South Dakota Mountain Lion Management Plan 2010-2015

South Dakota Department of Game, Fish & Parks

Version 13-2
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About this Document

This document is for general, strategic guidance for the South Dakota Department of Game, Fish & Parks and serves to identify the role that the agency plays, how we function and what we strive to accomplish related to mountain lion management. The planning process is more important than the actual document. By itself this document is of little value; the value is in its implementation. This process will emphasize working cooperatively with interested publics in both the planning process and the regular program activities related to mountain lion management.

While this is a five-year planning process, this document can be revised at any time depending on circumstances, need, and future research results. This document is Version 13-2 (year-consecutive number**) of the South Dakota Mountain Lion Management Plan 2010-2015. An electronic copy in PDF format can be found by visiting the SDGFP website at http://gfp.sd.gov/wildlife/docs/ SDmountainLionmanageplan2010-2015.pdf.**

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Executive Summary

Historically, mountain lions (*Puma concolor*) occurred througout 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 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 hunting season was established in 2005 as an "experimental season" and a season continues to be implemented as a management tool to manage mountain lion populations at a desired level.

The *"South Dakota Mountain Lion Mangement Plan (2010-2015)"* provides a concise, yet comprehensive overview of topics such as inventory and status, population monitoring, season summaries, response protocol, public attitudes issues related to mountian management, and research results.

The goal for mountain lion management in the Black Hills of South Dakota is to monitor and maintain 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.

To achieve this goal, the following five objectives have been identified and strategies have been developed for each objective to guide implementation of this management plan:

1. To reach a sustainable and socially acceptable "pre-season" mountain lion population that is in balance with available habitat and other game animal populations in the Black Hills of South Dakota at 175 +/- 25 individuals (includes adults, sub-adults and kittens).
2. Manage mountain lions in Custer State Park with a holistic approach as part of the Black Hills population while considering the unique management needs of the Park.
3. Develop a list of mountain lion research needs and to annually evaluate and prioritize these needs.
4. Develop a comprehensive public education plan for informing and educating department staff, South Dakota citizens and visitors about mountain lions and personal safety while in mountain lion country.
5. Develop a public involvement plan for implementing the objectives and strategies of this management plan.

Overall, South Dakota residents have a positive attitude towards mountain lions; however, there is a level of controversy surrounding how mountain lions should be managed. 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.

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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 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 (SDGFP 1998). During 1906 through 1931, only one lion was recorded as being taken in the Black Hills (Young and Goldman 1946). A detailed hunt of a male 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 Department of 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 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 the Department of Wildlife and Fisheries Sciences at

South Dakota State University (SDSU) in cooperation with SDGFP to determine distribution and provide a current population estimate of mountain lions in the Black Hills. At the conclusion of that research project in 2003, results indicated a population estimate of 127-149 animals within the Black Hills ecosystem. 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 harvest 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 lions will prey on a variety of species including small mammals such as rabbits (*Sylvilagus* spp), skunks (*Mephitis* spp), porcupines (*Erethizon* spp), beavers (*Castor* spp) and rodents; however, large ungulates make up the majority of their diet. In North America deer is the primary prey species documented in diets (Pierce and Bleich 2003, Thompson et al. 2009); however, other large ungulates including elk (*Cervus elaphus*), bighorn sheep (*Ovis canadensis*), moose (*Alces americana*), and pronghorn antelope (*Antilicapra americana*) are also consumed when available (Ross and Jalkotzy 1996, Ross et al. 1997, Murphy and Ruth 2010, Anderson and Lindzey 2003). The Black Hills not only provide an adequate number of prey species for mountain lions, but also provides the cover (i.e. thick spruce [*Picea* spp.]) and variety of geographic terrain (e.g., rocky outcroppings) necessary for a sustainable population of mountain lions.

Inventory and Status

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 population of mountain lions occurs in the Bighorn Mountains (200 km to the west), Laramie Range (120 km to the southwest, Anderson et al. 2004) and the Badlands of North Dakota (120 km to the north). The Black Hills occupy 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 ponderosa pine (*Pinus Ponderosa*) with codominants of white spruce (*Picea glauca*) and quaking aspen (*Populus tremuloides*) at higher elevations (Appendix Figure 1).

Large ungulate prey species available to mountain lions includes: white-tailed deer (*Odocoileus virginianus*), mule deer (*O. hemionus*), elk, bighorn sheep, mountain goat (*Oreamnos americanus*), and domestic livestock. Other species commonly consumed by mountain lions in the Black Hills includes porcupine and voles (Microtus spp.). Coyote (*Canis latrans*) and bobcat (*Lynx rufus*) 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 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).

Custer State Park

Mountain lions in Custer State Park (CSP) are a subcomponent of the Black Hills mountain population and will be managed as integral part of the overall population within the unique management considerations of the Park. The goals for management of the wildlife program in CSP are to: 1. Maintain and improve quality of wildlife habitat and diversity of wildlife; 2. Provide visitors with optimum opportunity to observe wildlife (inclusive of all animal types in the park); 3. Provide recreational hunting opportunities in harmony with goals 1 and 2. CSP has never had a hunting season for mountain lions in the fenced portion of the Park; however roughly 5,000 acres of the unfenced portion of CSP can be hunted during the regular season.

Extensive research was conducted on mountain lions within CSP from 2007-2009. This information is very valuable in directing future activities pertaining to lion management. In the Park, mountain lion diets consist primarily of large vertebrate prey species. Based on data collected from GPS collared yearling males and anecdotal evidence, mule deer, white-tailed deer, and elk comprise the majority of mountain lion diets, but other large ungulates such as bighorn sheep and pronghorn (*Antilocapra americana*) may also be consumed (South Dakota State University, unpublished data). Although mountain lions primarily subsist on large ungulates, small mammals including raccoons (*Procyon lotor*), lagomorphs, ground squirrels (*Spermophilus* spp.), and mink (*Mustela vison*) may also supplement mountain lion diets.

Based on radio telemetry data collected by SDSU all of the acreage of CSP is occupied by at least one mountain lion. There appears to be much home range overlap among females. By 2009, 22 lions (including cubs) had been radiomarked in the park. During the 2009 Black Hills mountain lion hunting season, 12 of those were located exclusively

within the unhunted portion of CSP, and 3 were located exclusively outside of CSP. For the remaining 7 cats, the average time spent outside of Custer State Park during the hunting season was 36%. Based on SDSU research data from 2009-10, it is estimated that the Park has an average of 18 independent (harvest-age adult and subadult) mountain lions within the boundaries of the Park at any given time during the year (mean = 18, SE = 2, 95% CI = 13–23).

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, Bureau of Land Management, National Park Service public lands and tribal lands interspersed among private lands. The middle of the state is split with the Missouri river and associated broken breaks. The eastern prairie consists of mostly private lands with more than 75% in agricultural use (Johnson and Nichols 1982).

Dispersal of mountain lions onto the prairies of South Dakota is well documented with both male and female lions leaving the Black Hills (Thompson 2009). However, to date there has been no documentation of any lions establishing home ranges on the prairie. Marked and unmarked subadult, mountain lions have generally traversed these prairies traveling to the north (North Dakota to Saskatchewan and Minnesota), south (to Nebraska and Oklahoma), west (to Wyoming and Montana), and east (to Yankton, Miner, and Deuel counties in eastern South Dakota). These movements indicate that the prairies of eastern South Dakota have a limited capacity to support mountain lions. Thompson et al. (2009) documented food habits of mountain lions on the prairies of North and South Dakota. Results from their study indicated that mountain lions obtained prey opportunistically when hunting in grassland habitats with traditional prey species (i.e., deer) less frequent (Appendix Table 1) than documented within diets of mountain lions inhabiting western states (64% summer, 77% winter -Robinette et al., 1959; 57% - Spalding and Lesoski, 1971; 81% - Ackerman et al., 1984; 70% deer and elk - Koehler and Hornocker, 1991).

Population Information

Mountain lion population size is estimated using population reconstruction and mark-recapture methodologies. Population reconstruction began with the estimated population size in 1998 and adding to the population based on rate of population growth. Rate of population growth was estimated using a maximum value (r = 0.28) reported by Logan and Sweaner (2000) for an unhunted population (Appendix Figure 2), 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 reconstruction provided a mean population size of 245 mountain lions. Because nutritional condition of mountain lions had declined, consumption of domestic prey increased, home range size of females declined, and dispersal of female subadults from the population increased, the assumption

was that the population was saturated in 2005 (Thompson 2009). Consequently, the median estimate of population size was considered reasonable.

During 2007-2009 when sufficient radio-collared mountain lions were available to estimate the population post harvest, an estimate of harvest rate was generated for the female segment of the population. 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 2007-2009 were compared to those generated via population reconstruction to adjust temporal change in the mountain lion population. In 2007, estimates of population size were generated for the female segment of the population only due to total harvest of 1 radio-collared male. Harvest rate for the female segment of the population was estimated at 0.143 (5/35 = 0.143) where 5 radio-collared female mountain lions were harvested of a total of 35 available radio-collared female mountain lions. Total number of females in the population was then estimated by dividing total number of females harvested (n = 16) by harvest rate (0.143), which gave an estimate of 112 female mountain lions. The following assumptions were used to estimate reproduction: 1) 50% of females were with kittens; 2) survival of kittens was 0.67 and 3) litter size was 3 kittens/litter (based on field data collected over the past 5 years [Thompson 2009, B. Jansen, unpubl. data]). Thus, the number of kittens added to the population was 112 females multiplied by 0.5, which equals 56 females with kittens. The 56 females with kittens were multiplied by 3 kittens/female for a total of 168 kittens born. This number was multiplied by the survival rate of 0.67 to estimate total number of kittens added to the population or 113 kittens. The sex ratio of the population was estimated at 70% females, based on observed data and those from other populations (Logan and Sweanor 2000), which provided an estimate of adult and transient males of 48. Thus, total number of males and females was 160 and this estimate was adjusted by multiplying by survival rate for males and females of 0.86 (Thompson 2009), which gave 138 adult mountain lions.

In 2007, total population was estimated at 251 mountain lions (138 adults and 113 kittens). The standard deviation was used for our estimate of the female segment of the population to generate a confidence interval for the estimate of population size of 225 – 275 mountain lions. This estimate of population size supported that generated via population reconstruction (n = 245). No harvest occurred in calendar year 2008 due to movement of the hunting season to January 2009. Harvest data for 2009 provided a similar estimate of population size to that of 2007. In 2010, increased harvest resulted in an estimated 10% decrease in population size from 251 to 223 mountain lions. The current population estimate of 223 will be confirmed with future population modeling.

Furthermore, monitoring of ancillary data including vehicle mortality, department removals due to depredation or public safety, incidental snare during the bobcat trapping season, and unknown cause of mortalities were stable to slightly declining during this period (Appendix Figure 3), which along with information on nutritional condition, consumption of domestic prey, evidence of emaciation, injuries to territorial males, and decreased female home range size, supported population stability.

Population Monitoring

Annual population trends are monitored in the Black Hills through a series of established road transects that are surveyed for mountain lion tracks on an annual basis. Road surveys are used to detect the presence or absence of mountain lion tracks to estimate trends in mountain lion populations over multiple years. The Black Hills has one of the highest road densities of any National Forest (Appendix Figure 4). Fecske (2003) found that mountain lion tracks were most prevalent on Class 3 and Class 4 roads in the Black Hills. Surveys are conducted during winter months, during morning hours after fresh snowfall and are distributed throughout the Black Hills. A total of 10 transects encompassing a total of 170.4 miles have been established and these transects are run as often as weather conditions and personnel availability allow during November – April. Difficulties that may be encountered are adequate snow conditions and accessibility to established road transects throughout the winter months. The data analyzed will only give trend data, and not exact population numbers.

Track counts of mountain lions have been conducted since 2006. Data collected include: total tracks of all surveys, high count per route per year, presence of tracks, and total average number of tracks per route. For comparisons among years, data is reported in number of tracks per 100 miles of surveys. Appendix Table 2 and Appendix Figures 5-6 contain the data from the first 4 years of this survey.

The data in this table is only used for trends in mountain lion populations, and is not an exact method of estimating current population numbers. The relationship between mountain lion tracks and population densities, while potentially direct and linear under ideal tracking conditions, are not easily interpreted, but may be a reliable estimator of relative abundance (Beier and Cunningham 1996). Therefore, drawing conclusions from this survey should be done carefully, as it may only be detecting major changes in the population. Data will be analyzed annually to determine if there is an increase or decrease in mountain lion population trends in the Black Hills of South Dakota.

Season Summaries

Mountain Lion Management in South Dakota

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 was 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 with 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 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. 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 and 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 providing recreational opportunity while sustaining a viable population of 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 quotas have occurred every year since 2005 as more information has been acquired and refinement to season structure has been warranted.

Due to land ownership on the prairie and limited available habitat preferred by mountain lions, SDGFP currently does not intend to manage for a sustainable population outside of the Black Hills ecosystem.

Season Structure

As with all the other hunting seasons in South Dakota, the mountain lion season has its own specific rules and requirements that must be adhered to while participating in the season. These requirements are not only concerned with hunter safety, but also fair chase and management implications for this specific species. These requirements are:

- Mountain lions with spotted coats (kittens) may not be harvested.
- Any mountain lion accompanying another mountain lion may not be harvested.
- All mountain lions taken in the Black Hills must be presented to the Game, Fish and Parks at the Rapid City office.
- All firearms, muzzleloaders and archery equipment must meet the same minimum requirements established for deer hunting in South Dakota
- Hunters may not hunt with the aid of dogs, bait or traps
- Hunters may use electronic calls.
- Hunter Orange is required while hunting Mountain Lions.

There were two units for the 2005 season with one unit consisting of the Black Hills Fire Protection District and the other unit consisting of the remainder of the state referred to as the prairie unit. 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 lions or 5 "breeding age" females. A "breeding age" female was defined as a female that had lactated or was currently lactating or was 2 ½ years old or older. All harvested lions counted towards the harvest limit. Season dates were October 1 through December 15. It was believed that these dates would give both the elk and deer hunters an opportunity to harvest a lion while pursuing the primary species of their hunt. The goal was to have a long enough season, and enough 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.

Subsequent hunting seasons were modified every year after the first season as more information was acquired and refinements were warranted (Appendix Table 3). In 2006, the harvest limit for total lions was again 25, however the female limit was increased to 8 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, the total limit was increased to 35 and female limit increased to 15. The season was also opened to the entire state. During 2009 season dates were changed to January 1 through March 31, 2009 in an attempt to avoid harvesting any females with dependant young younger than 3 months of age (see *Orphaned Cub* section) and to have season dates specifically for lion hunters. The season harvest limit remained at a total of 35 or 15 females, however, landowners on their own land were able to harvest a lion year round and lions harvested did not count toward the quota outside of the season dates set for the Black Hills hunting unit. In 2010 the total limit was increased to 40 with a sub-limit of females set at 25. Season dates and unit boundaries did not change.

Recommendations for future hunting seasons will be based upon the most recent biological data for mountain lions, population estimates of other game animal populations, harvest statistics, and public opinion. In addition, mountain lion harvest models which consider mountain lion population estimates, harvest quotas, and other biological information will used to assist in developing future hunting season strategies.

Season Results and Hunting Methods

Numerous data is collected during the mandatory check in of harvested lions including sex, age (Appendix Table 4), body condition, and status of lactation for females. Body measurements are collected as well as tissue samples for genetic data. All collected data is used to determine harvest effects on population parameters and next years season structure and quota.

Hounds, baiting, and trapping have not been allowed as a method to hunt mountain lions in South Dakota. Season dates allowed for incidental harvest of lions during deer or elk season as well as harvest by hunters specifically targeting lions during the 2005 through 2007 hunting seasons. With the dates changing for the 2009 mountain lion season, the majority of hunters specifically targeted lions. Therefore, hunting methods have changed over time; however average days hunting for successful hunters only increased by one day when the mountain lion season became a stand-alone season (Appendix Table 5).

Orphaned Cubs

Mountain lions can breed at any given time of the year. This suggests that the opportunity exists for a female, with kittens that are too young to accompany her when she is away from the den, could be harvested during the season. Since all lions harvested during the

season are subject to the 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). Since young 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 their mother. 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 and 75% are with dependent young each year (Logan and Sweanor 2001). Therefore, 25% adult females are without young and 25% are with yearlings. Since, the percentage of females with kittens younger than 3 months of age would be a small fraction of the harvestable animals available, the possible loss of the kittens would be biologically insignificant to the continued survival of the whole population. In addition, survival of kittens in the Black Hills from birth to independence is documented at 67% (Thompson 2009), indicating that not all kittens born are recruited into the population due to natural caused mortality. In South Dakota, of the 49 females that have been harvested from 2005-2010, it was determined during the mandatory check that 6 females (2 in 2005, 3 in 2007, 1 in 2010) or 10 % of total female harvest, had young less than 3 months of age. A total of 13 kittens were found by department staff and placed in licensed zoological parks throughout the United States. It is the department work direction that kittens that are younger than 3 months of age will be found, if possible, and held at the facility at South Dakota State University until placed in an accredited Association of Zoological Parks and Aquariums public facility.

In an attempt to even further avoid the loss of kittens due to the harvest of a female lion with young cubs, the season dates were changed for the 2009 hunting season (Appendix Table 3) to the months of January – March, 2009. As a result of this change in season structure, no season was held in 2008. Past research in the Black Hills found that even though lions may give birth at any time of the year, 65% of parturition dates occur during the months of July through September (Appendix Figure 7). This would indicate that only 8% of the dependant young less than 3 months of age in the Black Hills might be affected by the current hunting season.

Compensatory Mortality

It has been suggested that it is unlikely that harvest mortality compensates for other forms of mortality in mountain lion populations (CMGWG 2005, Cooley et al. 2009). Cooley et al. (2009) did not document compensation between hunting and natural mortality in a localized mountain lion population in Washington. However, it is plausible that when mountain lion populations are at high densities, reduction in density-dependent mortality would result in some compensation between mortality factors especially in systems with multiple prey available to mountain lions, and in mountain lion populations prone to human-caused mortality (i.e., urban and exurban mountain lion populations). For example, vehicle mortalities comprised 33% of mountain lion mortalities documented prior to initiation of harvest (2005) in the Black Hills (Thompson 2009). During the three years following the harvest, documented vehicle mortality declined from 22.5% in 2005, to 16.1% in 2006, to 8.9% in 2007 while harvest rate on this population increased to 14% (based on harvest of radio-collared mountain lions) and total documented mortality was

relatively stable at 56 ± 6 mountain lions (Appendix Figure 3). Harvest also resulted in an improvement in nutritional condition of mountain lions (Appendix Figure 8), which provided circumstantial evidence of reduced density dependence via increased food availability. Mountain lion population size during this time was estimated to be stable (approximately 250 ± 25 animals) to slightly increasing based on population reconstruction and mark-recapture analyses (J. A. Jenks, South Dakota State University, unpublished data).

Incident/Observation Summary

It is department policy to document all incidents and observations of mountain lions throughout South Dakota. A "Mountain Lion Observation Report" is used by all department staff to record information of all incidents and observations (Appendix Figure 9). All reports are entered into a centralized database.

A total of 326 mortality events were documented in the Black Hills from 1998-2009. Death associated with hunter harvest was the primary mortality source (*n*=80), followed by removal (*n*=72), vehicular trauma (*n* = 52), unknown causes (*n*=33), intraspecific strife (*n*=31) from interactions or infanticide, sick or emaciated lions (*n*=21), incidental snaring/trapping (*n*=16), and illegal killing (*n* = 7) (Appendix Figure 10). These cause specific mortalities vary relative to detection probability. For example, causes such as road mortalities have higher detection probabilities than illegal killing. The number of mortality events recorded annually increased from 1998-2009 (Appendix Figure 11) along with a significant increase in the number of animals removed for depredation reasons or due to human safety risk (Appendix Figure 10). The number of recorded lion sightings throughout the state of South Dakota increased from 1998-2009 (Appendix Figure 12), coinciding with the increased number of mortality events, depredation complaints, and human safety complaints. There was a high correlation between annual mortality events and recorded mountain lion sightings (r^2=0.96). For documented mortalities between 1998 and 2009, the average age of death for cougars in South Dakota was 2.46 years and no difference was found between age at death of male and female cougars. A higher number of males (*n*=173) died compared to females (*n*=140). There were 13 lion deaths that were recorded as sex unknown. More females (*n* = 49) than males (*n* = 31) were harvested during established harvest seasons. More males (*n* = 54) than females (*n* = 18) were removed due to depredation or human safety reasons (Appendix Figure 17). Vehicular trauma was a major source of mortality for both male and female cougars (Appendix Figure 17).

Prevalence of resident male facial scarring has been documented. Thompson (2009) found of 11 resident male mountain lions captured, 89% showed moderate to severe scarring primarily across the face and skull along with scarring of the forelimbs.

Human Dimensions

South Dakota Game, Fish and Parks (Division of Wildlife) 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). Black Hills deer hunter attitudes related to mountain lion management were measured in 2004, 2005 and 2006 and Black Hills elk hunter attitudes related to mountain lion management were measured in 2005 (Gigliotti 2005a, 2006a,b, 2007a). The 2002 South Dakota citizens' survey and the 2004 Black Hills deer hunter survey, which used the same attitude question, found high support for a mountain lion hunting season (Appendix Table 6). Support for the mountain lion season was 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.

A second South Dakota citizen survey conducted in 2002 contained a small sub-section measuring attitudes towards mountain lions (Gigliotti 2002). A majority of South Dakota residents (56%) agreed with the statement '*having a healthy, viable population of mountain lions in South Dakota is important to me,*' while 23% were neutral or undecided and 21% disagreed. A five-cluster attitude model was identified as being useful for understanding and classifying South Dakota residents based on their attitudes related to mountain lions in South Dakota (Appendix Figure 13). People with stronger support for mountain lions also tended to have higher participation and interest in fishing, hunting and much higher participation and interest in wildlife watching.

Prior to implementation of South Dakota's first mountain lion hunting season, GFP Division of Wildlife held twenty public meetings around the state in April and May of 2005 related to management of mountain lions in South Dakota (Gigliotti 2005b). A total of 747 people attended these meetings and 364 completed a short survey provided at the meeting. The public meeting started with a presentation of mountain lion biology and ecology and ended with a description of the planned 2005 mountain lion hunting season. Support for the mountain lion season as proposed was relatively high (Appendix Table 7). A non-scientific poll conducted by Rapid City Journal on March 31, 2005 asked the question, *'Should there be a hunting season on mountain lions?'* Of the 536 responses, 57% said yes, about 8% were neutral (don't know or don't care) and 35% said no.

South Dakota's first mountain lion hunting season started on October 1, 2005. In spite of relatively strong citizen support for the mountain lion season the season was controversial, involving extensive public involvement and a court challenge just days before the season started (Leif 2006; Gigliotti 2005_b). Due to the controversial nature of the start of the mountain lion season, GFP Division of Wildlife conducted a short, scientifically designed e-mail survey of citizens' attitude towards the mountain lion season (survey period: October 14 through October 25, 2009). Results showed that despite much negative press, most residents (69%) supported the current season (5% were neutral and 26% were opposed) (Gigliotti and Teel 2008).

A survey of Black Hills residents (N=8,501) conducted in the fall of 2008 included a few questions related mountain lion management in the Black Hills (Gigliotti et al. 2009). Most Black Hills residents do not want a non-problem lion removed just because it is near where they live, although there was no clear consensus on a preferred management action (Appendix Table 8). However, most residents do support having a mountain lion

season in South Dakota (Appendix Table 7). Many residents felt that the current population levels of mountain lions, elk, deer, coyote, and black bear were at about the right level in the Black Hills (Appendix Table 9 and Appendix Figure 14). Overall average desired population trend was for a small decrease in the next five years for mountain lions, deer, and coyote and a small increase for elk and black bear (the attitude towards black bear may be difficult to interpret because the black bear population in the Black Hills has been and currently is extremely low).

In 2010 the South Dakota Game, Fish and Parks (Division of Wildlife) conducted public meetings designed to provide information to the public about mountain lion management and gather public input to use for up-dating South Dakota's Mountain Lion Management Plan at eleven locations around the state (Appendix Table 10) (Gigliotti, 2010). A total of 396 people attended the public meetings and 355 (90%) of the meeting attendees completed a survey questionnaire handed out at the meeting. In addition, some people made copies of the survey questionnaire and passed them around to be completed by people who did not attend the public meetings. A total of 110 of these 'unsolicited' responses were received and analyzed separately. This data was compared with results from a scientific survey of Black Hills citizens conducted in late fall of 2008 (Gigliotti, et al., 2009). The Black Hills citizen survey had a large, randomly selected sample with a good response rate and adjusted for non-response bias. Public meetings and unsolicited responses are not scientific measures and usually obtain biased results.

The Black Hills citizen survey data provides the most accurate, scientific measure of Black Hills citizens' general attitude towards a South Dakota mountain lion season (Appendix Table 11). The public meeting responses had a much more favorable attitude towards a South Dakota mountain lion season compared to the general population of the Black Hills (87% vs. 63% favorable, or about 22% more favorable on the attitude scale). On the other hand, the unsolicited responses were much more opposed to a South Dakota mountain lion season compared to the general population of the Black Hills (78% vs. 24% opposed, or about 44% more opposed on the attitude scale). The two non-scientific input formats (public meetings vs. unsolicited responses) produced very different results: about a 65% difference on the attitude scale.

Although all three groups were significantly different in their overall preferred management action for this scenario, educating the public on how to safely live in lion areas had the highest percentage of responses for all three groups (public meetings, 37%; unsolicited responses, 52%, and Black Hills citizens, 39%) (Appendix Table 12). Desired population direction for mountain lions in the Black Hills was measured on a 6-point scale (0=eliminate to 5=increase a lot) (Appendix Table 13). The public meetings and unsolicited responses were significantly different from each other and from the Black Hills citizen survey.

Black Hills Deer Hunters. In addition to measuring Black Hills deer hunters' general attitudes towards mountain lions in 2004 through 2006, Division of Wildlife has measured observations of mountain lions by Black Hills deer hunters during the past six deer seasons (Gigliotti, 2006a, 2007a, 2008a, 2009a, 2010a). The observation rate has been fairly consistent over the past six Black Hills deer seasons (Appendix Table 14).

Mountain Lion Hunters. Mountain lion hunters were surveyed following each season[1] (Gigliotti 2006c, 2007b, 2008b, 2009b). Many hunters holding a mountain lion license do not actually spend any time hunting for mountain lions (Appendix Table 15). Key information collected includes observations of mountain lions, success and satisfaction with the mountain lion hunting season (Appendix Tables 16 – 18).

Issues

Outline of issues associated with mountain lions and mountain lion management in South Dakota:

A. <u>Legal and jurisdictional issues:</u>

1. **Legal status of mountain lions.** The mountain lion is presently classified as a big game animal and a limited hunting season has occurred since 2005.

2. **Relationships with border states regarding mountain lions, specifically Wyoming, Montana, North Dakota, and Nebraska.** Because the mountain lion is a wide-ranging species, multi-state coordination will be useful in designing management strategies, particularly related to harvest goals for hunting seasons used as a management tool.

3. **Prairie mountain lions.** Mountain lions are no longer just a Black Hills issue, with their presence now documented on the prairie. Prairie lions increase the complexity of mountain lion issues and management in South Dakota.

B. <u>Direct impacts to people and property (real and perceived):</u>

1. **Pet and livestock issues.** Mountain lions have the ability to kill or injure pets and livestock. Under South Dakota Codified Law, 41-6-29, game animals may be removed to alleviate damage to property or to protect human health. In addition to this legal recourse, SDGFP has shared information with the public via a brochure and web page listing precautions for living in areas with mountain lions.

2. **People.** The mountain lion is one of a small number of wildlife species in North America with the ability to stalk and kill humans. Although mountain lion attacks on people are very rare, SDGFP has developed response protocols designed to minimize any threats from mountain lions to pets, livestock and humans by evaluating every reported interaction and taking an appropriate action.

C. <u>SDGFP reputation:</u>

1. **Agency credibility.** With the mountain lion protected as a big game animal and a limited hunting season held since 2005, much attention is now focused on future management direction. It is critical that the agency makes well-reasoned choices to establish and maintain credibility on this issue. This will require maintaining an appropriate amount of scientific research and demonstrated use of that science in making management decisions.

[1] Note: the 2005 lion season was held during the Black Hills elk season (October) while the 2006 and 2007 lion seasons were held during the Black Hills deer season (November), and the 2009 season was outside of the deer season (January-February).

2. **Philosophical differences in opinions on management.** As SDGFP proceeds with discussions of management direction for the mountain lion, it is important that varying opinions be sought out and considered in a well-reasoned way. This approach, both internal and external, will help avoid a perception that a select group is developing recommendations.

D. Mountain lion limiting factors:

1. **Development into mountain lion habitat.** As human development of the Black Hills continues, potential results include the possibility of increased conflicts between lions, people, and pets; and possible impacts to mountain lion population stability.

2. **Identifying habitats for mountain lions.** Management planning should include an evaluation of habitats likely to support mountain lions with the least likelihood of conflicts with people.

E. Education and outreach:

1. **Public perception of impacts on other wildlife.** With all carnivores, the sporting public is often concerned about predator impacts to big game populations. In Gigliotti's recent public opinion survey (Gigliotti, et al. 2002), 25% of respondents were concerned about mountain lions killing too many game animals, and 52% of respondents were not concerned. SDGFP should be prepared to address the issue of impacts on mountain lions on big game populations in the Black Hills.

2. **Public education.** SDGFP has circulated a brochure about mountain lions occurrence in the state, which includes recommended precautions when living near mountain lions. In Gigliotti's recent public opinion survey (Gigliotti, et al. 2002), 90% of respondents had previously been exposed to the brochure, and 88% found the brochure's information useful. SDGFP staff have also made themselves available to the public and to the media on this issue. The management plan should address these and other public education opportunities.

3. **Public involvement.** Public involvement opportunities need to be made available in relation to mountain lion planning and management direction.

F. Information needs:

1. **Determining a desired population level; setting a population goal/level; monitoring of populations; population dynamics and life history.** SDGFP will use research data collected by SDSU in setting a desired population goal consistent with available habitat and prey and that minimizes potential threats to people and livestock. Currently SDSU has provided twelve years of mountain lion research and has generated enough information for sound, scientifically based mountain lion management. Follow-up data will be needed to periodically evaluate management strategies.

2. **Documentation of livestock/pets/wildlife killed by mountain lions.** At present, SDGFP field staff investigate reports of mountain lion sightings and complete a

Mountain Lion Observation Report form. Wildlife damage management personnel respond to reports of possible depredation by mountain lions in the same manner as with other depredation complaints.

3. **Public involvement.** The most recent effort to provide information and solicit public input towards the management of mountain lions was conducted through eleven public meetings from late-March to mid-April 2010. A total of 396 people attended the public meetings and 355 (90%) completed a questionnaire handed out at the meeting. In addition, unsolicited input was collected and summarized in a final report (Gigliotti 2010b).

Public Comments

The draft management plan was available for public comment from June 30 through July 26, 2010. Public comment was submitted both electronically at the SDGFP website at http://gfp.sd.gov/hunting/big-game/mountain-lion.aspx. and by paper copies. A total of 112 individual comments were received on the draft plan. While there were a variety of comments on several topics, many addressed some common themes regarding the draft plan. Therefore, a general response to these overriding comments has been provided by the mountain lion management team.

Population Dynamics and Estimate

Currently, mountain lion population size is estimated using population reconstruction and mark-recapture methodologies. Population reconstruction began with the estimated population size in 1998 and adding to the population based on rate of population growth. Rate of population growth was estimated using a maximum value (r = 0.28) reported by Logan and Sweaner (2000) for an unhunted population (Appendix Figure 2), 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 reconstruction and estimate concluding the 2010 hunting season indicates a mean population size of 223 (+/-25) individuals by the end of 2010. As new research data is obtained, variables within the population model will be updated to reflect the most recent scientific information available.

Population Objective

A number of decision-making alternatives were taken into consideration in the development for the "pre-season" total population objective of 175 (+/-25) in the Black Hills ecosystem of South Dakota. This population level will maintain a genetically and nutritionally healthy population of lions and a level that fulfills the broad range of public opinion. According to a recent survey conducted by Gigliotti (2009), 46% of Black Hills residents would like to see the lion population at the current level and 30% thought it should decrease slightly. Reducing the current population estimate to this level will reduce the number prey species taken by mountain lions by 1,650 (e.g. deer, elk, bighorn sheep) and reduce the number of dispersing mountain lions by approximately 24% based upon current research findings. Managing the population at this level will allow for the continuation of an

annual harvest on mountain lions, with a harvest rate of 20-25% for adult female mountain lions.

To clarify some misinterpretation of the data found in the draft plan, harvest rate for the female segment of the population in 2007 was estimated at 0.143 (5/35 = 0.143), where 5 radio-collared female mountain lions were harvested of a total of 35 available radio-collared **"female"** ("female" was inadvertently not included in the draft plan) mountain lions.

Management of Mountain Lions Outside of the Black Hills

Dispersal of mountain lions onto the prairies of South Dakota is well documented with both male and female lions leaving the Black Hills (Thompson 2009). In addition, SD GFP has documented mountain lions outside of the Black Hills through removals, confirmed sightings and hunter harvest. However, to date there has been no documentation of any lions establishing home ranges on the prairie. Due to land ownership on the prairie and limited available habitat preferred by mountain lions, SDGFP currently does not intend to manage for a sustainable population outside of the Black Hills ecosystem.

In response to suggestions stating that South Dakota mountain lions should be used to repopulate those habitats in eastern United States, no state wildlife agency has ever contacted SDGFP for such request. Therefore, it is the responsibility of SDGFP to manage mountain lions for the identified "pre-season" total population objective of 175 (+/-25) individuals based upon the most recent available research data and public opinion.

To view all public comments received on the draft management plan, visit http://gfp.sd.gov/hunting/big-game/mountain-lion.aspx.

Guiding Philosophies of the Department of Game, Fish and Parks: Division of Wildlife

Values are deeply held beliefs. They form the salient basis for all decisions, actions and attitudes. Agencies do not have values; people do. The following statements reflect the collective values of the people who are the Division of Wildlife in relation to management of mountain lions in South Dakota.

WE BELIEVE…

- that wildlife, including mountain lions, contributes 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.

- that having mountain lions in South Dakota will require the Division of Wildlife to implement education and involvement strategies related to safely living with mountain lions.

- in providing accurate and timely information to the public concerning mountain lions in South Dakota.

- that both the Division of Wildlife and the public have a responsibility to learn to live with mountain lions in a way that maintains a viable mountain lion population in South Dakota while dealing with problems that mountain lions may cause.

- that the future of mountain lions in South Dakota depends on a public that appreciates, understands and supports mountain lions.

Mountain Lion Management Goal

Goal for mountain lion management in the Black Hills of South Dakota is to monitor and maintain mountain lion populations and habitats consistent with ecological, social, aesthetics and economic values of South Dakota citizens while addressing the concerns and issues of both residents and visitors of South Dakota.

Objectives and Strategies

Objective 1. **To reach a sustainable and socially acceptable "pre-season" mountain lion population that is in balance with available habitat and other game animal populations in the Black Hills of South Dakota at 175 +/- 25 individuals (includes adults, sub-adults and kittens).**

The following is a list of expected benefits from achieving this "pre-season" population objective (2010 Population Estimate=223 (+/-25); Population Goal=175 (+/-25):

1. An estimated 50% reduction in the occurrence of problem lions and removals by the Department,
2. An estimated 40% reduction in the number of mountain lion mortalities caused by vehicle collisions.
3. An improvement in the overall health of the mountain lion population and reduction in the occurrence of disease,
4. An estimated reduction in the mortality of 1,650 big game species by mountain lions in the Black Hills, and
5. A continuation of a science-based hunting season to obtain genetic and other population data.

Strategies:

A. A regulated hunting season will be the main strategy for achieving the population objective for mountain lions in the Black Hills.

B. Continue to document and evaluate reported sightings of mountain lions to monitor changes in the mountain lion population.

C. Continue to document and evaluate all mortality of mountain lions to monitor changes in the mountain lion population.

D. Annually conduct the mountain lion track count survey to monitor changes in mountain lion population trends.

E. Annually utilize genetics and the Lincoln-Petersen method to estimate the mountain lion population.

F. Continue to document age structure of mountain lion mortality to detect changes in the percent and average age of females and males.

G. Maintain a statistically-sound sample of marked mountain lions in the Black Hills to estimate the mountain lion population through 2015.

H. Continue to monitor and study prey populations in the Black Hills in an attempt to detect the effects of a reduced mountain lion population.

I. SD GFP staff will continue to work in cooperation with the Wyoming Game and Fish as well as other neighboring state agencies to manage mountain lion populations.

J. Annually evaluate the achievement of objective 1 in relation to the level of attainment of the expected benefits.

Objective 2. Manage mountain lions in Custer State Park with a holistic approach as part of the Black Hills population while considering the unique management needs of Park.

Strategies:

A. Mountain lion management should be based on latest and best available evidence on mortality rates and population dynamics in Custer State Park and the Black Hills. Management direction will be based on results of the information collected from SDSU studies. Management decisions would use mountain lion movement, survival, population estimates, and prey selection data. Additional data on mortality rates and the impacts of hunting on population dynamics would provide information on sustainable harvest levels.

B. Assuming CSP currently has 18 independent (harvest-age adult and subadult) mountain lions, harvest in excess of 15-25% of lions would reduce the subpopulation of lions in the Park without any ingress from outside the Park. As available space for lion home ranges develops both in and out of the Park, ingress and egress likely occurs between the Park and the rest of the Black Hills.

C. A system to regulate hunter numbers and periods of activity would need to be developed. This would require a draw system be put in place for a limited number of tags. A hunting season in the Park would provide some recreational opportunity and limited income under current license fees.

D. Continuing to monitor and document mountain lion sightings in the Park. CSP has equipment and expertise for both capture and handling as well as lethal control. Should a lion become a problem, Park staff would address the problem lion on a case-by-case basis. Two lions have been lethally removed from CSP with this approach since 2006.

Objective 3. Annually develop, evaluate, and prioritize a list of mountain lion research needs.

Strategies:

A. The South Dakota Mountain Lion Management/Research Team[1] shall meet annually and review the status and results of past and ongoing mountain lion research in South Dakota in cooperation with SDSU and other mountain lion research and management professionals.

B. The Management/Research team shall be responsible for identifying, developing and prioritizing a list of mountain lion research needs and management options based upon literature review, the best available information and current trends and conditions in South Dakota.

C. The Management/Research team shall be responsible for identifying and developing research project recommendations for mountain lion research and management and present them to the annual Department Research Review Committee for evaluation and funding.

D. Develop future research and management strategies as research studies are completed and population numbers, structure and dispersal dictate.

E. By 2015, develop a genetics database for use in estimating population size of mountain lions annually. Methods will involve the use of biopsy darts to obtain tissue samples from mountain lions opportunistically captured via traditional methods (i.e., hounds). Standard genetics methods (20 microsatellites, Polymerase chain reaction procedures) will be used to develop profiles for use in Mark-Recapture Analyses. Estimates of population size and confidence intervals will be generated annually to revise population projections and assess effects of harvest on population size of mountain lions.

[1]SD Mountain Lion Management/Research Team (current staff): Wildlife Program Administrator (Chad Switzer), Region 1 Supervisor (Mike Kintigh), Region 1 Wildlife Manager (John Kanta), Big Game Biologists (Andy Lindbloom, Steve Griffin, and Kevin Robling), Custer State Park Staff (Dr. Gary Brundige and Dr. Chad Lehman), SDSU Professor (Dr. Jon Jenks) and any graduate students currently involved in mountain lion research, and Planning Coordinator (Dr. Cindy Longmire).

Objective 4. Develop a comprehensive public education strategy for informing and educating Department Staff, South Dakota citizens and visitors about mountain lion and personal safety while in mountain lion country.

Strategies:

A. Annual review and evaluation of the South Dakota mountain lion brochure (information contained in the brochure and its distribution) by the South Dakota Mountain Lion Management/Research Team and make improvements where necessary and appropriate.

B. Continue to provide mountain lion presentations by Department Staff to public and civic groups and document the efforts. In 2009, SDGFP naturalists in the Rapid City area presented 51 programs to 1,279 individuals on mountain biology, behavior, safety, and management. In addition, numerous Department Staff present information to local sportsmen's clubs, etc. annually.

C. By 2011, determine if programs and presentations related to mountain lions can be conducted on a regular basis through the school systems by Department Staff (Maggie Lindsey, Laurie Root, Chad Tussing, WCO's and Outdoor Campus personnel).

D. Work with local newspapers and publishers to develop and distribute a "flyer" on mountain lions, mountain lion behavior, and living with mountain lions for distribution with newspaper subscriptions.

E. By 2011, determine the feasibility of producing a mountain lion information poster for free distribution to educators, realtors, civic groups, and citizens at sports and home shows.

F. Continue to educate the public on mountain lions through the Project Wild Program. From 2005-2009, 11 workshops were held with 135 participants, mostly teachers. Based on the South Dakota average student:teacher ratio of 14:1, a formal educational package on mountain lions is delivered to an estimated 1,890 students per year.

G. By 2012, determine the feasibility of producing a short video on mountain lions and living in mountain lion country for Department and statewide distribution.

H. Continue to encourage Department staff to work with local media to report factual and special interest stories about mountain lions on a more frequent basis.

I. Produce a mountain lion status and management story for inclusion in the SD Conservation Digest on an annual basis.

J. Maintain and update as necessary the SDGFP web page with a mountain lion section. Annual review and evaluation of mountain lion web-page will be made by the South Dakota Mountain Lion Management/Research Team.

http://gfp.sd.gov/hunting/big-game/mountain-lion.aspx

K. Produce a brief annual report that lists the progress and accomplishments under Objective 3.

Objective 5. Develop a public involvement plan for implementing the objectives/ strategies in this plan.

Strategies:

A. Plan for periodic public surveys. This plan started with a comprehensive evaluation of public opinion on mountain lions in South Dakota (Gigliotti et al. 2002). Monitoring of public opinion will continue by inserting a few questions about mountain lions on future public opinion surveys conducted by the SDGFP. A detailed assessment of public opinion concerning mountain lions will be conducted in the future if the South Dakota Mountain Lion Management/Research Team determines that it is needed.

B. Plan for periodic public involvement as deemed necessary by the South Dakota Mountain Lion Management/Research Team.

C. Develop Conservation Digest articles summarizing the results of any mountain lion public opinion surveys.

D. By 2011, develop a media plan/policy for mountain lion incidents (communications and public involvement plan).

E. By 2011, develop a list of groups and individuals (e-mail list) that have an interest or role in mountain lion management and maintain routine contact with them. The ideal will be to use e-mail as the main method for maintaining contact and providing information to interested citizens concerning mountain lion information.

F. Develop an annual summary status report on mountain lions in South Dakota, posting the results to the SDGFP web page.

G. Produce a brief annual report that lists the progress and accomplishments under Objective 4.

Mountain Lion Response Protocol

INTRODUCTION

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 has increased. Research indicates an increasing lion population in the Black Hills to the point of saturation. This is confirmed by the number of lions leaving the Black Hills to where it is becoming more common to observe a mountain lion across the prairie of South Dakota. As a result, the number of people reporting lion activity has increased. Reports range from mistaken identification (e.g. domestic dogs or cats) to verified mountain lion sign (e.g. tracks or kills), sightings of mountain lions, 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 the South Dakota Game, Fish and Parks (Department). The probability does exist in South Dakota for an attack on humans causing serious injury or death. However, it is the belief of the Department that the probability is extremely small.

In 1995, SDGFP developed and adopted response goals for dealing with mountain lion/human encounters. Over the years, this response protocol 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.

PROTOCOL PURPOSE

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

DEFINITIONS

1. Sighting - a visual observation of a lion or a report of lion tracks or other sign.

2. Encounter - an unexpected direct neutral meeting between a human and a lion without incident.

3. Incident - a conflict between a human and lion in which the human must take action to make the lion back away or leave the immediate area, without injury to the human. Recurring observations of a lion in close proximity to human developed areas. A pet or livestock is killed by a 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 lion sightings increase in an area.

RECEIVING, COMPILING AND CLASSIFYING MOUNTAIN LION REPORTS

Department personnel receiving a report of mountain lion will complete a mountain lion observation report form (appendix A) and 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, etc…). When reports of mountain lion occur within known mountain lion range, 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 that occur within their natural habitat or range (e.g. the Black Hills) will not be removed unless they are aggressive, dangerous or judged to be an unpreventable threat to public safety. Mountain lions will be removed if they attack a human, livestock or if they are judged to be a substantial threat to public safety. Under South Dakota codified law 46-6-29.2, killing of a mountain lion is permitted if reasonably necessary to protect the life of a person or if a 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 will remove a mountain lion for attacking domestic animals (i.e. pets), but may not remove a 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 mountain lions is not a viable solution as mountain lions have large home ranges and all suitable habitat is currently occupied in South Dakota. Further, the Department can not move mountain lions far enough and to remote enough locations to avoid mountain lions returning to the capture site or becoming a problem at a different location. The Department has attempted to relocate lions within the Black Hills in the past with no success. The relocated lions returned to the capture site, moved to a different site and became a problem, or were killed by other lions. In Arizona, two mountain lions transported from their home areas both turned up 20-50 miles from the points they were released (Puma Field Guide 2007, page 57). Both had killed livestock at their second capture sites. A study conducted in New Mexico found that 8 of 14 translocated mountain lions moved greater than 50 miles from their release sites. Two males traveled back to the area they were captured and 9 of the 14 died (Logan and Sweanor 2001). Therefore, based on past experiences and data collected in South Dakota and other states the general department policy is not to relocate 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.
- Complete mountain lion observation report form (Appendix Figure 9) and submit the report for entry 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.
- Complete mountain lion observation report form (Appendix Figure 9) and submit the report for entry into the wildlife incident database.
- Contact the appropriate Regional Supervisor and/or Regional Wildlife Manager and local Department staff.

3. Incident

- Prompt field response is **required** in all cases to verify the presence of a mountain lion. Where a lion is judged to be a substantial threat to property or public safety it may be removed. **The decision to remove a mountain lion will be made by the Regional Supervisor and/or the Regional Wildlife Manager.** However, if Department personnel observe a conflict between a human and a lion, a lion

attacking a pet or livestock or a lion in a heavily populated area (e.g. downtown Rapid City) it may be removed immediately.

- If presence of a mountain lion is verified **IMMEDIATELY NOTIFY** - Regional Supervisor and/or Regional Wildlife Manager. 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.

- Complete mountain lion observation report form (Appendix Figure 9) and submit the report for entry into the wildlife incident database.

- The entire carcass including all parts of a mountain lion that is removed will be taken to the respective Regional Office. The Regional Supervisor or the Regional Wildlife Manager will report the lion removal to the Secretary of the Department.

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 Regional Wildlife Manager. Regional Supervisor will notify the Division Director, the Assistant Director of Operations, the Chief of Terrestrial Resources and the Public Information Officer. The Regional Supervisor and/or the Regional Wildlife Manager will institute the **Emergency Action Plan for a Lion Attack.** 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 Regional Wildlife Manager.

Protocol for Radio-Collared Mountain Lions

Mountain lions are wild animals and as such their behavior and actions cannot be predicted. Nothing in the process of radio-collaring a mountain lion and monitoring its movements changes its wild nature.

In the interest of public safety, if a radio collared lion meets the South Dakota Department of Game, Fish and Parks (SDGFP) Mountain Lion Response Protocol criteria of an attack on a human or a substantial threat to public safety, an immediate attempt will be made to remove the lion by SDGFP. To be judged a substantial public threat, a mountain lion would have to be observed or located by telemetry within concentrated

residential areas (where 10 or more residences can be seen), within view in an area of human recreation, within view of areas where children are regularly concentrated, or killing wildlife or pets within concentrated residential areas. If any of these criteria are met, the researcher monitoring the lion will immediately notify the SDGFP regional wildlife manager (RWM) and/or the regional supervisor (RS) for that respective area with the information. If telemetry information indicates that a radio collared lion could represent a substantial public threat, the researcher will intensively monitor that animal and report a "status assessment" to the RWM on a daily basis. The RWM will consult with the RS and other SDGFP supervisory staff about the disposition of the animal based on the "status assessment" for that radio collared lion.

If after receiving a report of a radio-collared lion within a concentrated residential area or area of human recreation, the lion is still within the concentrated residential area when a SDGFP representative arrives, the lion may be removed. If the lion has moved out of the concentrated residential area or area of human recreation, then the lion will be intensively monitored by the researcher and a "status assessment" relayed to the RWM on a daily basis.

If repeated (visits) reports of a radio-collared lion occur within a concentrated residential area or human recreation area, a "status assessment" will be conducted and forwarded to the RWM.

Any radio-collared lion involved in an attack, where a human is bodily injured or killed, will be immediately pursued by the SDGFP and removed using any means available.

If a radio-collared lion kills livestock, the researcher will contact the RWM and make arrangements to meet with the affected landowner to discuss the situation, verify that a radio-collared lion caused the depredation (a radio-collared lion is confirmed to be in the area and was observed at the kill site), and determine if some resolution short of killing the lion is acceptable to the landowner. Instances where verification can not be ascertained, but a radio-collared lion is in the vicinity of the kill, the lion will be intensively monitored and a "status assessment" conducted. If no resolution can be reached on a verified kill by a radioed-collared lion, the lion may be removed by SDGFP.

In cases where a monitored mountain lion is regularly frequenting the area of rural residences or areas where livestock are concentrated, but does not meet the criteria of a substantial public threat, the researcher will notify the RWM to discuss the situation. Efforts may be made to notify the rural residents of the lion's proximity and/or provide them with educational information such as the brochure "Living with Mountain Lions."

Research Results

To date, two research studies in conjunction with SDGFP have been conducted and completed by SDSU. These studies have added to the information known about mountain lions within South Dakota and data collected have been used in establishing scientific based management and hunting seasons. An overview of research results is provided to educate and provide justification for mountain lion management in South Dakota.

Capture

Mountain lions were captured from 1998-2006 throughout the Black Hills study area (Fecske 2003, Thompson 2009): methods included hounds, 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 a telazol/xylazine cocktail based on live animal body weight (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 adult VHF radio transmitters (Telonics, Inc., Mesa, Arizona, USA). Immobilized mountain lions were released on site and observed until recovered from immobilization. Kittens (<2 months of age) of marked female mountain lions also were captured to determine age of independence and dispersal; kittens were fitted with expandable VHF radio-collars (Thompson 2009).

Research animals were located weekly via aerial telemetry from a fixed-wing aircraft and/or ground triangulation. Locations of marked mountain lions were plotted in ArcGIS (ESRI, Redlands, California, USA). 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. Home ranges were calculated (95% Adaptive Kernel) using the Home Range Extension in ArcGIS. Bandwidths were selected that resulted in the lowest least squares-crossed validation scores (LSCV) to create smoothed home range polygons (Kie et al. 2002). Mountain lions that established home ranges with >5% overlap of natal home ranges were considered philopatric (Sweanor et al. 2000). If animals established home ranges within the study area they were then considered recruited into the Black Hills mountain lion population.

A total of 19 subadult male and 10 subadult female mountain lions were captured in the Black Hills from 2003-2006 (Thompson 2009). In addition, 18 kittens from seven separate litters captured and marked. Age of independence averaged 13.5 months (range 10-16 months) with dispersal occurring 1-3 months after independence from mothers. Upon reaching independence, subadult mountain lions of the same sex generally traveled together prior to separating and subsequently dispersing. 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). Study animals were located weekly via aerial telemetry from a fixed-wing aircraft, and ground triangulation and

visual observation was used to relocate animals between flights. The high road density of the Black Hills allowed adequate access for ground triangulation throughout the majority of the study area. Visual observation and track counts were used to assess kitten survival.

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 (Howard 1960).

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. c. cougaur*; Culver et al. 2000), and it was found that across the Wyoming Basin geographically separate populations were considered one panmictic 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).

Dispersal of subadult female mountain lions averaged 48.5 km (range 12.5-110.0 km, n=10). Female mountain lions exhibited philopatry in 40% (n =4) of documented dispersals. Three females were documented leaving the study area and either establishing home ranges or dieing in other habitats. Dispersal of subadult male mountain lions averaged 320.5 km (12.3-1,067.0 km, n=18) (Appendix Figure 15). No subadult male mountain lions were recruited into the Black Hills mountain lion population. All male mountain lions successfully dispersed from the natal area, however, several animals (n=5) died before establishing residency. When animals that sustained mortality while dispersing were censored, average dispersal rate increased to 540.5 km. The longest dispersal movement by a mountain lion (1,067 km) from the Black Hills was documented in 2003 (Thompson and Jenks 2005), and since that observation at least 5 additional radio-collared subadult males made movements in excess of 250 km (Appendix Figure 15). In addition, five subadult female mountain lions dispersed > 50 km from natal ranges (Appendix Figure 16).

Female dispersal movements within the Black Hills generally consisted of a movement towards the periphery of the ecosystem (Appendix Figure 16). 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 subadult male mountain lions dispersed farther than females. Although female mountain lion dispersal rates were within ranges documented by Sweanor et al. (2000), both males and females dispersed greater distances on average than found in previous studies (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). Upon reaching independence, same sex littermates commingled for a period of 1-3 months before disbanding and making solitary dispersal movements.

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 subadult mountain lions indicate prairie habitats and associated topographic characteristics do not act as barriers to movements. This finding contrasts with those of other populations (McRae et al. 2005). In contrast to other populations (Logan and Sweanor 2001, Pierce and Bleich 2003), female mountain lions were not philopatric. Movements of females indicated that density dependent factors, such as resource limitation and intraspecific competition (e.g., environmental dispersal; Howard 1960) where displacing individuals. 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 facilitate female dispersal. Biek and others (2006) found that intrapopulation 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 animals traveling in excess of 300 km upon leaving the Black Hills. 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 (Berger et al. 2001) readily available there would generally not be competition for resources. Unless an animal was successful in reaching regions to the west 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 (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 subadult 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.

Population Dynamics

Age classifications are defined as the following: kitten—still dependent with mother, subadult—independent but not part of the breeding population (usually <2.5 yrs old), and adult—an animal occupying a resident home range within the study area (generally >2.5 years old). Kaplan-Meier procedures were used to calculate annual survival between sex and age classes allowing for staggered entry (Pollock et al. 1989). Generally, as animals left the population they were censored; however, due to the high percentage of subadult males that leave mountain lion populations, survivorship was calculated while they were transient within the study area. Animals leaving the population were eventually censored. Two techniques were used for assessing mortality. Cause-specific mortality of radio-collared animals was documented continuously throughout the project. When a mortality signal of a radio-collared mountain lion was encountered, the collar was immediately retrieved and the cause of the mortality signal was determined. In instances of mortality, a thorough examination of the carcass was conducted along with surveying the surrounding area within a 100 m radius of the mortality site. In cases where mortality could not be determined on site from gross observation, the carcass was transported to South Dakota State University or South Dakota Department of Game, Fish and Parks (SDGFP) and a necropsy was conducted to determine cause of death. In addition, mortalities of mountain lions that occurred within the Black Hills were documented in conjunction with SDGFP. If cause-specific mortality could not be determined from gross examination of the carcass, the mortality site was surveyed to collect information that would assist with determining cause of mortality using the same techniques as those employed with radio-collared mountain lions. In addition to cause of death, all carcasses were examined to determine age and gender information for individuals. Known mountain lion mortalities were recorded beginning in 1998 in South Dakota, which resulted in trend data that related deaths/year and cause of death. Kruskall-Wallis tests were used to compare mortality events between years. In particular, an objective was to document changes in survival rates and causes of mortality through time.

Survival

A total of 35 mountain lions were radio-collared from 2005-2009 for survival analyses (n= 15 males; 20 females). Males were tracked an average of 600.8 days (range=53-2440 days) and females an average of 599.5 days (range 50-2081 days). Annual female survival ranged from 0.50-1.0 from 1999-2005 (Appendix Table 19). Annual male survival ranged from 0.50-1.0 from 1999-2005 (Appendix Table 19). Mean annual male (0.82; SE=0.07) and female (0.85; SE=0.08) survival of mountain lions did not differ (P>0.05). Survival of subadult and adult female mountain lions did not differ (P>0.05); therefore, annual survival estimates were pooled. Five mortality events were documented of radio-collared females (Appendix Table 19). Of the 15 males tracked, 8 were subadult males and 7 were resident males. No subadult males were recruited into the population

primarily due to dispersal. However, survival of males was monitored prior to their dispersal. Three subadult males died (2 vehicle trauma, 1 removal) while in the Black Hills study area, with the remaining five dispersing from the Black Hills (Survival = 0.62). Subadult males were tracked an average of 155.8 days while in the study area. Three adult male mountain lions died during the study; two of the resident males captured were tracked > 2,300 days and were still alive at the end of the study.

Harvest rate on male mountain lions was 44.2% in 2010. No previous harvest rate estimates have been produced for male mountain lions due to small sample sizes in harvest. Harvest rate on female mountain lions increased from 14.0% in 2009 to 21.5% in 2010. Increased harvest resulted in a decrease in survival rate of male and female mountain lions; survival rate was reduced to 0.37 and 0.723, respectively, for male and female mountain lions. These updated survival rates were used to model the mountain lion population.

A total of 29 litters (n=84 kittens <6 weeks old) were captured post initiation of season harvest (2005). Litter size averaged 2.9 kittens with a 1:1 (male=42:female=42) sex ratio. Kitten survival from 2005-2009 averaged 0.587. Recent data collected indicates an average kitten survival of 0.587. Using 2010 harvest rates and recent survival estimates for males, females, and kittens, population projections indicate that population size prior to harvest 2011 will be reduced approximately 10% to 223 mountain lions.

Cause-specific Mortality (Radio-collared mountain lions)

Thirteen mortalities of marked mountain lions was documented from 1999-2005. Depredation removal (*n*=3) and illegal kill (*n*=3) accounted for the highest number of radioed mountain lion mortalities. Vehicular trauma (*n*=2) and intraspecific strife (*n*=2) accounted for 30.8 % of mortalities. Infanticide was documented of one marked animal, with the other three littermates succumbing to infanticide. Cause-specific mortality was documented from drowning (*n*=1) and forest fire (*n*=1; Fecske et al. 2003). Natural mortality accounted for 38.4 % of total cause-specific mortality from radio-collared mountain lions.

Mortality Characteristics (All documented mortality)

A total of 326 mortality events were documented in South Dakota between the years 1998-2009. Death associated with hunter harvest was the primary mortality source (*n*=80), followed by removal (*n*=72), vehicular trauma (*n*=52), unknown causes (*n*=33), intraspecific strife (*n*=31) from interactions or infanticide, incidental snaring/trapping (*n*=16), sick or emaciated lions (*n*=21) and illegal killing (*n*=7) (Appendix Figure 10). The number of mortality events recorded annually increased from 1998-2008; then decreased in 2008 due to the lack of a hunting season. In 2009, the mortality events increased to 2007 numbers (Appendix Figure 11).

For documented mortalities between 1998 and 2009, the average age of death for cougars in South Dakota was 2.46 years and no difference was found between age at death of

male and female cougars. A higher number of males (*n*=173) died compared to females (*n*=140). There were 13 lion deaths that were recorded as sex unknown. More females (n = 49) than males (n = 31) were harvested during established harvest seasons. More males (n = 54) than females (n = 18) were removed due to depredation or human safety reasons (Appendix Figure 17). Vehicular trauma was a major source of mortality for both male and female cougars (Appendix Figure 17).

Of the 293 mortality events attributed to a specific cause, 56 were considered natural mortality (19 %), with the remaining events (*n*=237; 81 %) considered human-induced or human-related causes of mortality. Natural mortality was primarily due to interaction with other lions or emaciation.

Genetic Diversity

A total of 134 individuals from the Black Hills mountain lion population were analyzed to assess genetic diversity (Appendix Table 20). Black Hills samples were compared to 18 individual mountain lions from North Dakota based on 20 loci to compare genetic structure and conduct population assignment tests. In addition to comparing genomic results between Dakota mountain lions, analyses was performed to compare the North and South Dakota populations to the Wyoming mountain lion database (Anderson et al. 2005), based on 8 loci. South Dakota mountain lions had an average observed heterozygosity (H_O) of 0.547 (Appendix Table 21), which was similar to other viable mountain lion populations (Culver 2010). Effective population size (N_e) or number of breeding individual mountain lions in the Black Hills was 28 animals (22.65-38.97; 95%CL). This should not, however, be equated with a minimum number at which the population would remain viable. Maehr et al. (2002) conducted a Population Viability Analysis (PVA) for the Florida Panther, which indicated that at a population size of about 74 individuals, probability of persistence declined due to the potential for inbreeding depression. Consequently, a population size above that level with adequate immigration of individuals from outside the Black Hills region (e.g., 1 male per generation; 1 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 175 (+/- 25) individuals is within the range to provide for sufficient genetic diversity amongst this Black Hills mountain lion population.

When comparing between mountain lion populations, Black Hills mountain lions had higher genetic variation than those from North Dakota. Both populations had alleles unique to each population (SD: n = 26; ND: n = 6), and each population showed a marginally significant genetic bottleneck using a two-phase evolutionary model (SD: p=0.02; ND: p=0.07). Use of 20 loci resulted in an F_{ST} (proportion of the total genetic variance contained in a subpopulation relative to the total genetic variance) of 0.05 between mountain lions from Black Hills and North Dakota, along with allowing fine scale resolution of population membership using assignment tests (Appendix Table 22). Two individuals from the North Dakota samples were assigned to the Black Hills population. Population assignment tests using both allele frequency and Bayesian

analyses produced similar results. Based on comparisons using only 8 loci, mountain lions from the Black Hills were more closely related to Wyoming (F_{ST} = 0.024) than North Dakota (F_{ST} = 0.043) mountain lions.

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. 2005, Biek et al. 2006, 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, crytporchidism) were noted in Black Hills mountain lions. Results support conclusions by Anderson et al. (2005) 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. (2006) 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 of mountain lions from the Black Hills is much lower than reported for some mountain lion populations. Utah reported an effective population size of 571 animals based on a population estimate of 3,000-4,000 individuals (Sinclair et al. 2001). Wyoming N_e estimates averaged approximately 2,500 individuals for the statewide mountain lion population (Anderson et al. 2005). In comparison, N_e for the Florida panther was estimated at 20-40 (Hedrick 1995). 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). Population estimates for mountain lions in the Black Hills ranged from 200-220 individuals (Huxoll 2006) during the period when samples were collected for genetic analyses. N_e for the Black Hills population is estimated at 70 breeding individuals, which includes 30 breeding-aged adults and 50 adolescence or dependent young (Allendorf & Ryman 2002). Periodic assessment of effective population size as it relates to overall population size could assist in detecting deleterious population effects associated with a reduction in N_e through time (Schwartz et al. 2006).

Mountain lions were successfully assigned to populations in North and South Dakota using 20 loci. Two mountain lions from North Dakota were assigned to the Black Hills population, supporting emigration from the Black Hills and were either transient or resident mountain lions in the North Dakota population when samples were collected. Based on 8 loci, mountain lion populations in Wyoming were considered part of one panmictic population (Anderson et al. 2005). Current analyses support conclusions of Anderson et al. (2004).

Nutritional Condition

Data collected has shown that dispersal due to "population saturation" with associated density dependence effects (Howard 1960) occurred prior to establishing a harvest on the species. For example, nutritional condition of mountain lions declined prior to harvest (Appendix Figure 8, Yearcode 2) and adults and kittens died from starvation and there was a shift in prey use from primarily natural prey to consumption of more domestic species (e.g., domestic cat). In addition, subadult female mountain lions were documented dispersing from the Black Hills (Thompson 2009) Appendix Figure 16. Estimated total kidney fat index (ETKFI; an index to nutritional condition) of mountain lions for three periods: Yearcode 1, from 1998-2001 (Fecske 2003), Yearcode 2, from 2002 -2005 (Thompson 2009), and Yearcode 3, from 2006-2009. Harvest of mountain lions was initiated in 2005 (Yearcode 2). There was no difference between sexes or ages in ETKFI for the sample ($n = 75$) but a difference ($P < 0.001$) for year period (orthogonal contrast comparing year periods 2 vs. 1 and 3) indicating that nutritional condition of lions was lower just prior to harvest than early and post harvest.

Ongoing & Upcoming Research

SDSU has completed a baseline study (Study No. 7594, Fecske 2003) to estimate the mountain lion population and to predict carrying capacity. A follow-up study (Study No. 7594, Thompson 2009) evaluated survival, dispersal, and genetic structure of the mountain lion population. Studies evaluating effects of harvest on the mountain lion population (Study No. 7587) and evaluating prey selection of mountain lions (Study No. 7537) are in progress. Future studies should be closely tied to information needs for state management planning.

Projects currently in progress include the following:

Project Title: *Evaluating effects of harvest on mountain lions in the Black Hills of South Dakota.*

Mountain lions historically occurred throughout South Dakota but were extirpated around the turn of the century due to a bounty placed on the animal in 1889. Information collected on mountain lions (*Puma concolor*) occurring in the Black Hills of South Dakota has indicated population increase from the late 1990s to 2006. Indices that support this increase include verified sightings, subtle changes in male territories, and estimates of population size based on home range size and mark recapture. Current indices (population and nutrition) suggest the population has become saturated. This information was used by South Dakota Department of Game, Fish and Parks to establish a mountain lion harvest in 2005. An evaluation of this harvest is in need to assess compensation relative to natural (including other human-caused mortality) mortality, effects of sex-specific harvest on population size and potential recruitment, and harvest rate that will provide sustained opportunity for hunters in the Black Hills region. In addition, information on disease prevalence in mountain lions will aid in assessing population quality.

Objectives:

1. To determine if harvest mortality is compensated for or additive to other forms of mortality in mountain lions in the Black Hills, South Dakota, by 2011.

2. To determine if there is a change in annual production of mountain lions as a result of sport-harvest of mountain lions in the Black Hills, South Dakota, by 2011.

3. To determine the characteristics of mountain lions that are removed by Department of Game, Fish, and Parks personnel in the Black Hills, South Dakota, by 2011.

4. To examine the seroprevalence of infectious diseases of mountain lions in the Black Hills, South Dakota, by 2011.

Justification:

Since its listing as "state threatened" in 1978, the mountain lion population has increased and a recognized breeding population occurs in the Black Hills (Fecske 2003). Information on mountain lion survival, dispersal, and density is critical to understanding population dynamics of this species in the Black Hills. Previous, and on-going, research has estimated population size (Fecske 2003, Study No. 75106), dispersal (Study No. 75106), and survival (Fecske et al. 2003, Study No. 75106) of lions. Currently, the mountain lion population is estimated at 250 based on population reconstruction, modeling, and mark recapture (Study No. 75106). Dispersal is male biased with approximately 90% (Study No. 75106) of subadults dispersing up to 1067 km from the Black Hills (Thompson and Jenks 2005). Data collected on this population also indicates that it has become saturated. Total percent kidney fat of mountain lions has declined from average levels documented prior to 2004 (Study No. 75106). In addition, some adults and kittens have appeared emaciated and domestic prey has increased in diets since 2004. Moreover, some individuals have developed eye disorders (i.e., uveitis), which are likely related to availability of the amino acid, Taurine, to kittens. This information was used, in addition to requests for harvest opportunities, to justify a harvest of mountain lions in the Black Hills. In 2005, a total of 13 lions (7 females, 6 males) were harvested from the Black Hills (Leif 2006).

For mountain lions, harvest mortality is believed to add to natural mortality. Some researchers have suggested that no compensation (100% additive mortality) occurs between harvest and natural mortality in mountain lion populations. This conclusion has not been verified scientifically. In addition, harvests of 20% have been recommended as sustainable for mountain lion populations provided refugia and ample emigration exist (Anderson and Lindzey 2005). Yet, this conclusion might not be supported in the Black Hills because of limited emigration and high road density. Consequently, a need exists to evaluate harvest of mountain lions to quantify the level of compensation that occurs due to harvest and the effect of harvest rate on population size and characteristics.

Project Title: *Determining impacts of mountain lions on bighorn sheep and other prey sources in the Black Hills*

Bighorn sheep (*Ovis Canadensis*) survival and reproduction have declined in the Black Hills region based on field reconnaissance conducted annually by South Dakota Department of Game, Fish and Parks personnel. Cause of this decline is unknown but could be associated with an increase in the mountain lion (*Puma concolor*) population or diseases (e.g., *Mycoplasma* spp.) that have been documented in bighorn sheep in this region. Mountain lion predation rates on deer (*Odocoileus* spp.) and elk (*Cervus elaphus*) also are unknown in the Black Hills. Information on predation rates of mountain lions is needed to assess the role of mountain lions on the population dynamics of bighorn sheep and for current models that predict population size and harvest mortality of deer and elk in this region.

Objectives:

1. Assess prey selection of mountain lions during the bighorn sheep lambing period by 30 June 2014.

2. Evaluate seasonal and annual consumption rates for prey, including deer and elk, of mountain lions by 30 June 2014.

3. Determine cause-specific mortality of adult ewe and lamb bighorn sheep by 30 June 2014.

4. Determine impact of disease on the reproductive potential of bighorn sheep by 30 June 2014.

Justification:

Since its listing as "state threatened" in 1978, the mountain lion population has increased and a recognized breeding population occurs in the Black Hills (Fecske 2003). Information on mountain lion survival, dispersal, and density is critical to understanding population dynamics of this species in the Black Hills. Previous, and on-going, research has estimated population size (Fecske 2003, Study No. 75106), dispersal (Study No. 75106), and survival (Fecske et al. 2003, Study No. 75106) of lions. Currently, the mountain lion population is estimated at 223 based on population reconstruction, modeling, and mark recapture (Study No. 75106) (Appendix Figure 2). Dispersal is male biased with approximately 90% (Study No. 75106) of subadults dispersing up to 1067 km from the Black Hills (Thompson and Jenks 2005). Data collected on this population also indicates that it has become saturated. Total percent kidney fat of mountain lions has declined from average levels documented prior to 2004 (Study No. 75106). In addition, some adults and kittens have appeared emaciated and domestic prey has increased in diets since 2004. Moreover, some individuals have developed eye disorders (i.e., uveitis), which are likely related to availability of the amino acid, Taurine, to kittens. This information was used, in addition to requests for harvest opportunities, to justify a harvest of mountain lions in the Black Hills. In 2005, a total of 13 lions (7 females, 6

males) were harvested from the Black Hills. More recently (2010), harvest was increased to a quota of 40 mountain lions or 25 female mountain lions (whichever occurred first) and a total of 40 mountain lions was harvested.

Some researchers have suggested that 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). Predation by mountain lions was the primary proximate cause of mortality (75% of mortalities) on bighorn sheep in one population in Arizona (Rominger et al. 2004). Moreover, Kamler et al. (2002) also documented that mountain lions caused 66% of mortality on a translocated bighorn sheep population in Arizona. In California, mountain lions were responsible for 69% of bighorn sheep mortalities (Hayes and Rubin 2000). In contrast, others have suggested that mountain lions can cause limited mortality to bighorn sheep and other large mammal populations (Rominger et al. 2004, Cougar Management Guidelines Working Group 2005). However, lamb production and survival are generally correlated with summer climatic conditions and populations of bighorn sheep can experience disease-mediated lamb mortality during this season (Enk et al. 2001). The controversy surrounding prey use by mountain lions has resulted in a need for information for the Black Hills due to the existence of limited local information on prey use of this population of mountain lions (Fecske et al. 2003) and a lack of information on cause-specific mortality (i.e., predation, disease) of bighorn sheep (adult ewes and lambs). Information obtained from this study will be used in population models for estimating harvest of deer and elk, as well as bighorn sheep in the Black Hills region.

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List of Appendix Tables

Appendix Table 1. Frequency of occurrence (%) of prey species in diet of Dakota mountain lions, 2003-2007 (From Thompson et al. 2009).

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

* Porcupine (*n* = 2), badger (*n* = 1), and beaver (*n*= 1).
** Mink (*n* = 1) and jackrabbit (*n* = 1).

Appendix Table 2. Mountain lion winter track counts, Black Hills, South Dakota, 2006-2010.

	Total of all surveys			**High count per route for year**			**Presence/ Absence**			**Total of Average # of tracks per route**		
Year	Total Tracks	Miles Surveyed	Tracks per 100 miles	Total Tracks	Miles Surveyed	Tracks per 100 miles	Total Surveys	Surveys w/Tracks	Proportion	Total Average Tracks	Miles Surveyed	Average Tracks per 100 miles
06-07	3	141.6	**2.12**	3	141.6	**2.12**	8	3	**0.375**	3	141.6	**2.12**
07-08	15	234.3	**6.40**	15	160.4	**9.35**	14	5	**0.357**	9	160.4	**5.61**
08-09	40	563.6	**7.10**	21	150.9	**13.92**	31	17	**0.548**	10.97	150.9	**7.27**
09-10	29	299.8	**9.67**	24	170.4	**14.08**	17	13	**0.765**	17.5	170.4	**10.27**

Appendix Table 3. Mountain Lion Season Structure, 2005 – 2010.

Year	Season Dates	Total Quota	Female Sub-quota	Units
2005	Oct. 1-Dec. 15	25	5 breeding age	Black Hills & Prairie
2006	Nov. 1-Dec. 31	25	8	Black Hills & Prairie
2007	Nov. 1-Dec. 31	35	15	Statewide
2009	Jan. 1-March 31[A]	35	15	Statewide
2010	Jan. 1-March 31[A]	40	25	Statewide

[A]Landowners on own land may harvest a lion year round outside Black Hills. Harvest does not count toward quota outside of the Black Hills management unit season dates.

Appendix Table 4. Black Hills management unit mountain lion hunting season results, 2005 – 2010.

Year	Total	Males		Females	
		Adult	Sub-Adult	Adult	Sub-Adult
2005	13	1	5	5	2
2006	15	2	5	2	6
2007	18	0	2	9	7
2009	26	7	2	3	12[A]
2010	40	11	5[B]	18	6[C]

[A]One female classified as a kitten (less than one year of age).
[B]Two males classified as kittens (less than one year of age).
[C]Three females classified as kittens (less than one year of age).

Appendix Table 5. Hunting methods and average days hunted for successful hunters.

Year	Methods	Number	Ave. Days Hunted
2005	Predator Call	6	
	Road Hunting	1	
	Kill Site	1	
	Hunting Off Deck	1	3.9[A]
	Incidental	4	2.0[B]
2006	Predator Call	9	
	Road Hunting	1	
	Hunting Off Deck	1	4.3[A]
	Incidental	4	2.0[B]
2007	Predator Call	6	
	Road Hunting	1	
	Spot & Stalk	1	
	Sitting	1	4.2[A]
	Incidental	8	3.0[B]
2009	Predator Call	11	
	Lion Call	3	
	Bobcat Distress Call	1	
	Spot & Stalk	3	
	Tracking	4	
	Sitting	3	
	Kill Site	1	5.0[C]
2010	Predator Call	23	
	Lion Call	1	
	Spot & Stalk	7	
	Tracking	6	
	Kill Site	3	6.9[C]

[A]Includes all methods except incidental.
[B]Includes only incidental.
[C]Includes all methods.

Appendix Table 6. Comparing attitudes from the general public sample (2002) with the sample of resident Black Hills deer hunters (2004) – *I would support a mountain lion season if the state acquires data that the mountain lion population is healthy and could sustain a prescribed level of harvest.*

Attitude – Support for a mountain lion season …	General Public (2002)	Black Hills Deer Hunters (2004)	Public Meeting (2005)
Strongly Agree (+3)	30.6%	55.7%	67.5%
Moderately Agree (+2)	26.0%	20.3%	7.1%
Slightly Agree (+1)	15.1%	11.2%	3.7%
Neutral / No Opinion (0)	14.2%	7.0%	1.7%
Slightly Disagree (-1)	2.6%	1.5%	1.4%
Moderately Disagree (-2)	4.0%	1.1%	1.7%
Strongly Disagree (-3)	7.5%	3.1%	16.9%
Total Number	1,081	1,846	354
Mean	1.26	2.06	1.65
95% C.I.	1.15 – 1.37	1.99 – 2.12	1.41 – 1.89
SUMMARIZED RESULTS			
AGREE	71.7%	87.2%	78.2%
NEUTRAL / NO OPINION	14.2%	7.0%	1.7%
DISAGREE	14.1%	5.7%	20.1%

Appendix Table 7. Do you oppose or favor a mountain lion hunting season in South Dakota?

Full Attitude (scale)	Percent	SUMMARIZED ATTITUDE	PERCENT
Strongly Oppose (-3)	**11.1%**	**OPPOSE**	**23.7%**
Moderately Oppose (-2)	**5.7%**		
Slightly Oppose (-1)	**6.9%**		
Neutral (0)	**13.5%**	**NEUTRAL**	**13.5%**
Slightly Favor (+1)	**13.3%**	**FAVOR**	**62.8%**
Moderately Favor (+2)	**17.2%**		
Strongly Favor (+3)	**32.3%**		
Number	**4,381**	**NUMBER**	**4,381**
Mean / 95% C.I.	**0.93**	**0.87 – 0.99**	

Appendix Table 8. If it was known that a **mountain lion** lives in the area where you live but had not caused any problems or exhibited any threatening behavior, which action would you want the state wildlife agency (GFP) to take?

Take no action	**11.7%**
Educate the public on how to safely live in lion areas	**38.5%**
Take steps to chase the lion out of the area	**10.6%**
Capture and remove the lion	**30.6%**
Destroy the lion	**7.0%**
No opinion	**1.4%**
Number	**4,333**

Appendix Table 9. Would you like the following **wildlife populations in the Black Hills** to increase, decrease, or remain at their current levels over the next five years?

Desired Population Direction for Black Hills	Wildlife Populations of:				
	Mountain Lion	Elk	Deer	Coyote	Black Bear
Eliminate this species	3.1%	0.3%	0.2%	2.9%	6.1%
Decrease Greatly	10.3%	1.0%	13.6%	10.2%	7.7%
Decrease Some	30.1%	6.5%	32.3%	21.5%	6.3%
Remain at Current Level	46.2%	40.8%	36.5%	52.8%	48.4%
Increase Some	8.0%	34.8%	11.3%	9.9%	20.4%
Increase Greatly	2.2%	16.6%	6.1%	2.7%	11.1%
Number	4,351	4,337	4,377	4,325	4,170

Table 10. Attendance at the 2010 public meetings on mountain lion management planning.

City	Date – 2010	Attendance	Returned Surveys
Spearfish	March 22	70	64
Sioux Falls	March 23	27	27
Yankton	March 24	41	36
Mitchell	March 25	23	19
Hot Springs	March 29	38	29
Buffalo	March 30	9	6
Custer	March 31	43	39
Rapid City	April 1	79	74
Aberdeen	April 12	23	20
Winner	April 13	21	19
Pierre	April 14	22	22
Total	-	396	355

Table 11. In general, do you oppose or favor a mountain lion hunting season in South Dakota?

Attitude (scale)	Public Meetings		Unsolicited Responses		Black Hills Citizens	
	Number	Percent	Number	Percent	Number	Percent
Strongly Oppose (-3)	18	5.2%	65	59.1%	486	11.1%
Moderately Oppose (-2)	11	3.2%	14	12.7%	248	5.7%
Slightly Oppose (-1)	7	2.0%	7	6.4%	300	6.9%
Neutral / No Opinion (0)	11	3.2%	3	2.7%	593	13.5%
Slightly Favor (+1)	14	4.0%	7	6.4%	583	13.3%
Moderately Favor (+2)	28	8.0%	4	3.6%	754	17.2%
Strongly Favor (+3)	260	74.5%	10	9.1%	1,417	32.3%
Total	349	100%	110	100%	4,381	100%
Mean	2.20		-1.68		0.93	
95% C.I.	2.02 – 2.38		-2.07 – -1.30		0.87 – 0.99	
SUMMARIZED RESULTS						
OPPOSE	36	10.3%	86	78.2%	1,034	23.6%
NEUTRAL / NO OPINION	11	3.2%	3	2.7%	593	13.5%
FAVOR	302	86.5%	21	19.1%	2,754	62.9%

Table 12. Preferred Action: If it was known that a mountain lion frequented the area where you live but had not caused any problems or exhibited any threatening behavior, which action would you want the state wildlife agency (GFP) to take?

Preferred action	Public Meetings		Unsolicited Responses		Black Hills Citizens	
	Number	Percent	Number	Percent	Number	Percent
Take no action.	64	18.2%	36	32.7%	509	11.7%
Educate the public on how to safely live in lion areas.	128	36.5%	57	51.8%	1,668	38.5%
Take steps to chase the lion out of the area.	21	6.0%	7	6.4%	461	10.6%
Capture and remove the lion.	47	13.4%	7	6.4%	1,328	30.6%
Kill the lion.	83	23.6%	2	1.8%	305	7.0%
No Opinion.	8	2.3%	1	0.9%	63	1.4%
Total	351	100%	110	100%	4,333	100%
SIGNIFICANT TESTS – PEARSON CHI-SQUARE						
Variables Compared				X^2	df	*p*-value
Public Meetings – Unsolicited Responses				39.028	5	<0.001
Public Meeting – Black Hills Citizen				160.901	5	<0.001
Unsolicited Responses – Black Hills Citizen				70.785	5	<0.001

Table 13. Preferred Mountain Lion Population in the Black Hills.

Preferred Mountain Lion Population for the Black Hills (scale)	Public Meetings		Unsolicited Responses		Black Hills Citizens	
	Number	Percent	Number	Percent	Number	Percent
Eliminate (0)	21	6.2%	2	1.9%	133	3.1%
Decrease a Lot (1)	112	32.9%	3	2.9%	448	10.3%
Decrease Some (2)	93	27.4%	9	8.6%	1,312	30.1%
Current Level (3)	78	22.9%	40	38.1%	2,011	46.2%
Increase Some (4)	29	8.5%	41	39.0%	350	8.0%
Increase a Lot (5)	7	2.1%	10	9.5%	97	2.2%
Total	340	100%	105	100%	4,351	100%
Mean	2.01		3.38		2.53	
95% C.I.	1.89 – 2.13		3.19 – 3.58		2.50 – 2.55	
SIGNIFICANT TESTS – PEARSON CHI-SQUARE						
Variables Compared				X^2	df	*p*-value
Public Meetings – Unsolicited Responses				109.424	5	<0.001
Public Meeting – Black Hills Citizen				184.142	5	<0.001
Unsolicited Responses – Black Hills Citizen				158.665	5	<0.001

Appendix Table 14. Reported observations of mountain lions by Black Hills deer hunters (2004–2009).

Mountain Lion Interactions	Years – Percent YES					
	2004	**2005**	**2006**	**2007**	**2008**	**2009**
Observed a mountain lion while Black Hills deer hunting	**6.3%** N=1,841	**6.5%** N=1,711	**7.7%** N=1,330	**6.1%** N=1,550	**6.0%** N=2,370	**8.5%** N=2,559

Appendix Table 15. Did you spend any time hunting for mountain lions this year (2005–2009)?

Hunted Mountain Lions?	**YEAR**							
	2005		**2006**		**2007**		**2009**	
	Number	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
NO	875	43.1%	956	38.6%	1,384	41.0%	628	32.2%
YES	1,153	56.9%	1,518	61.4%	1,988	59.0%	1,320	67.8%
TOTAL	2,028	100%	2,474	100%	3,372	100%	1,948	100%
Pearson Chi-Square: X^2=58.013; df=3; p<0.001								

Appendix Table 16. Interactions with mountain lions during the 2005–2009 mountain lion seasons.

Observed Tracks or Sign of Lions	**YEAR**							
	2005		**2006**		**2007**		**2009**	
	Number	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
NO	618	54.1%	849	50.3%	1,159	58.3%	339	25.7%
YES	524	45.9%	839	49.7%	820	41.7%	981	74.3%
TOTAL	1,142	100%	1,688	100%	1,988	100%	1,320	100%
Pearson Chi-Square: X^2=372.043; df=3; p<0.001								
Observed a Mountain Lion	**YEAR**							
	2005		**2006**		**2007**		**2009**	
	Number	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
NO	967	86.1%	1,512	89.6%	1,783	89.7%	1,135	86.0%
YES	156	13.9%	176	10.4%	205	10.3%	185	14.0%
TOTAL	1,123	100%	1,688	100%	1,988	100%	1,320	100%
Pearson Chi-Square: X^2=18.233; df=3; p<0.001								

Appendix Table 17. Success statistics for the 2005–2009 mountain lion seasons.

YEAR	PARAMETER		
	Success per Licensed hunter	Estimated number of lion hunters	Success per lion hunter
2005	13 / 2,294 = **0.57%**	56.9% X 2,294 = **1,305**	13 / 1,305 = **1.00%**
2006	15 / 3,016 = **0.50%**	59.8% X 3,016 = **1,804**	15 / 1,804 = **0.83%**
2007	19 / 4,070 = **0.47%**	59.0% X 4,070 = **2,401**	19 / 2,401 = **0.79%**
2009	26 / 2,428 = **1.07%**	67.8% 2,428 = **1,646**	26 / 1,646 = **1.58%**

Appendix Table 18. Overall, how satisfied were you with the mountain lion season as conducted in 2005–2009?

Satisfaction (scale)	2005	2006	2007	2009
	Percent	Percent	Percent	Percent
Very Satisfied (3)	32.0%	23.9%	24.8%	27.2%
Moderately Satisfied (2)	25.0%	23.0%	24.5%	23.0%
Slightly Satisfied (1)	11.5%	12.2%	10.7%	11.0%
Neutral / No Opinion (0)	15.8%	26.9%	25.5%	28.3%
Slightly Dissatisfied (-1)	6.9%	7.1%	6.4%	4.1%
Moderately Dissatisfied (-2)	4.4%	3.4%	4.5%	2.9%
Very Dissatisfied (-3)	3.9%	3.5%	3.7%	3.5%
Total Number	1,956	2,386	2,052	1,840
Mean	1.31	1.06	1.08	1.18
95% C.I.	1.24 – 1.39	N/A	1.00 – 1.15	1.11 – 1.26
SUMMARIZED RESULTS				
SATISFIED	69.0%	59.1%	59.9%	61.2%
NEUTRAL	15.8%	26.9%	25.5%	28.3%
DISSATISFIED	15.2%	14.0%	14.6%	10.5%

Appendix Table 19. Annual survival estimates for independent aged mountain lions in the Black Hills of South Dakota, 1999-2005 (From Thompson 2009).

Year	Males (*N*)	Annual Male S_i	Females (*N*)	Annual Female S_i
1999	4	0.75	0	N/A
2000	3	0.67	4	0.75
2001	2	1.00	3	1.00
2002	3	1.00	4	0.50
2003	7	1.00	5	1.00
2004	8	0.50	13	0.92
2005	5	0.80	16	0.94
Mean =	**4.57**	**0.82**	**6.43**	**0.85**

Appendix Table 20. Genetic variability by locus of Black Hills, South Dakota mountain lions (From Thompson 2009).

Locus	*n*		*Alleles*		Effective Alleles		H_O		H_E		F_{IS}	
	SD	**ND**	**SD**	**ND**	**SD**	**ND**	**SD**	**ND**	**SD**	**ND**	**SD**	**ND**
Fca43	134	18	5	2	1.92	1.60	0.50	0.39	0.48	0.38	-0.05	-0.04
Fca57	133	18	5	4	1.99	2.93	0.45	0.72	0.50	0.66	0.09	-0.10
Fca77	134	18	2	2	1.01	1.06	0.01	0.06	0.01	0.05	0.00	-0.03
Fca90	134	18	5	5	2.38	2.78	0.60	0.67	0.58	0.64	-0.03	-0.04
Fca96	134	18	5	3	2.74	2.76	0.63	0.72	0.64	0.64	0.00	-0.13
Fca132	134	18	5	4	3.02	2.46	0.76	0.61	0.67	0.59	-0.14	-0.03
Fca559	132	18	8	6	3.42	1.81	0.70	0.28	0.71	0.45	0.02	0.38
Fca176	130	18	4	6	2.96	2.37	0.72	0.72	0.66	0.58	-0.09	-0.25
Fca35	133	18	2	2	1.92	1.86	0.44	0.50	0.48	0.46	0.09	-0.08
Lc109	134	18	4	2	2.91	1.53	0.71	0.33	0.66	0.35	-0.08	0.04
Fca391	133	18	4	3	2.34	2.11	0.53	0.44	0.57	0.53	0.07	0.16
Fca08	134	18	2	3	1.74	2.18	0.45	0.72	0.43	0.54	-0.05	-0.33
Fca30	134	18	4	2	1.29	1.25	0.22	0.22	0.22	0.20	0.04	-0.13
Fca82	121	18	6	3	2.98	2.99	0.61	0.78	0.66	0.67	0.08	-0.17
Fca149	134	18	3	3	1.41	1.48	0.27	0.39	0.29	0.32	0.08	-0.21
PcoA208	131	18	3	3	2.59	2.96	0.63	0.72	0.61	0.66	-0.03	-0.09
PcoB10	132	18	7	4	3.23	3.56	0.70	0.72	0.69	0.72	-0.01	0.00
PcoC112	133	18	4	2	2.57	2.00	0.60	0.53	0.61	0.50	0.01	-0.06
PcoB210	133	18	5	4	3.58	2.17	0.74	0.39	0.72	0.54	-0.03	0.28
PcoC108	133	18	3	3	2.86	2.62	0.67	0.61	0.65	0.62	-0.03	0.01

Appendix Table 21. Mean and standard error of genetic variability metrics for Dakota mountain lions (From Thompson 2009).

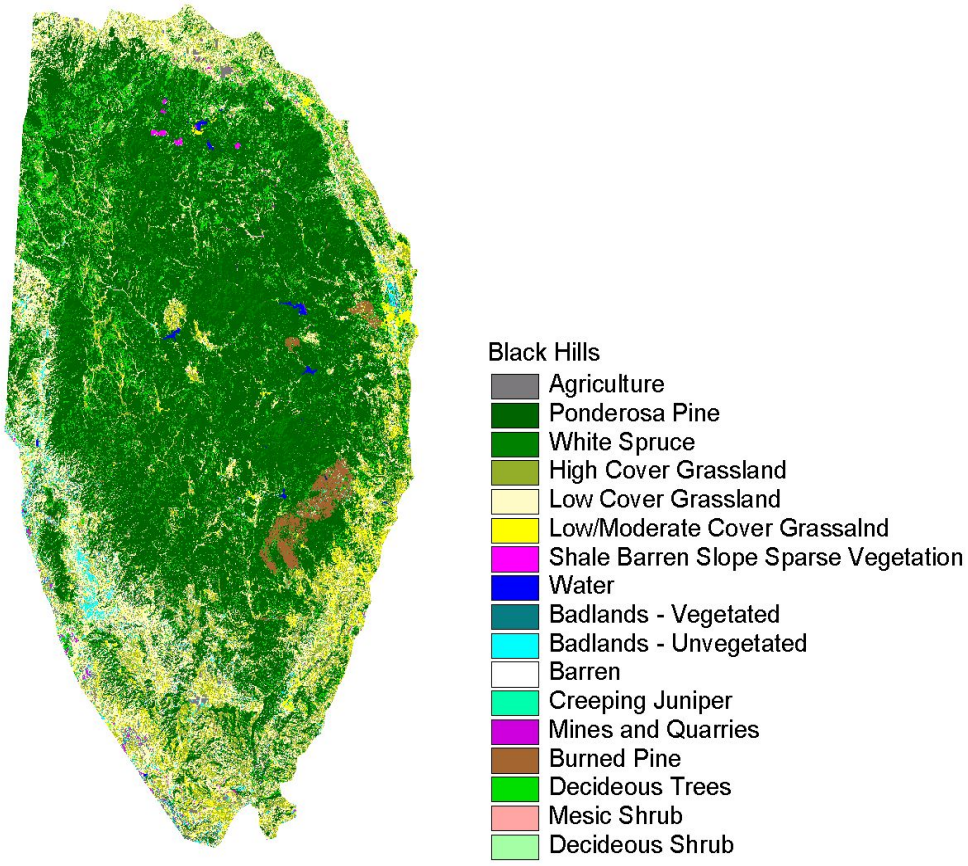
	South Dakota		North Dakota	
	Mean	SE	Mean	SE
Alleles/Locus	4.3	0.356	3.3	0.282
Allele with Freq ≥ 5%	3.3	0.252	2.6	0.169
Effective Alleles/Locus	2.442	0.162	2.223	0.148
# Alleles found only in:	1.3	0.291	0.3	0.147
$\mathbf{H_E}$	0.542	0.041	0.504	0.039
$\mathbf{H_O}$	0.547	0.044	0.526	0.046

Appendix Table 22. Population assignment tests between North Dakota and South Dakota Mountain lions using 20 microsatellite loci. (From Thompson 2009).

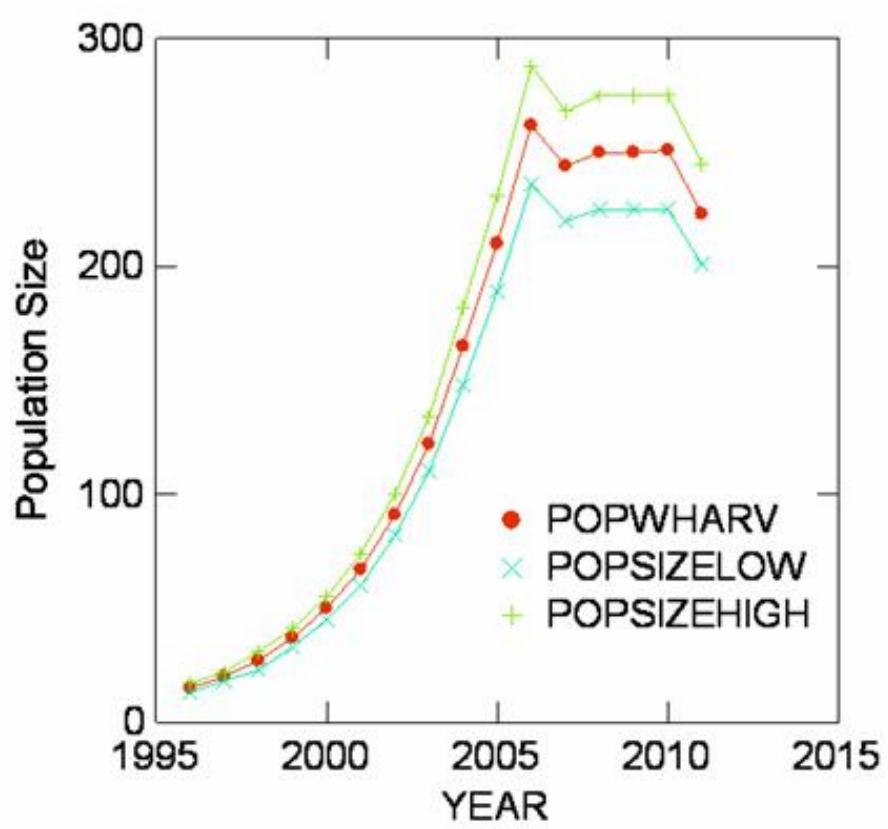
	Assigned Population	
Sample Population	Sample Pop.	Other Pop.
South Dakota (n = 134)	133	1
North Dakota (n = 18)	16	2
Total	149	3
Percent	98%	2%

List of Appendix Figures

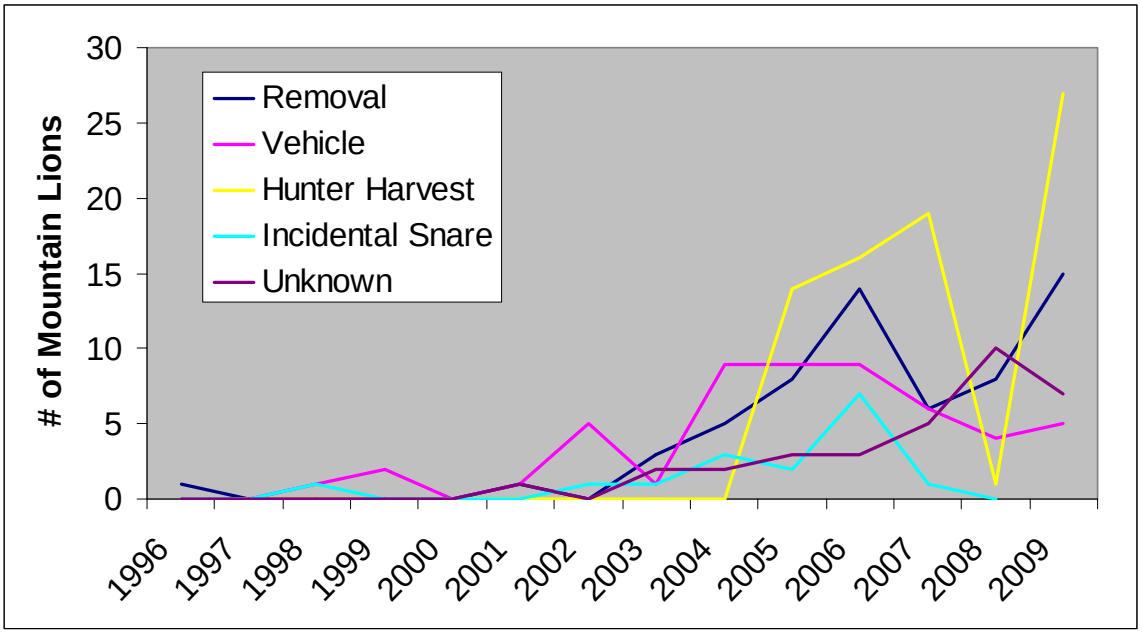
Appendix Figure 1. Land cover of the Black Hills ecosystem.



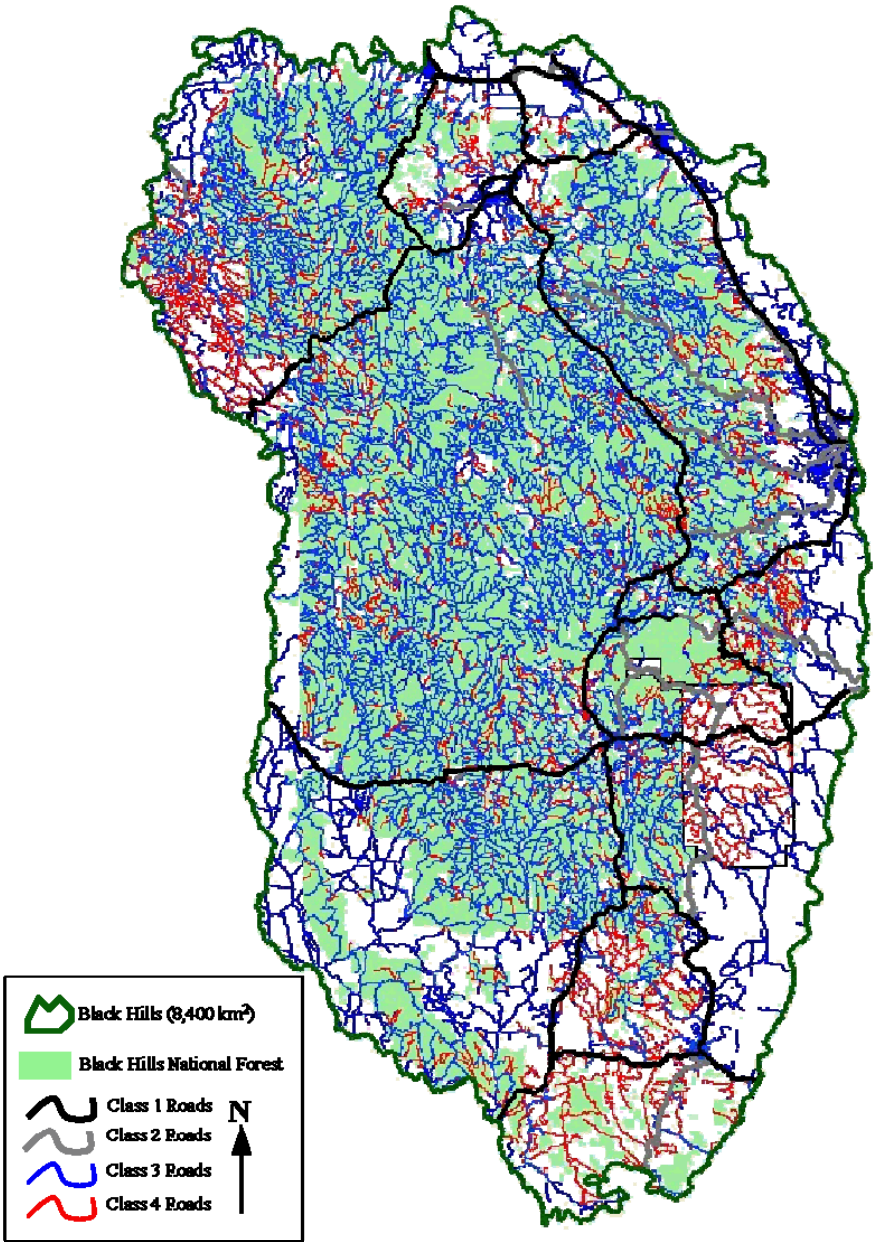
Appendix Figure 2. Rate of population growth for mountain lions in the Black Hills, South Dakota. POPWHARV = population estimate adjusted for harvest; POPSIZELOW = minus 10% of population estimate; and POPSIZEHIGH = plus 10% of population estimate.



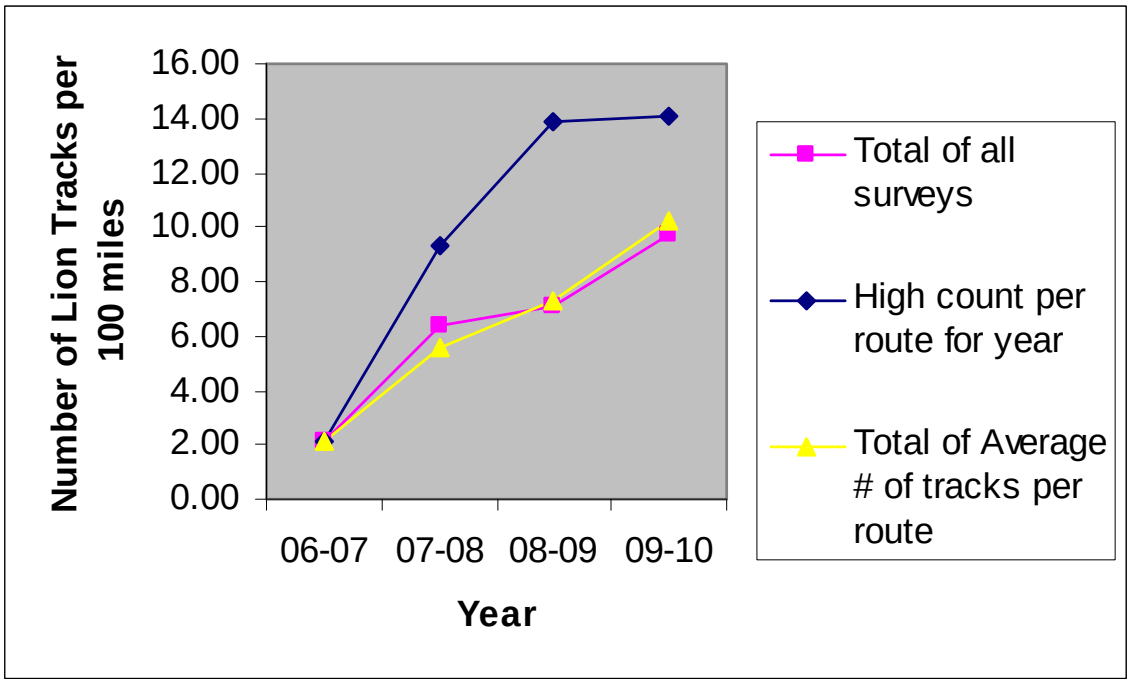
Appendix Figure 3. Documented mortality events of mountain lions, 1996-2009.



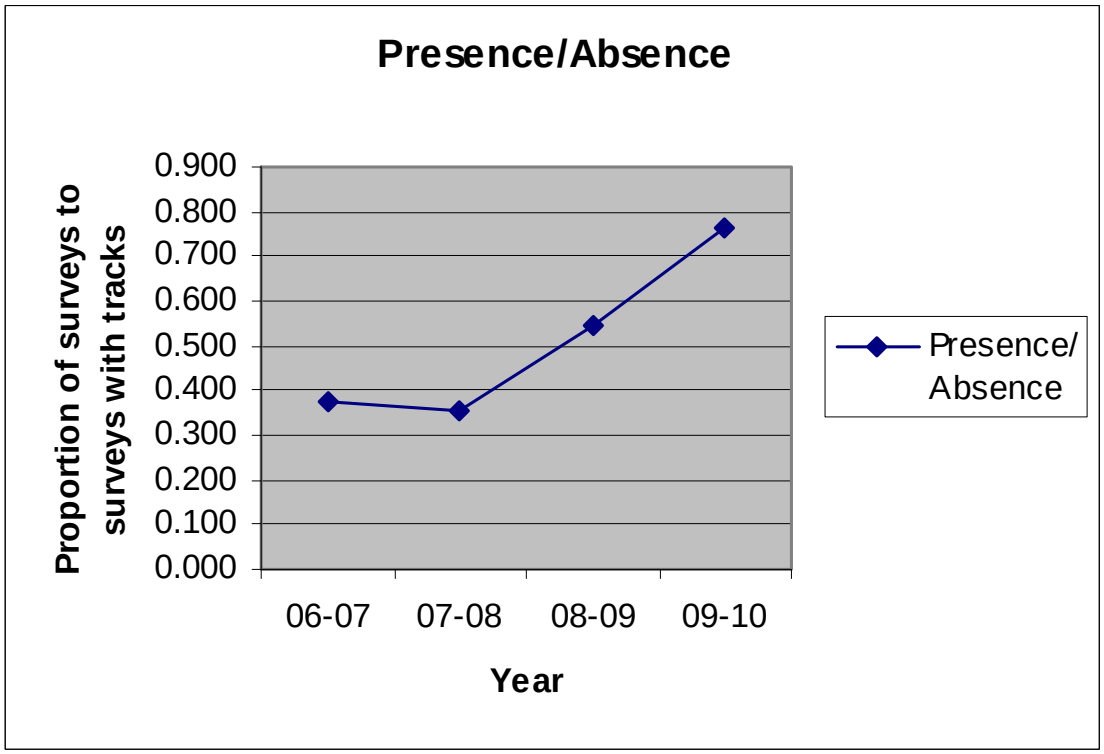
Appendix Figure 4. Network of roads traversing the Black Hills region.



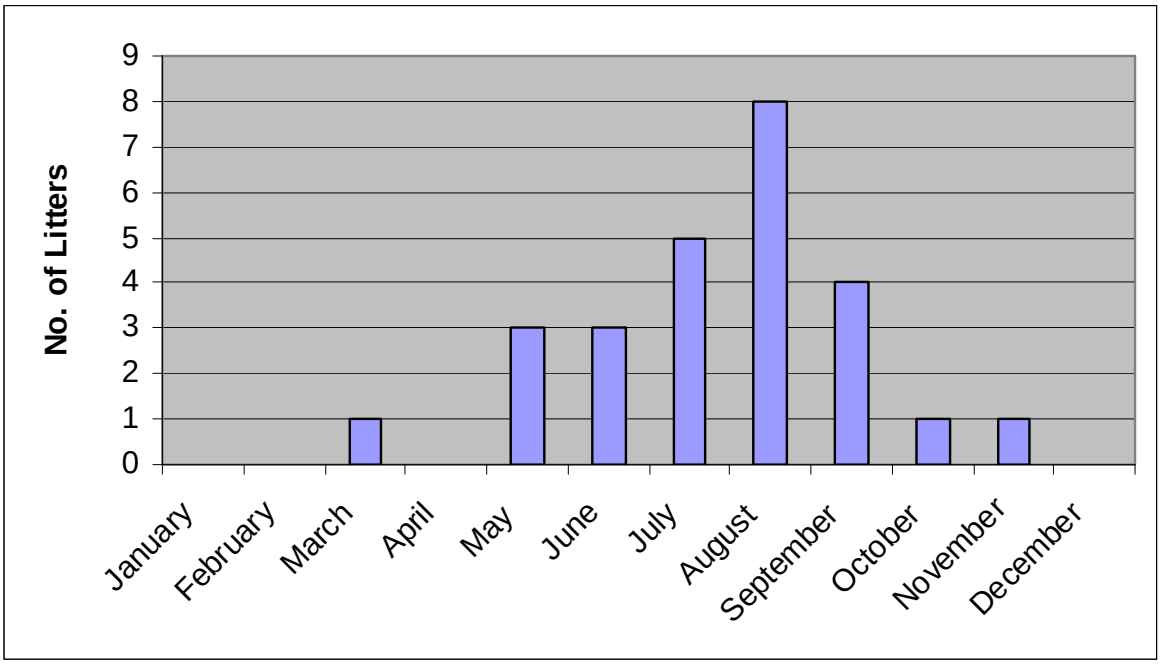
Appendix Figure 5. Number of mountain lion tracks per 100 miles of surveys in the Black Hills, South Dakota, 2006-2010.



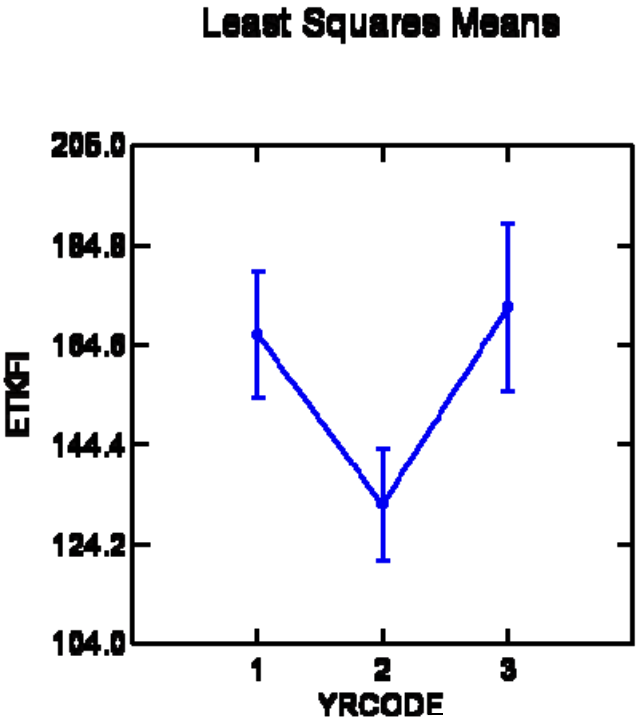
Appendix Figure 6. Proportion of surveys to surveys with tracks in the Black Hills, South Dakota, 2006-2010.



Appendix Figure 7. Black Hills Mountain Lion Parturition Dates.



Appendix Figure 8. Estimated total kidney fat index (an index to nutritional condition) of mountain lions for three periods.



Appendix Figure 9. Mountain lion observation report.

South Dakota
Game, Fish and Parks

Mountain Lion Observation Report

Type of Observation ☐Public ☐Department Personnel | **Investigator**

Date of Incident	Time of Incident	County

Name of Reporting Party	Address	General Location Description/TRS/Coordinates
Phone		

Type of Investigation Select one	Observer Distance from Lion Select one
Location of Observation Select one	Distance from Dwelling Select one

Type of Event:
☐Sign ☐Visual Observation ☐Close Encounter ☐Threatening Encounter Attack : ☐Person ☐Livestock

Reported Lion Behavior:
☐Sedentary ☐Walking ☐Running ☐Chasing/Stalking Prey ☐Evasive ☐Aggressive/Defensive

Evidence:
☐None ☐Track ☐Scat ☐Hair ☐Scrape ☐Sound
☐Wildlife Kill: Type ☐Domestic Kill: Type

Number Seen
Adults Young

Event Verification Status
Select one

Mistaken Identification ☐Yes ☐No Mistaken species	Lion Brochure Provided ☐Yes ☐No

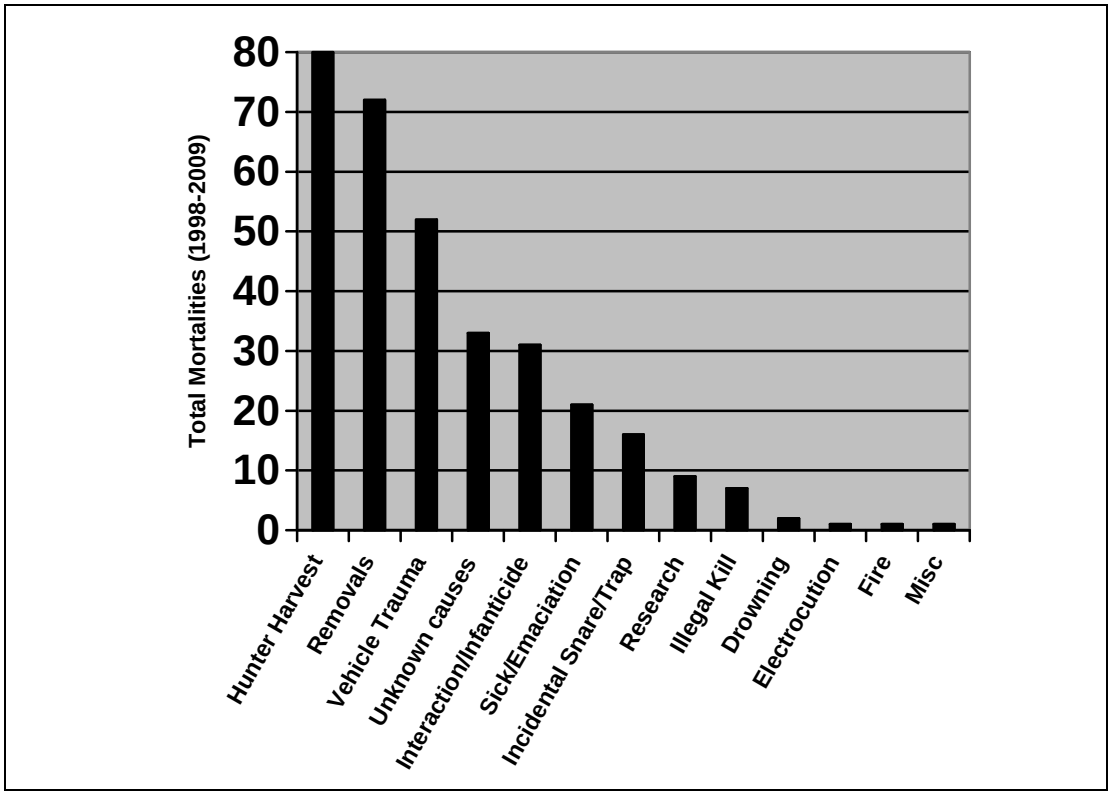
Division Action

Division Field Response: ☐No Action ☐Harassed ☐Dog Pursuit Harassment	☐Hunted: ☐Successful ☐Unsuccessful	☐Trapped: ☐Successful ☐Unsuccessful

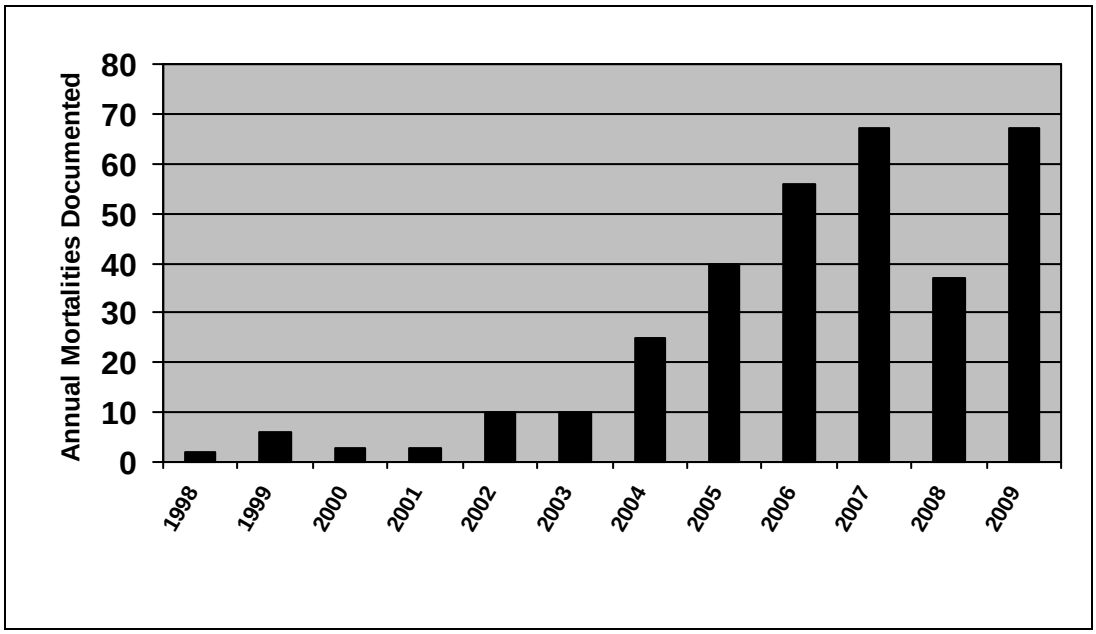
Field Response Results ☐No Contact ☐Harassed ☐Relocated ☐Euthanized By Whom Date	Disposition of carcass

Comments

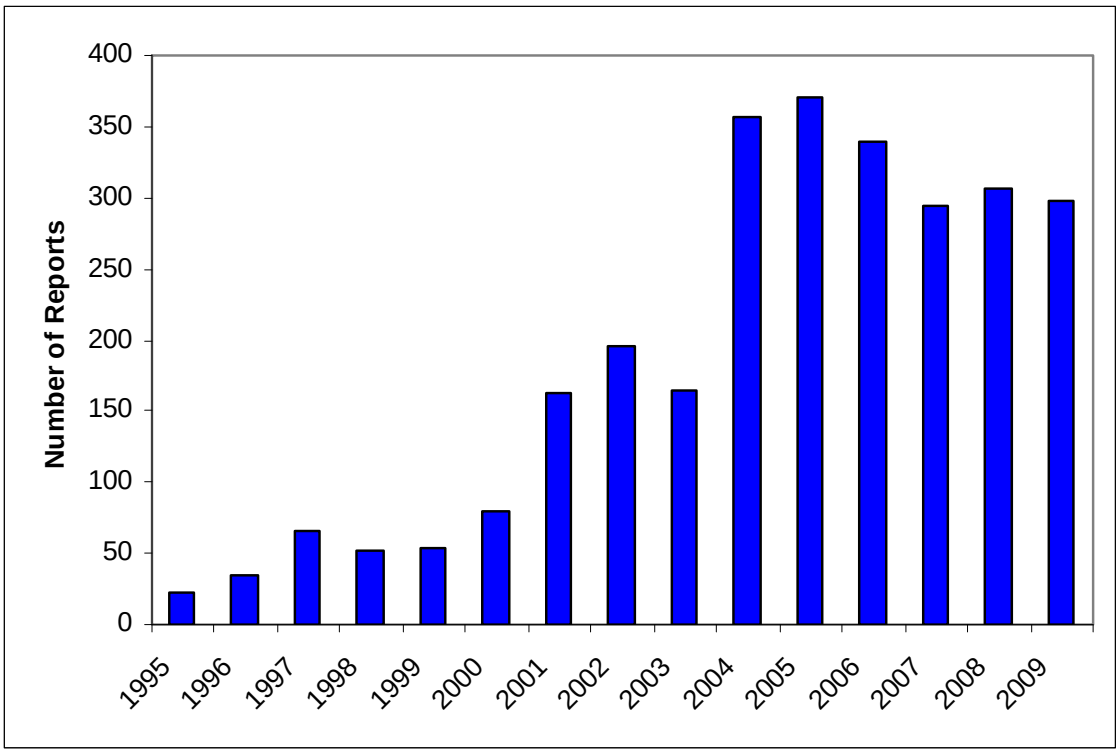
Appendix Figure 10. Total mortality events (n=326) documented for mountain lions in South Dakota 1998-2009.



Appendix Figure 11. Yearly breakdown of annual mountain lion mortality events documented in South Dakota, 1998-2009.



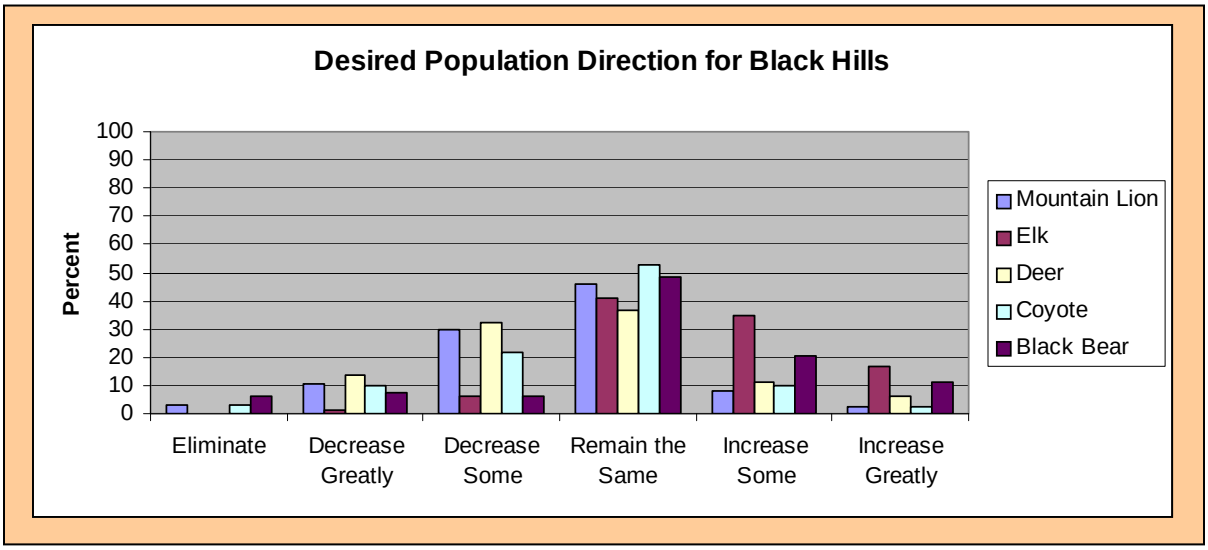
Appendix Figure 12. Annual number of mountain lion reports/sightings documented in South Dakota, 1996-2009.



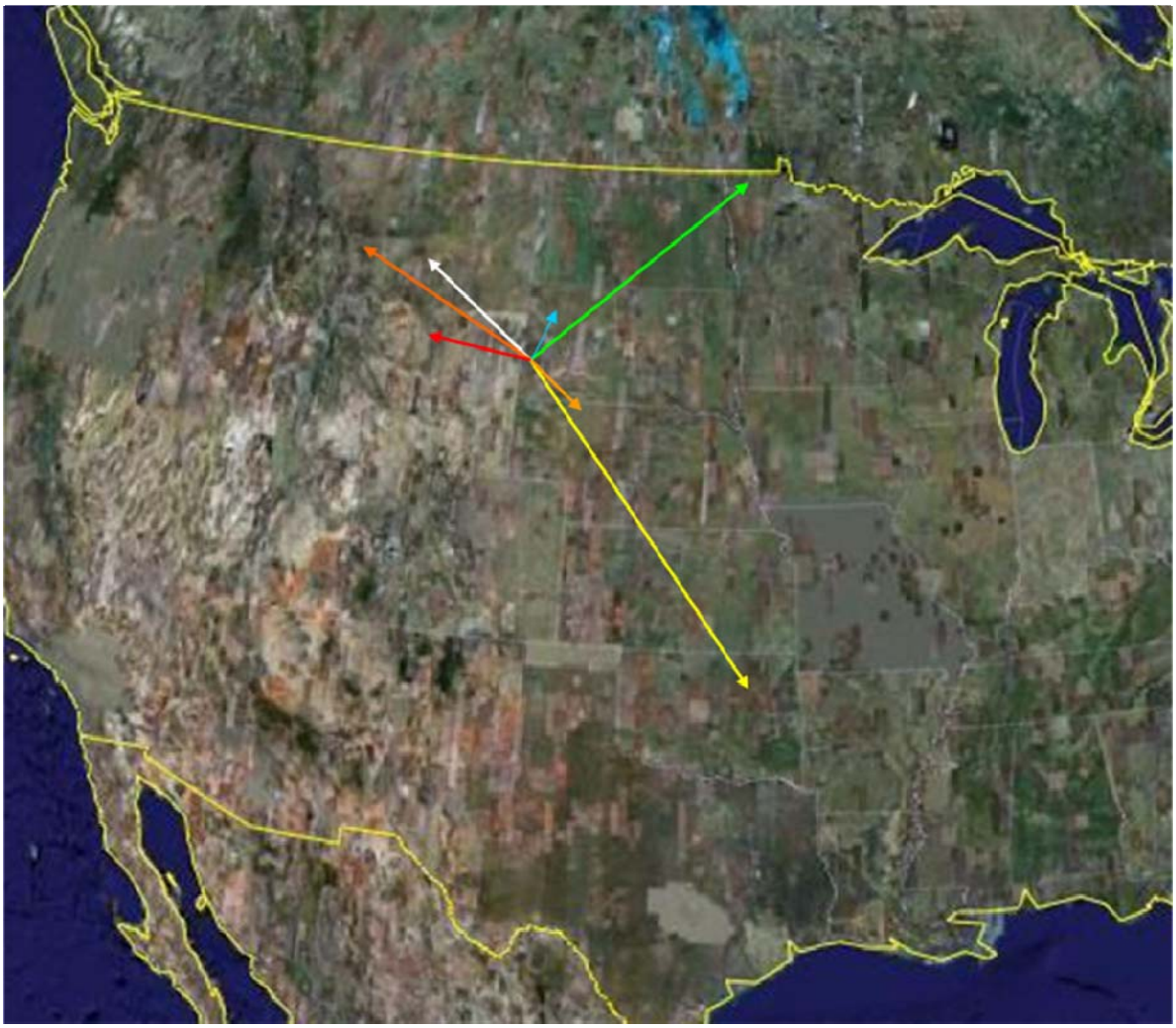
Appendix Figure 13. Five-cluster model based on South Dakota residents' attitudes towards mountain lions in South Dakota, measured in 2002 (Gigliotti 2002).

Strong Support for Mountain Lions……..	17.8%
Moderate Support for Mountain Lions……..	18.8%
Slight Support for Mountain Lions……...	19.8%
Neutral *to* Slight Opposition to Mountain Lions…...	29.0%
Strong Opposition to Mountain Lions……...	14.6%

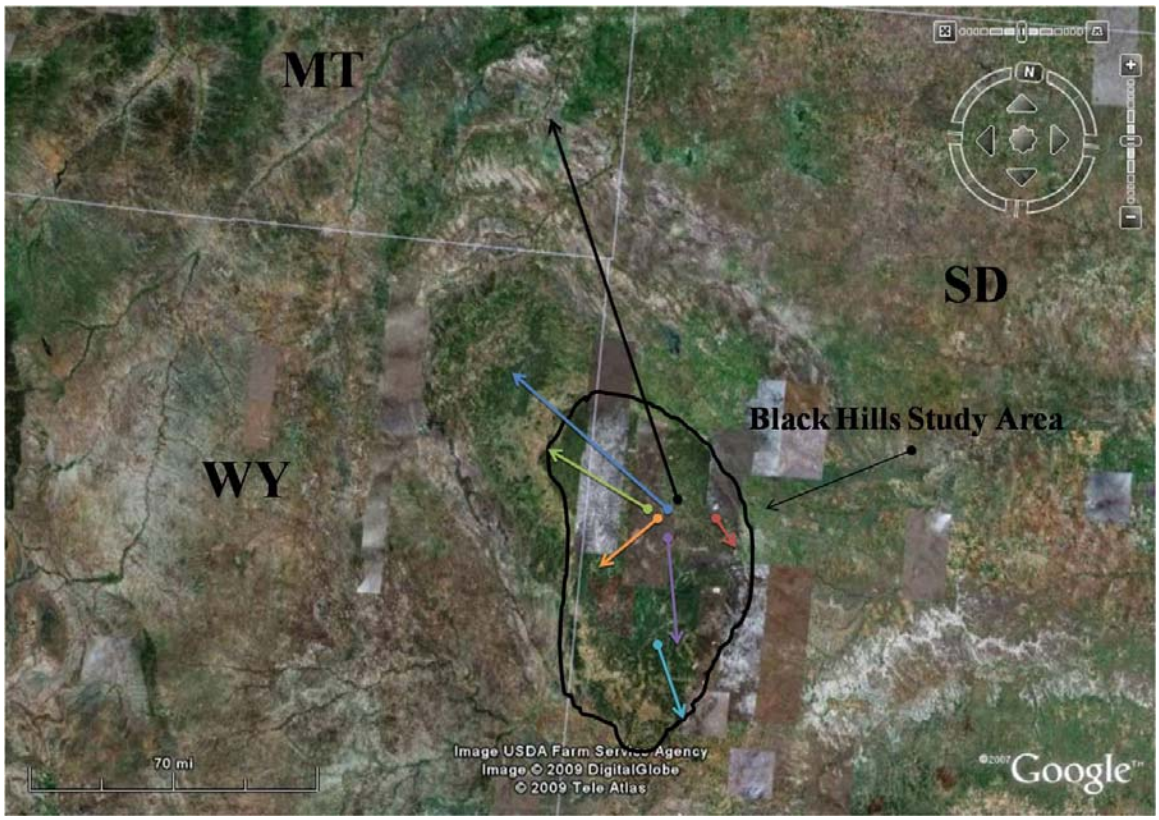
Appendix Figure 14. Black Hills residents' desired levels of wildlife populations in the Black Hills for the next five years (see Appendix Table 13).



Appendix Figure 15. Long-distance dispersal movements by subadult male mountain lions from the Black Hills of South Dakota, 2003-2006. (Background image incorporated from Google 2007). (From Thompson 2009).



Appendix Figure 16. Dispersal movements by subadult female mountain lions from the Black Hills of South Dakota, 2003-2007. (Background image adapted from Google 2007). (From Thompson 2009).



Appendix Figure 17. Comparison between male and female mountain lion mortalities documented in South Dakota, 1998-2009. (Categories represent primary sources of mortality).