

CHARACTERISTICS OF MOUNTAIN LION MORTALITIES IN THE BLACK HILLS, SOUTH DAKOTA

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Abstract: Mountain lions (*Puma concolor*) are a state threatened species in South Dakota, and few sightings were documented from the early 1900's until recently. In 1985, the South Dakota Department of Game, Fish and Parks (SDGF&P) began compiling and verifying sightings of mountain lions in the Black Hills. Since then, sightings have increased but little is known of population characteristics for this species. We documented deaths of mountain lions in the Black Hills from 1996 to 2000. Mountain lion carcasses were obtained from SDGF&P, transported to South Dakota State University, necropsied and cause of death determined. Carcasses were sexed and aged based on tooth wear. Nutritional condition was assessed based on kidney fat (ranked as high, medium, or low), and foods consumed documented from identification of intestinal tract contents or evidence on the carcass. A total of 12 mountain lion deaths were documented between 1996 and 2000. Mountain lions were killed by vehicle collisions (3), shootings (5), died from capture-related or trap injuries, or injuries inflicted by another mountain lion. One mountain lion sought refuge in a cave during a fire and was asphyxiated. Sex ratio of the dead lions was 50:50 and age ranged from 4 months to 9 years (n=12). Of the 9 mountain lions we assessed, 6 had high levels of kidney fat suggesting they were in relatively good nutritional condition. Eight of the 12 mountain lions showed evidence of porcupine (*Erethizon dorsatum*) consumption.

INTRODUCTION

Historically, mountain lions occurred throughout South Dakota (Paquet and Hackman 1995), and in the late 1800's were relatively common (Turner 1974). Mountain lions were found in the plains and Badlands region of the state and were numerous in the Black Hills (Young and Goldman 1946). In the early 1900's, the population dramatically declined from bounties placed on the animal in 1889 (SDGF&P 1998). One mountain lion was killed in the Black Hills in 1931, but in the 25 years prior to this occasion, no other reports of mountain lions were recorded in the state (Young and Goldman 1946). Nevertheless, the species remained listed as a state pest until 1966, and in 1972, its status was changed to state threatened. Transient mountain lions, likely from Wyoming, recolonized the Black Hills (Berg et al. 1983). Since its protection, lion sightings have increased, especially the last few years (19, in 1995; 40, in 1996; and 56, in 1997). However, many are unverified and no information exists on population characteristics of this species in South Dakota. As part of a study to determine distribution and estimate population size of mountain lions in the Black Hills, we documented mortalities of mountain lions from 1996 to 2000.

STUDY AREA

The Black Hills is an 18,050 km², isolated mountain range located in western South Dakota and northeastern Wyoming (Petersen 1984). Elevations range from 973 to 2,202 m (Orr 1959, Turner 1974), with forests occurring at elevations between 1,200 and 2,100 m (Hoffman and Alexander 1987). Ponderosa pine (*Pinus ponderosa*) forest alliances occupy 84% of the forested landscape within the Black Hills (Rumble and Anderson 1996). The remaining forests are composed of white-spruce (*Picea glauca*) forest alliances in high-elevation, cool, moist sites, and burr oak (*Quercus macrocarpa*) forest alliances, in low elevation, warm, dry sites. The mountain range has semi-arid continental and mountain climate types. Generally, precipitation in the northern Black Hills is higher and temperatures are cooler than in the southern Black Hills (Hoffman and Alexander 1987). Average annual precipitation ranges from 45 to 66 cm (Orr 1959); mean annual temperature is 7.5°C. Forests are managed by the United States Department of Agriculture Black Hills National Forest primarily for timber production, livestock grazing, and recreation

METHODS

Carcasses of mountain lions killed in the Black Hills were transported to South Dakota State University for necropsy. We determined place of death through interviews with SDGF&P employees. Proximity of death was coded as northern, central or southern Black Hills. During our initial examination of the carcass, we determined sex and estimated age of animals. Age was estimated based on presence of a subcanine ridge, wear on incisors and canines, coloration (white or yellowed) of the teeth, and fur coloration (i.e., presence of spots on the body or barring on the limbs) (Anderson and Lindzey 2000). Average age of mortalities was estimated using the midpoint of the range in age estimate for each carcass. Carcasses were then necropsied and, if unknown, cause of death was established. Nutritional condition of animals was evaluated by ranking kidney fat as high, moderate, or low. Foods consumed were assessed based on a cursory examination of digesta in the stomach and gastrointestinal tract or evidence on the carcass of interactions with potential prey (e.g., porcupine quills).

RESULTS

Twelve mountain lion mortalities were documented over the 4-year period, 1996-2000. Sex ratio of mortalities was 50:50. Age of mortalities ranged from 4-5 months to 8-9 years and averaged 3.3 years. Causes of mortality were categorized as: shooting, vehicle collision, intraspecific interaction, fire, and accidental (unintentional trapping in a bobcat snare, and capture-related) (Table 1). Of mortalities, 5 (41.7%) were due to shooting with 3 (25.0%) resulting from vehicle collisions. Other causes of mortalities (1 trapping, 1 capture-related, 1 intraspecific interaction, and 1 fire) were equally represented at 8.3% of the total. Eight (66.7%) of the mortalities occurred in the southern Black Hills region. Two (16.7%) mortalities occurred in the central Black Hills, and 2 (16.7%), in the northern region. Of the 9 specimens assessed, 6 (66.7%) had high kidney-fat levels, indicating the animals were in good nutritional health at the time of their death. Preliminary results of foods consumed were obtained for 8 lions. Of these, 6 (75.0%) showed evidence of consumption or interactions with porcupines. Other foods documented during cursory examination included vegetation ($n = 2$) and small mammals (i.e., *Peromyscus* spp.) ($n = 1$).

Table 1. Characteristics of mountain lion mortalities in the Black Hills, South Dakota (1996-2000).

Sex	Age	Fat	Food	Mortality	Location	Proximity
M	8.5-9.5	L	PP	Shooting	Custer	South
M	2.5-3.5	L	None	Vehicle	Spearfish	North
F	1.5-2.5	H	PP	Accidental	Pactola Lake	Central
M	4-5 months	M	NE	Vehicle	Hill City	South
F	3.5-4.5	NE	NE	Shooting	Pringle	South
F	3.5-4.5	H	PP	Accidental	Custer	South
M	1.5-2.5	H	PP	Vehicle	Black Hawk	North
F	1.5-2.5	H	PP	Shooting	Deerfield Lake	Central
M	3.5-4.5	NE	NE	Shooting	Hot Springs	South
M	2.5-3.5	H	PP	Interaction	Custer	South
F	3.5-4.5	H	None	Fire	Jewel Cave	South
F	1.5-2.5	NE	NE	Shooting	Hot Springs	South

¹ Fat reserves were ranked as high (H), medium (M), or low (L) based on kidney fat

² Food categories: PP= porcupine, NE=not evaluated, None=GI tract empty

³ Proximity refers to region of the Black Hills.

DISCUSSION

We documented both human-caused and natural mortality of mountain lions in the Black Hills. Although mountain lions are protected, 83.3% of the deaths we encountered were human-caused. Legal and illegal shootings represented the majority of the mortalities, followed by vehicle collisions. Our findings are similar to those of protected mountain lion populations in Colorado, Arizona, and British Columbia, where humans also were the primary cause of mountain lion deaths (Logan and Sweanor 2000). South Dakota law provides that citizens can obtain a permit (issued by the Secretary of SDGF&P) to kill individual, problem mountain lions that persistently kill livestock, pose a threat to the public's health, safety or welfare, or damage property. In addition, any person can legally kill a mountain lion in an emergency situation involving an immediate threat to human life (SDGF&P 1998).

Three male mountain lions were killed from collisions with vehicles. Two relatively young male cats were killed on Interstate 90, a high-speed highway (104-120 km/h) that occurs on the northern and eastern periphery of the Black Hills. These animals may have been in the process of dispersing, which can occur anywhere from 10 to 33 months (Sweanor et al. 1999), or were forced to use suboptimal lion habitat to avoid aggressive encounters with older males (Logan et al. 1996). Based on preliminary findings of radio-collared animals, it is possible that male territories are limited in the Black Hills. Moreover, the kitten in our sample was killed on U.S. Route 16, where at least 3 adult cats (2 radio-collared adult males and 1 uncollared female with two kittens) have been documented to cross on more than one occasion all within a 0.8 km stretch of road. In 1997, on the same stretch of road, an adult mountain lion was hit by a car but not killed. Specific locations on high-speed highways could act as population sinks for cats with home ranges fragmented by such roads. In populations in California and Florida, where animals exist in severely fragmented habitat,

vehicle collisions are the predominant cause of death to lions (Logan and Sweanor 2000). This information has important long-term management implications for mountain lions. Managers could identify locations where lions are known to cross high-speed highways and construct wildlife underpasses. Wildlife culverts were constructed in Florida in 1994 to decrease mountain lion/vehicle collisions. The culverts were used by mountain lions and other species as well (i.e., black bears (*Ursus americanus*), bobcats (*Lynx rufus*), raccoons (*Procyon lotor*), deer (*Odocoileus virginianus*), etc.) (Foster and Humphrey 1995).

In un hunted mountain lion populations, intraspecific killing may be the major natural cause of death of these territorial carnivores. In New Mexico, 44.0% of kitten deaths resulted from infanticide and cannibalism, and intraspecific aggressive encounters resulted in 100% of deaths of subadults and 52.0% of adults, respectively. All killing was done by male mountain lions (Logan et al. 1996). Intraspecific aggression also was the predominant cause of death to mountain lions in Florida (Maehr 1997) and California (Beier et al. 1993). We documented an intraspecific aggressive encounter between 2 radio-collared male mountain lions in the Black Hills (66 kg, 4 to 5-year-old and 54 kg, 2.5-year-old), which resulted in the death of the younger cat. Other reported natural causes of death include deaths from other carnivores (Boyd and Neale 1992), injuries sustained during pursuit of prey (Ross et al. 1995), starvation, accidents (Lindzey 1987), and from parasites and disease (Dixon 1982). To our knowledge there have been no reports of mountain lions killed during natural disturbances such as fire. We documented the death of a radio-collared, adult female mountain lion from a recent fire in the Black Hills. The death probably occurred because most of her 12,950 ha home range was contained within a region of the 33,795 ha fire. The lion's death likely occurred on the second day of the fire when 19,650 ha burned, trapping her in the draw where she died.

Results of 9 mountain lions evaluated for body fat reserves indicated the population of lions in the Black Hills is in good overall nutritional health. Six animals had high fat reserves and of the 2 animals that had low reserves, 1 was a young potentially dispersing male, and 1, an old male cat, which was partially blind. Gross examination of 7 carcasses revealed evidence of consumption of porcupines in all age classes represented indicating this species may be an important food item for lions in this region. Further analysis of foods consumed by mountain lions in the Black Hills is forthcoming. The fact that 66.7% of the cats died in the southern Black Hills supports findings of reported mountain lion sightings by SDGFP. For example, when reported sightings were corrected for county population size, more reports were obtained in the southern counties suggesting mountain lion densities may be higher in this region of the Black Hills.

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