer State Park mountain lion seasons.

Please take a few minutes to answer this short survey and return it using the pre-paid envelope provided. The ID number on your survey is used to identify hunters who have responded so we can check your name off the mailing list when you return your survey.

1. Did you spend any time hunting for mountain lions within the Black Hills Fire Protection District, *excluding* Custer State Park, during the 2018 Black Hills season?

☐ Yes, how many days did you hunt for mountain lions? _____ Days

☐ No ⟹ **If NO, please skip to question 3.**

2. Did you harvest a mountain lion in the Black Hills, not including Custer State Park, during the 2018 season?

☐ No

☐ Yes

3. Did you spend any time hunting for mountain lions in Custer State Park during the 2018 season?

☐ Yes, how many days did you hunt for mountain lions in CSP? _____ Days

☐ No ⟹ **If NO, please skip to question 6.**

4. Did you use hounds while hunting mountain lions in Custer State Park during the 2018 season?

☐ No

☐ Yes

5. Did you harvest a mountain lion in Custer State Park during the 2018 season?

☐ No

☐ Yes

6. How satisfied or dissatisfied were you with the Black Hills mountain lion season, *excluding* Custer State Park, as conducted in 2018? *Please circle only one response.*

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

7. How satisfied or dissatisfied were you with the structure of the Custer State Park mountain lion season as conducted in 2018? *Please circle only one response.*

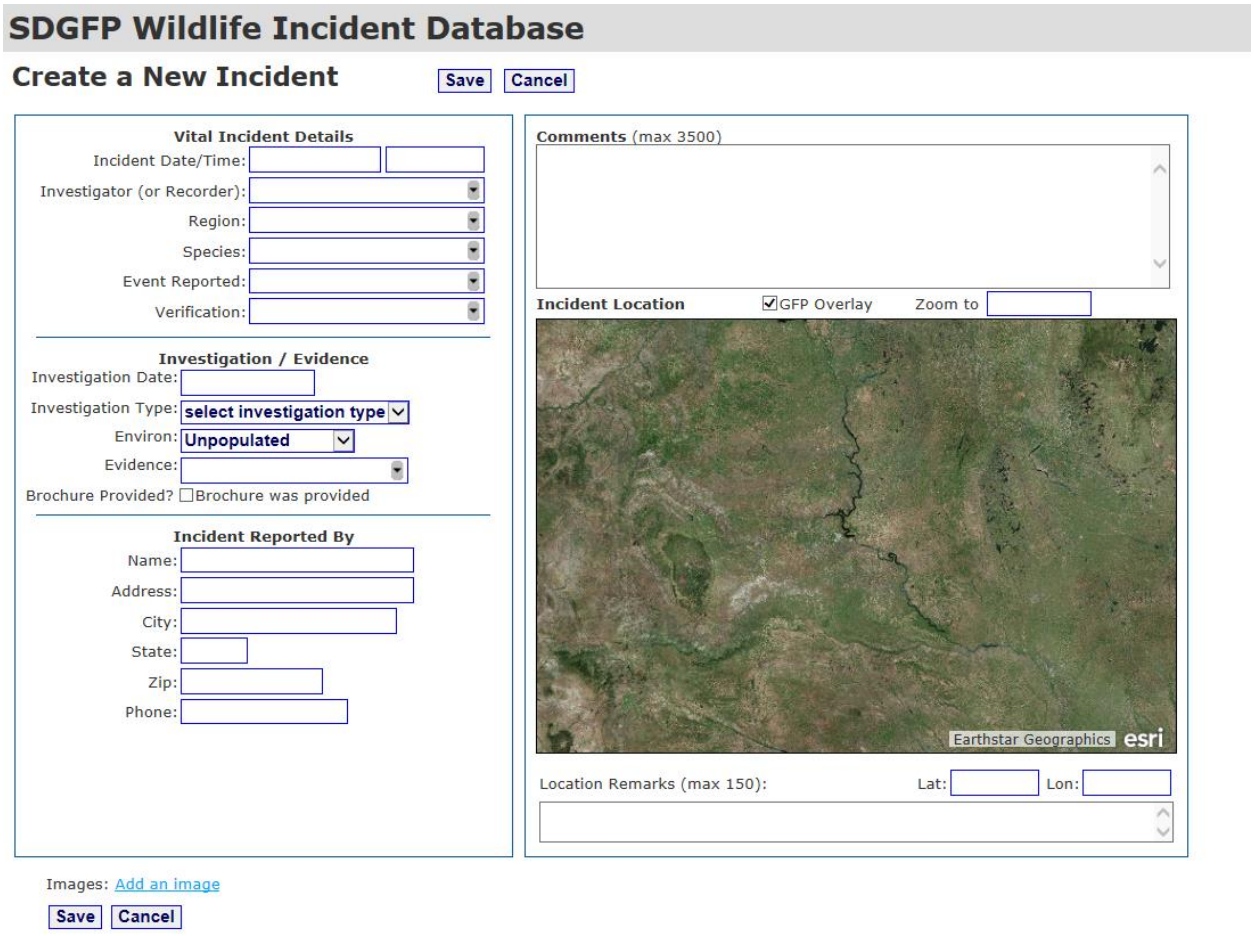
Very Dissatisfied	Moderately Dissatisfied	Slightly Dissatisfied	Neutral	Slightly Satisfied	Moderately Satisfied	Very Satisfied
1	2	3	4	5	6	7

8. Over the next five years, would you prefer to see the mountain lion population in South Dakota... *Please circle only one.*

Decrease A Lot	Decrease A Little	Stay About The Same	Increase A Little	Increase A Lot	Not Sure
1	2	3	4	5	6

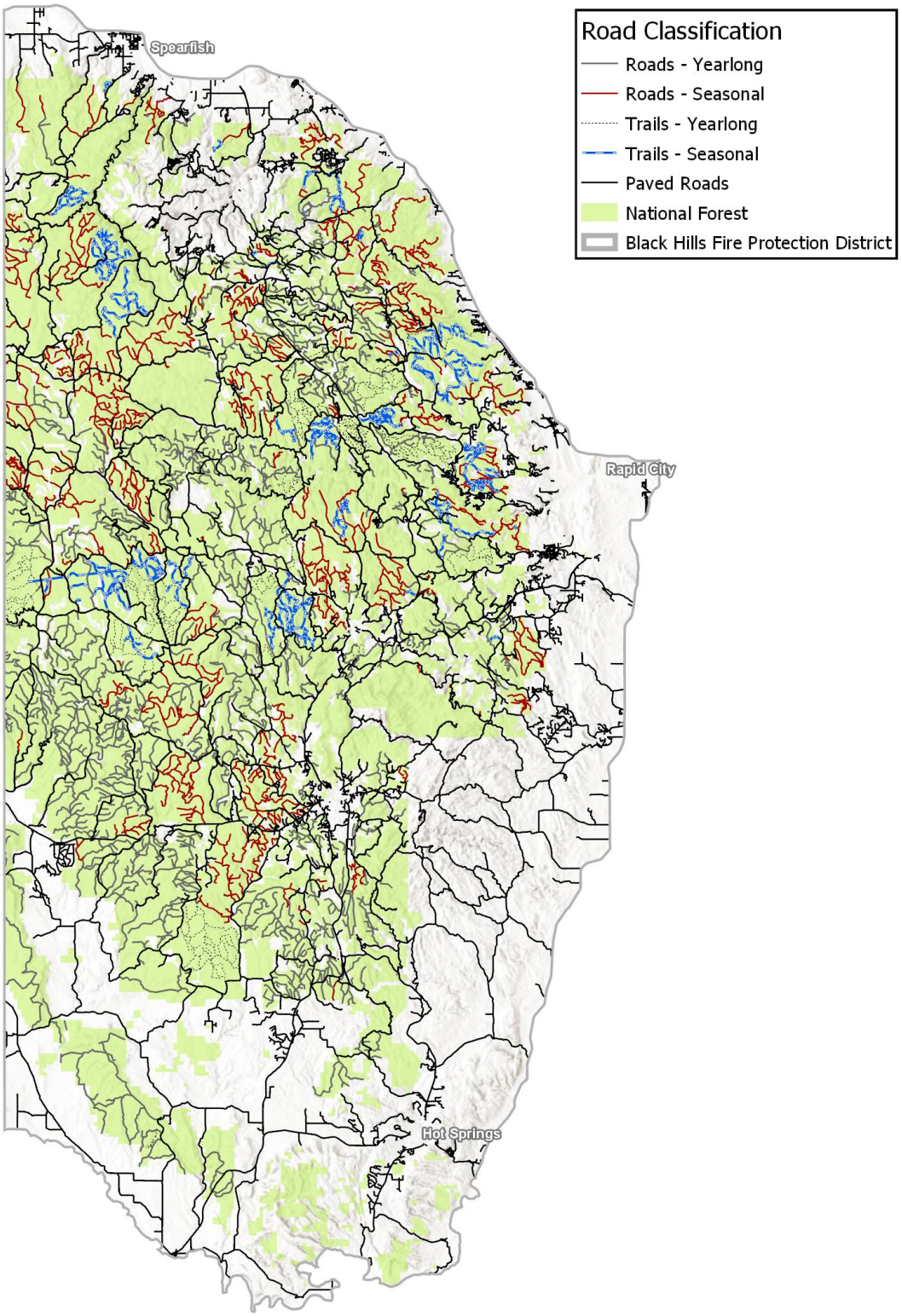
Thank you for your completing this survey. You can use this section for any comments you would like to make regarding the 2018 Mountain Lion season.

Appendix D. Mountain lion observation report.



Selections in dropdown lists:
Verification Status: Verified(True), Unverified(unsure) or Unfounded(false)
Investigation Type: Phone call only, Drop-in discussion, or On site investigation
Evidence: None, Photo, Scat, Scrape, Sound, Track, Hair, Kill evidence, Mountain Lion present, or Visual observation only

Appendix E. Road classification in the Black Hills of South Dakota (USFS 2019).



Appendix F. Review of published estimates of ungulate kill rate by cougars in North America during 1949-2009 (Source: Knopff et al. 2010b).

Table 1. A review of published estimates of ungulate kill rate by cougars in North America during 1949–2009.

Source	Location	Primary prey[a]	Kill rate[b]							Estimation technique[c]	Calculation technique[d]	Sample size[e]	Monitoring period[f]
			UC	UM	UF	AM	SM	AF	SF	FG				
Connolly (1949)	UT	MD	0.73								Snow-tracking	Ratio	≥26	<4
Hornocker (1970)	ID	MD, ELK	0.27–0.38								Model (E)	NA	NA	NA
Hornocker (1970)	ID	MD, ELK								1.17	Snow-tracking	Ratio	2	15
Shaw (1977)	AZ	MD						0.67		1.04	Model (LC–R)	NA	4	NA
Ackerman et al. (1986)	UT	MD				0.83		0.44		0.67–2.26	Model (E)	NA	NA	NA
Ackerman et al. (1986)	UT	MD								1.57	Radiotelemetry	IKI	2	11
Harrison (1990)	BC	BS, MD								1.67	Radiotelemetry	IKI	2	34
Beier et al. (1995)	CA	MD	0.93								Radiotelemetry	Ratio	≤26	NA
Murphy (1998)	WY	ELK, MD				0.94	0.64	0.64	0.69	0.98	Radiotelemetry	IKI	4	27
Nowak (1999)	OR	MD, ELK			0.92						Radiotelemetry	IKI	7	44
Janis and Clark (2002)	FL	WTD, FH		0.90	1.33						Model (LC–R)	IKI	8.5	136
Anderson and Lindzey (2003)	WY	MD, ELK				0.91	0.74	1.01	0.97	1.31	Model (LC–G)	Ratio	2.2	84
Laundré (2005)	ID	MD				0.37		0.29		0.85	Model (E)	NA	NA	NA
Mattson et al. (2007)	AZ	ELK, MD				0.95	0.88	0.76	1.17		Model (LC–G)	IKI	2.5	NA
Cooley et al. (2008)	WA	WTD, MD		0.74	0.91					1.20	Radiotelemetry	IKI	<5	<11
Laundré (2008)	ID	MD				0.47		0.49		0.59	Model (LC–R)	Ratio	12.6	3
Laundré (2008)	ID	MD						0.47		0.59	Model (LC–R)	Ratio	7	51
This study	AB	WTD, MD, MO				0.67	0.59	0.80	0.46	0.90–1.30[g]	GPS Telemetry	Ratio	10[h]	152

[a] Prey constituting >20% of cougar diet or primary prey available to cougars where diet was not reported: MD = mule deer, WTD = white-tailed deer, MO = moose, BS = bighorn sheep, FH = feral hog (*Sus scrofa*).

[b] Kill rate is ungulates/week: UC = cougar of unknown age–sex, UM = male cougar of unknown age, UF = female cougar of unknown age or reproductive status, AM = ad male, SM = subad male, AF = ad female, SF = subad female, FG = family group.

[c] Kill rate was either estimated directly by visiting kills in the field (snow-tracking, radiotelemetry, or Global Positioning System [GPS] telemetry), or indirectly using models (E = energetics model, LC-R = location cluster model based on radiotelemetry, LC-G = location cluster model based on GPS telemetry). In the case of Mattson et al. (2007) and Anderson and Lindzey (2003) field data were used to parameterize logistic-regression location cluster models, but the models were used instead of field data to estimate kill rates.

[d] Calculation technique can be either ratio or inter-kill (IKI; see Hebblewhite et al. 2003). NA indicates not applicable.

[e] Sample size is average no. of cougars used/demographic category estimate.

[f] Monitoring period is average no. of days monitored/cougar used in each estimate.

[g] These represent separate estimates for FG with kittens <6 months (lower estimate) and >6 months (higher estimate). Thus, we estimated kill rate for 6 cougar demographic classes, not 5.

[h] We calculated kill rates more than once for the same cougar if it transitioned among demographic categories.

Appendix G. South Dakota Game, Fish and Parks mountain lion response plan protocol.

PLAN PURPOSE:

- To guide Department personnel in responding to a report of a mountain lion-human interaction in a consistent fashion, while minimizing public safety risks and the need to eliminate specific mountain lions.
- To aid Department personnel in maintaining a mountain lion–human interaction database using reporting forms to ensure consistency in the collection of data.
- To assure the public that the Department will respond appropriately to mountain lion–human interactions.

DEFINITIONS:

1. *Sighting* - a visual observation of a mountain lion or a report of mountain lion tracks or other sign.
2. *Encounter* - an unexpected direct neutral meeting between a human and a mountain lion without incident.
3. *Incident* - a conflict between a human and mountain lion in which the human must take action to make the mountain lion back away or leave the immediate area, without injury to the human. Recurring observations of a mountain lion in close proximity to human developed areas. A pet or livestock is killed by a mountain lion.
4. *Attack* - when a human is bodily injured or killed by contact with a mountain lion.

EDUCATION:

Education will be an ongoing effort to increase the public's knowledge about mountain lions and to create an awareness of how to reduce the potential of mountain lion-human conflicts. A brochure, *Living with Mountain Lions*, has been developed and is available from the Department. Education efforts will be intensified when mountain lion sightings increase in an area.

RECEIVING, COMPILING AND CLASSIFYING MOUNTAIN LION REPORTS:

Department personnel receiving a report of mountain lion will enter the report into the wildlife incident database. Every report must be entered into the database in case repeat sightings or unacceptable behavior of an individual mountain lion develops. Reports shall only be accepted from the observer. Second or third hand reporters shall be advised to inform the actual observer to make the report. Department staff receiving a report will determine the extent of actual response that may be required. The observer should be asked about the existence of evidence that may be used to verify mountain lion presence (e.g. photographs, video, tracks, kill). When a report of mountain lion activity is received the need for an actual investigation will be determined by the level of perceived threat to humans, pets or livestock. An investigation will only be conducted if a report is recent enough to allow a reasonable chance of confirmation. Reports will be classified into the following categories:

- **Unfounded** – Evidence exists that proves the report was not a mountain lion

- **Unverified** – There is no evidence to support or reject the report of mountain lion
- **Verified** – Evidence exists that proves the report was a mountain lion

ACTIONS:
Mountain lions will not be euthanized unless they are aggressive, dangerous or judged to be an unpreventable threat to public safety. Mountain lions will be euthanized by the Department if they attack a human, livestock or if they are judged to be a substantial threat to public safety. Under SDCL § 41-6-29.2, killing of a mountain lion is permitted by the public if reasonably necessary to protect the life of a person or if a mountain lion is posing an imminent threat to a person's livestock or pets. If a person kills a mountain lion pursuant to this law, they must contact a department representative within twenty-four hours of killing the mountain lion. The Department will encourage and emphasize problem prevention when dealing with mountain lion incidents. The Department may euthanize a mountain lion for attacking domestic pets, but may not euthanize a mountain lion for attacking or killing pets that are free-roaming or that provoke a mountain lion. Feeding of prey species in urban areas or near rural homes will be discouraged as it can lead to an increased presence of mountain lion. Moving "problem mountain lions" is not a viable solution as mountain lions have large home ranges and the Department cannot move problem mountain lions far enough to reduce the chance that the mountain lion will return to the capture site or become a problem at a different location. The Department has attempted to relocate mountain lions within the Black Hills in the past with no success. The relocated mountain lions returned to the capture site, moved to a different site and became a problem, or were killed by other mountain lions. Based on science, data, and past experiences from South Dakota and other western states, the Department work direction is not to relocate mountain lions.

DEPARTMENT PERSONNEL RESPONSE:
1. Sightings
- Field response is recommended to verify the presence of a mountain lion. Personal contact is encouraged in all situations.
- Provide brochure *Living with Mountain Lions* to reporting party and make an effort to educate reporting party about mountain lions and their behaviors.
- Collect the pertinent information from the reporting party and enter into the wildlife incident database.

2. Encounter
- Field response is **required** to verify presence of a mountain lion.
- Provide brochure *Living with Mountain Lions* to reporting party and make an effort to educate reporting party about mountain lions and their behaviors. Information will be provided to reporting party if humans, pets or livestock are at risk.
- Collect the pertinent information from the reporting party and enter into the wildlife incident database.
- Report to the Regional Supervisor and/or Regional Terrestrial Resources Supervisor (RTRS)/ Regional Conservation Officer Supervisor (RCOS) and local Department staff.

3. Incident

- Prompt field response is **required** in all cases to verify the presence of a mountain lion. Where a mountain lion is judged to be a substantial threat to property or public safety it may be euthanized. **The decision to euthanize a mountain lion will be made by the Regional Supervisor and/or the RCOS/RTRS.** However, if Department personnel observe a conflict between a human and a mountain lion, a mountain lion attacking a pet or livestock or a mountain lion in a heavily populated area (e.g. downtown Rapid City) it may be euthanized immediately.
- If presence of a mountain lion is verified **IMMEDIATELY NOTIFY** – Regional Supervisor and/or RCOS/RTRS. Local staff should be notified as soon as possible.
- Provide brochure *Living with Mountain Lions* to reporting party and make an effort to educate reporting party about mountain lions and their behaviors. In the case of an attack on pets or livestock, Department personnel will encourage and emphasize problem prevention.
- Collect the pertinent information from the reporting party and enter into the wildlife incident database.
- The entire carcass including all parts of a mountain lion that is euthanized will be taken to the respective Regional Office. The Regional Supervisor and/or the RCOS/RTRS will report the incident to Department administrators.

4. Attack

- ***Immediate field response is required*** in all cases.
- Department personnel on scene will secure the scene and treat it as a crime scene.
- IMMEDIATELY NOTIFY - Regional Supervisor and/or RCOS/RTRS. Regional Supervisor will notify the Wildlife Division Director, Deputy Director and the Public Information Officer. The Regional Supervisor and/or the RCOS/RTRS will institute the *Emergency Response Procedure for Wildlife Attack on Humans***.** Local staff should be notified as soon as possible.

MEDIA GUIDELINES:

Department personnel should be helpful and open with the media, but specific questions about mountain lion-human interactions will be referred to the Regional Supervisor and/or the RCOS/RTRS.

Appendix H. Living with Mountain Lions brochure, SDGFP 2012.

WHEN MOUNTAIN LIONS MEET PEOPLE

WHAT TO DO IF YOU LIVE IN LION COUNTRY

Mountain lion sightings are rare, but for those living in lion country there are key points to remember that will help humans coexist with these magnificent predators.

We must respect mountain lions and their habitat. To reduce the risk of problems with mountain lions on or near your property, take a few simple precautions:

> DO NOT INTENTIONALLY FEED WILDLIFE.
> When outdoors make lots of noise during the times mountain lions are most active – dusk to dawn.
> Install outside lighting. Light areas where you walk so you can see a mountain lion if it is present.
> Closely supervise children whenever they play outdoors. Make sure children are inside before dusk and not outside until after dawn. Talk with children about mountain lions and teach them what to do if they encounter one.
> Landscape or remove vegetation to eliminate hiding places for mountain lions, especially around children's play areas. Make it difficult for lions to approach unseen.
> Plant only shrubs that deer will not browse to discourage concentrations of deer. Predators follow prey.
> Keep pets under control. Roaming pets are easy prey and can attract mountain lions. Bring pets in at night. If you leave your pet outside, keep it in a kennel with a secure top. Do not feed pets outside. This can attract raccoons and other animals that are eaten by lions. Store all garbage securely.
> Place livestock in enclosed sheds or barns at night. Close doors to all outbuildings since inquisitive mountain lions may go inside for a look.
> Mountain lions cover their kill. If you find what looks like a lion kill, stay clear. The lion may be guarding it.

Encourage your neighbors to follow these precautions. These measures will help prevent a possible mountain lion confrontation.

WHAT TO DO IF YOU MEET A MOUNTAIN LION

Mountain lion attacks in the United States are rare. According to statistics kept since 1890, mountain lions in the U.S. and Canada have killed fewer than two dozen people. Most of the lion attacks were by young lions, perhaps forced to hunt on their own and not yet living in established areas. There has never been a recorded attack in South Dakota.

Here are some steps to follow to avoid an attack should you encounter a lion:

> STAY CALM when you come upon a lion. Talk calmly yet firmly to it, while moving slowly away.
> STOP AND DON'T RUN. Back away slowly only if you can do so safely. Running may stimulate a mountain lion's instinct to chase and attack. Face the lion and stand upright.
> DO ALL YOU CAN TO APPEAR LARGE. Raise your arms. Open your jacket if you are wearing one. If you have small children with you, protect them by picking them up so they will not panic and run.
> MAKE PLENTY OF NOISE to reduce your chances of surprising a mountain lion. A sturdy walking stick can be used to ward off a lion. Make sure children are close to you and within your sight at all times. Talk with children about lions and teach them what to do if they encounter one. Do not approach a mountain lion, especially one that is feeding or with kittens. Most lions will try to avoid confrontation. Give them an escape route.
> CONVICE THE LION YOU ARE NOT PREY. If the lion behaves aggressively, throw stones, branches or whatever you can get your hand on without crouching down or turning your back. Wave your arms slowly and speak firmly.
> FIGHT BACK if a lion attacks you. Lions have been driven away by prey that fights back. People have fought with rocks, sticks, caps or jackets, garden tools and their bare hands successfully. Remain standing and try to get someone to help.

WHO DO YOU CALL?

In South Dakota, the Game, Fish and Parks Division of Wildlife is responsible for managing, conserving and protecting wildlife. Your concerns about wildlife are our concerns.

To report a mountain lion sighting, an encounter or attack, please contact the Division of Wildlife at one of the offices listed below. For after-hours emergencies contact your local sheriff's office or State Radio Communications at 605/393-8121 (Rapid City), 605/773-3536 (Pierre), 605/353-7132 (Huron). Your timely information is valuable.

We are interested in recording all the information we can about mountain lions in South Dakota. If you see a lion or have an encounter please call one of these offices:

GF&P Rapid City Office
4130 Adventure Trail
Rapid City, SD 57702
605/394-2391

GF&P Watertown Office
400 W Kemp Avenue
Watertown, SD 57201
605/882-5200

GF&P Mobridge Office
909 Lake Front Drive
Mobridge, SD 57601
605/845-7814

GF&P Chamberlain Office
1550 E King
Chamberlain, SD 57325
605/734-4530

GF&P Sioux Falls Office
4500 S Oxbow Avenue
Sioux Falls, SD 57104
605/362-2700

GF&P Information Office
20641 SD Hwy 1806
Ft. Pierre, SD 57532
605/223-7660

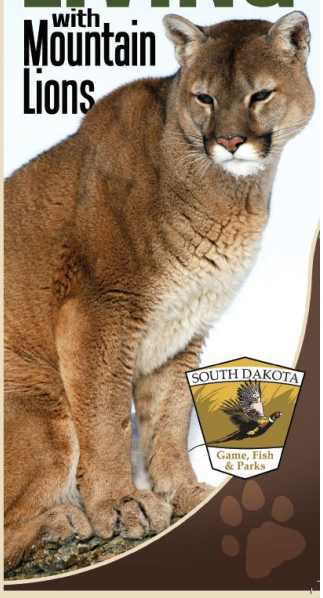
For more information about mountain lions, visit the GFP website at: gfp.sd.gov

SOUTH DAKOTA Game, Fish & Parks

Last Revised 2012

Front Cover Photo © Les Voorhis / Focus West Gallery

LIVING with Mountain Lions



Mountain lions are native to South Dakota. Primarily they are found in the Black Hills, but may occasionally travel through other parts of the state. These predatory cats have played both a historical – the Custer expedition of 1874 reported seeing a mountain lion near the headwaters of Castle Creek and found signs of their presence on several occasions – and a modern role to the balance of nature in this state.

Encounters with mountain lions are extremely rare. But, as with any wild animal, mountain lions can be dangerous. This pamphlet contains information on mountain lion sign, and what to do if you encounter a mountain lion.

WHAT WE KNOW ABOUT LIONS

Mountain lions are at home in the Black Hills and are known to travel through areas outside the Black Hills when pushed from their home territory, but there is no evidence of established prairie populations.

Mountain lions are powerful predators that primarily prey on deer. However, they have been known to feed on a number of different prey animals. In South Dakota their natural enemies include other lions, disease, vehicles and people.

South Dakota State University and the S.D. Department of Game, Fish and Parks are studying a wide range of topics related to mountain lions in the Black Hills including home range size, survival, dispersal, population size, prey selection, survey methods, hunting impacts, genetics and disease. Results of these studies will guide future management objectives for mountain lions in this state.

PHYSICAL APPEARANCE

The mountain lion's scientific name is *Puma concolor*, which means "cat of one color."

Mountain lions are tan to light cinnamon with black on the back of their ears and the tip of their tail. Adult males may grow to an excess of 8 feet in length, including the tail, and weigh an average of 150 pounds. Adult females may be up to 7 feet long and weigh an average of 90 pounds.

Kittens are spotted with dark rings around their tails. As they mature the spots fade. At six months they weigh more than 30 pounds, about the size of an adult bobcat.

Females begin having kittens when they are about 2-1/2 years old and will have a litter approximately every two years. The pregnancy lasts about three months. The mother will choose a secluded spot – under an uprooted tree or in a rocky depression – to give birth to a litter of two to four kittens. She raises the kittens and protects them from their main predator, male mountain lions.

When the kittens are six weeks old the mother begins taking them to her kills to feed. They are weaned at two to three months and at six months are becoming capable hunters. Kittens remain with their mother for up to a year-and-a-half while their hunting skills improve.

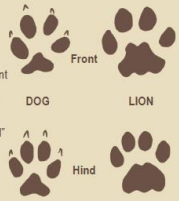
TRACKS AND SIGN

Mountain lions often place their hind paw in the imprint made by the front paw when walking. Since their claws are retractable, claw marks are rarely present. They have four toes and three distinct lobes at the base of the heel pad.

Mountain lions are solitary animals. If tracks indicate two or more lions traveling together, they are most likely from a female with young or siblings traveling together.

Mountain lions mark their home territory with piles of dirt and twigs, called scrapes, which signal to other lions that this area is occupied.

Note the obvious toenail prints for dogs that are absent for mountain lions. Also the lion track has a distinctive "M" shaped pad.

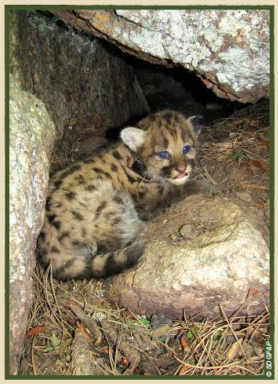


HUNTING AND FEEDING HABITS

Mountain lions are primarily nocturnal, although they will travel and hunt during the day. They are most active at dusk and dawn.

Deer provide the main source of food for lions, but they are opportunistic and will eat a number of things including elk, bighorn sheep, mountain goats, porcupines, small mammals, livestock and pets.

They are ambush hunters, using available cover to stalk prey, then rushing and attacking from behind. They have a powerful bite that they typically apply just below the base of the skull in the neck area. The carcass is drug to a sheltered spot beneath a tree or overhang where the lion can feed. After feeding the lion covers the carcass with dirt, twigs, leaves or snow and typically return to feed on it over the course of a few days. Mountain lions often move and re-cover their kills after each feeding. A mountain lion is protective of its kill and may be dangerous to people when feeding.



Appendix I. Informational handout on identification, sexing, and aging of mountain lions, SDGFP 2013.

MOUNTAIN LION IDENTIFICATION AND METHODS OF DETERMINING SEX AND AGE

Introduction

South Dakota Game, Fish and Parks (SDGFP) is responsible for managing wildlife and its habitat as well as providing outdoor-related recreation. Our public outreach programs promote appreciation, understanding, and stewardship of South Dakota's wildlife. SDGFP is funded through hunting and fishing license sales. The purpose of this document is to provide information to anyone who wants to hunt mountain lions and for anyone interested in mountain lion ecology. This document presents information about mountain lion biology, physiology, and behavior; explains how to determine the gender of a mountain lion; and details some of South Dakota's laws and regulations pertaining to mountain lion hunting.

Mountain Lions in South Dakota

Mountain lions are native to the Black Hills of South Dakota. Dispersals outside of the Black Hills have been documented; however, there has been no evidence of an established prairie population. Mountain lions are efficient predators that primarily prey on deer and other small mammals In South Dakota their natural predators include other mountain lions, disease, vehicles and humans. South Dakota State University and SDGFP have studied in the past, and continue to study a wide range of topics related to mountain lions in the Black Hills including home range size, survival, dispersal, population size, prey selection, survey methods, hunting impacts, genetics and disease. Results of these studies continue to guide management activities for mountain lions in South Dakota and can be found in the South Dakota Mountain Lion Management Plan at https://gfp.sd.gov/management-plans/.

South Dakota Mountain Lion Hunting Regulations

1) No person may harvest or attempt to harvest a mountain lion with a spotted coat (kitten) or any mountain lion accompanying another mountain lion

2) No person may release dogs (where allowed) on tracks indicating multiple mountain lions traveling together.

The information below is intended to assist hunters in making decisions by understanding and recognizing certain key observations while in the field. Additional information on mountain lion hunting in South Dakota can be found at https://gfp.sd.gov/mountain-lion/.

Physical Appearance

The mountain lion's scientific name is *Puma concolor*, which means "cat of one color." Adult mountain lions are tan to light cinnamon in color with a white underbelly and have black on the back of their ears and the tip of their tail. Adult males can grow to an excess of 8 feet in length, including the tail, and weigh an average of 140-150 pounds. Adult females can grow up to 7 feet long and weigh an average of 80-90 pounds. Mountain lions have very long tails which can be more than a third of the total length of the animal.

Mountain Lion Gender Identification (Sexing) in the Field

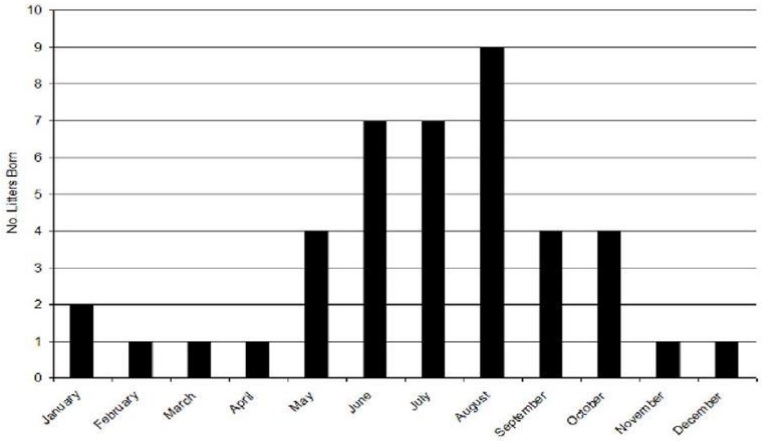
The only reliable way to determine the gender of a mountain lion is to look closely at the genital area. Adult and sub-adult male mountain lions have a conspicuous black spot of hair, about one inch in diameter, surrounding the opening to the penis sheath behind the hind legs, and about four to five inches below the anus. Between the black spot and the anus is the scrotum and it is usually covered with light brown and white hair. The anus is hidden below the base of the tail. Female adult and sub-adult mountain lions have a black vulva spot about 1" below the anus. Because the anus and vulva are up under the base of the tail, the vulva spot may not be evident, especially from a distance. The left picture below shows a female with a black spot and the right picture shows a male with a black spot.

Female mountain lion. © Ken Logan.

Male mountain lion. © Ken Logan.

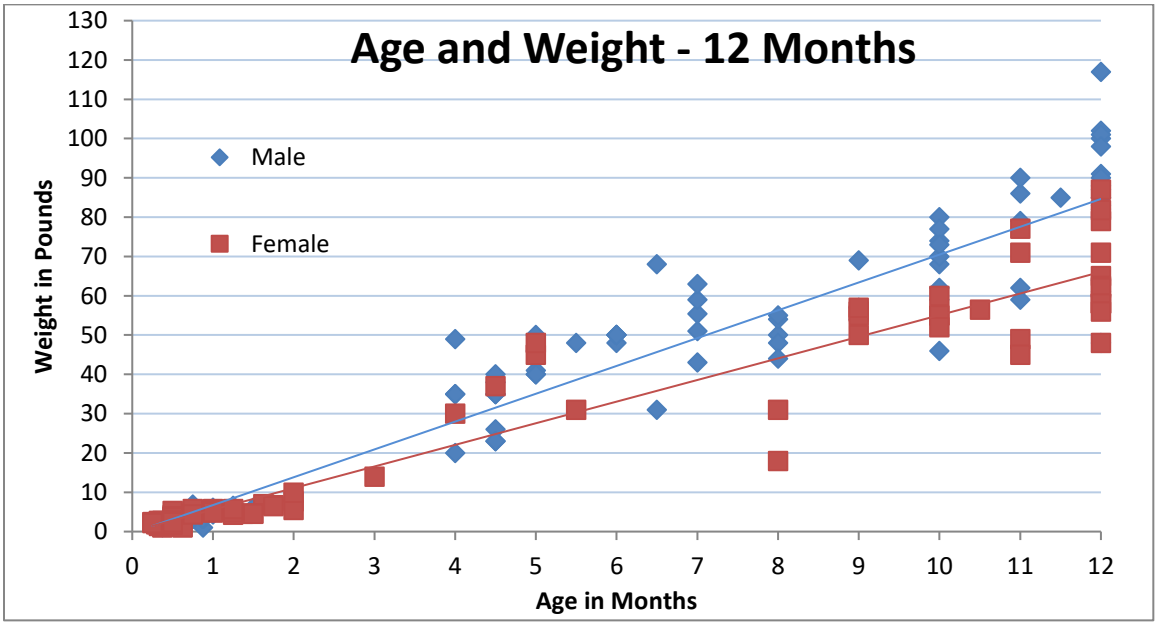
Mating, Breeding, & Raising Young Mountain Lions

Females begin reproducing when they are approximately 2½ years old, and typically breed every other year. Courtship begins when a roaming female in heat makes frequent calls and leaves scent that attracts males. After locating the female, the male accompanies her for just a few days, during which time mating occurs. Breeding can take place throughout the year. Most females give birth between May and October, following a three-month gestation period. Average litter-size is three kittens. Each year about 50% of adult female mountain lions produce kittens, while another 25% have dependent kittens from the previous year. Thus, about 75% of adult females might have dependent young at any given time.



Number of litters born during each month from 2005 to 2009 for mountain lions (Puma concolor) in the Black Hills, South Dakota.

Newborn kittens are heavily spotted for the first three months of life, and then the spots begin to fade. Typically by six months of age the spots have almost completely faded. However this can vary. Kittens may still have faded spots when they are a year old. At two to three months, kittens typically have been weaned and begin traveling with the mother. Kittens three months old weigh approximately 15 to 20 pounds. At six months of age kittens will weigh approximately 35 to 45 pounds (see graph and pictures on next page for examples). Kittens stay with their mother until they become independent sometime between 10 to 18 months old. Seeing a female mountain lion alone does not mean that she does not have dependent kittens.



Six-month-old mountain lion kitten weighing 48 pounds.

Two-month-old mountain lion kitten weighing ten pounds.

Tracks

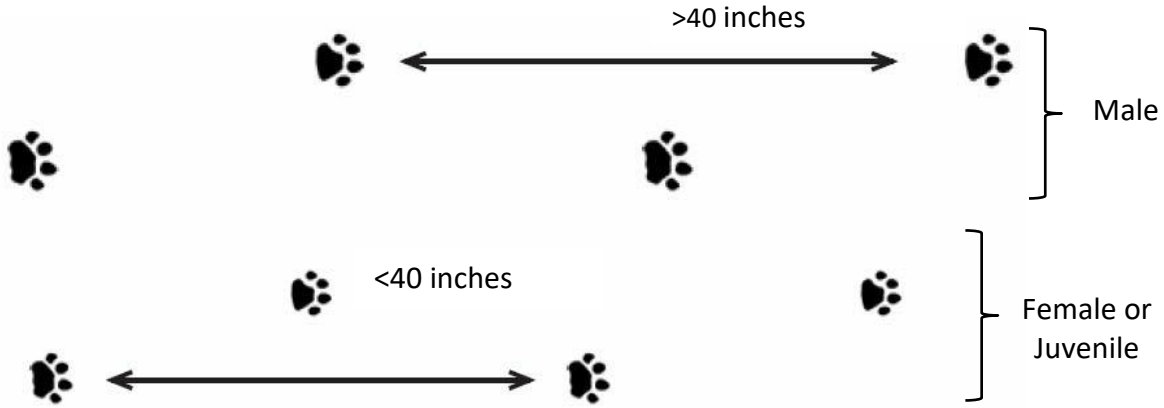
Tracks of mountain lions, especially in snow or mud, can be used as another indicator of the sex of a mountain lion or whether a female might have young with her. More than one set of tracks often indicates a female with young or a group of sub-adult mountain lions. Immature males may leave tracks as large as their mother's. The track of large adult males may be up to 5" wide and the average male will have tracks approximately 4" wide. Adult females leave tracks 3.5" in width or less. Another way to determine gender from tracks is to measure the plantar (heel) pad. Since a mountain lion in a walking gait usually places its hind foot on the track left by the same-side front foot, the hind track will usually be the most distinct and easiest to measure. The hind foot plantar pad width for a female adult mountain lion will usually be less than two inches wide; a male's plantar pad will usually be greater than two inches wide. The front foot planter pad width for a female adult mountain lion will measure between 2 - 2.5"; a male's will usually be 2.5 - 3" wide.

Adult female

Adult male

Stride Length

When walking in snow on level ground, mature males will have an average stride greater than 40". Females and young mountain lions will have a shorter stride, measuring less than 40". The illustration of tracks below shows a male's stride (top) and a female's stride (bottom).



Various factors may lead to incorrect conclusions when 'reading' tracks and stride:

- Nature of the surface the tracks are on—hard, soft, wet, etc.
- Snow depth
- Pace of the mountain lion's travel
- Tracks may have been left by a sub-adult

For more information about mountain lions in South Dakota, please visit https://gfp.sd.gov/mountain-lion/ or contact your local SDGFP Office (http://gfp.sd.gov/agency/contacts/contact-wildlife-offices.aspx).