South Dakota
SURVEY REPORT

Mountain Lion Population Status Update

2021 Biennial Report

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PIERRE, SOUTH DAKOTA

WILDLIFE SURVEY REPORT 2021-11

July 2021

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INTRODUCTION

Mountain lions (*Puma concolor*) are native to South Dakota and were historically considered numerous in the Black Hills. After near extirpation in the early 1900s due to unregulated harvest and bounties on mountain lions and unregulated harvest on their prey species, mountain lions were listed as a state threatened species in 1978. Mountain lion populations rebounded in the late 1900s and the species was reclassified as a big game animal in 2003. The first regulated hunting season was established in 2005. Mountain lion hunting seasons in South Dakota provide an important recreational opportunity for resident sportsmen and women, and also provide a means to manage mountain lion populations.

The current goal for mountain lion management in the Black Hills of South Dakota is to manage mountain lion populations and habitats consistent with ecological, social, aesthetic, and economic values of South Dakota citizens while addressing the concerns and issues of both residents and visitors of South Dakota. The South Dakota Mountain Lion Management Plan (https://gfp.sd.gov/UserDocs/docs/LionPlan_FINAL_2019.pdf) was revised in 2019 and provides a foundation for science-based management decisions, thus ensuring a healthy, self-sustaining population of mountain lions in the Black Hills of South Dakota (South Dakota Game, Fish and Parks 2019)

This report provides a statewide overview of mountain lion surveys and assessments conducted by the South Dakota Department of Game, Fish and Parks (SDGFP) and an update on the population status of mountain lions in the Black Hills.

POPULATION SURVEYS AND ASSESSMENTS

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

Hunting Season Evaluations

There is currently an established season and harvest limits for the Black Hills Fire Protection District (BHFPD) of South Dakota, and a year-round season with no limit in the remainder of the state. All harvested mountain lions must be presented to a SDGFP representative within 24 hours of harvest for inspection and DNA sampling. Location of harvest, estimated age, sex, and weight are all recorded for each harvested mountain lion. Age estimates are categorized as: <1-year old is a kitten (K), 1 to 3-year-old is a sub-adult (SA), and >3-years old is an adult (AD).

Female mountain lions follow the same age estimation with the exception that a female mountain lion is classified as an adult only if lactation has occurred. Harvest surveys are also sent to all licensed hunters to compile additional mountain lion season information. Tissue samples are collected from harvested mountain lions for genetic analyses used in mark/recapture population estimates. All harvest data are used to assess the impacts of harvest on population demographics and inform future hunting season structure and harvest limit.

Harvest

There were 3,779 mountain lion hunting licenses sold in 2020/21, and the hunting season for the BHFPD was December 26, 2020 – April 30, 2021. Regulations were in place to end the season immediately if the harvest limit of 60 mountain lions, or 40 females, was met before the hunting season concluded. Within the BHFPD, the use of dogs to hunt mountain lions was prohibited except during specified hunting intervals in Custer State Park (CSP). The 2020/21 mountain lion season in the BHFPD ended on April 30 with 48 mountain lions harvested (23 males, 25 females; Table 1; Figure 1); 9 of these mountain lions were harvested with the aid of dogs in CSP.

Table 1. Mountain lion hunting season data for South Dakota, 2005/06 – 2020/21.

	Licenses		BLACK HILLS HARVEST			PRAIRIE		Limit	Season
Year*	Sold	Season Dates	Males	Females	Total	HARVEST	Harvest Limit	Reached	Length(days)
2005/06	2,588	Oct.1 - Dec. 15	6	7	13	1	25 or 5 females	Female	24
2006/07	3,295	Nov. 1 - Dec. 31	7	8	15	1	25 or 8 females	Female	19
2007/08	4,070	Nov. 1 - Dec. 31	2	15	17	2	35 or 15 females	Female	23
2008/09	2,335	Jan.1 - Mar. 31	11	15	26	2	35 or 15 females	Female	45
2009/10	2,274	Jan.1 - Mar. 31	16	24	40	3	40 or 25 females	Total	41
2010/11	2,591	Jan.1 - Mar. 31	20	27	47	5	45 or 30 females	Total	52
2011/12	3,720	Jan.1 - Mar. 31	27	46	73	2	70 or 50 females	Total	61
2012/13	4,637	Dec.26-Mar. 31	26	35	61	6	100 or 70 females	Date	96
2013/14	3,856	Dec.26-Mar. 31	22	31	53	4	75 or 50 females	Date	96
2014/15	3,767	Dec.26-Mar. 31	21	22	43	5	75 or 50 females	Date	96
2015/16	3,681	Dec.26-Mar. 31	16	25	41	8	60 or 40 females	Date	97
2016/17	3,067	Dec.26-Mar. 31	14	16	30	5	60 or 40 females	Date	96
2017/18	3,384	Dec.26-Mar. 31	12	19	31	11	60 or 40 females	Date	96
2018/19	3,373	Dec.26-Mar. 31	13	8	21	10	60 or 40 females	Date	96
2019/20	3,483	Dec.26-Apr. 30	24	27	51	14	60 or 40 females	Date	127
2020/21	3,779	Dec.26-Apr. 30	23	25	48	10	60 or 40 females	Date	126

* Adjusted year = April 1 – March 31 from 2005/06 to 2018/19; May 1 – April 30 thereafter.

Outside of the BHFPD, the season is year-round and the use of dogs to pursue mountain lions is allowed on private land. A pursuit by dogs that originates on private land may cross over or culminate on property owned by the Office of School and Public Lands or the United States

Bureau of Land Management. On the prairie, ten mountain lions (7 males, 3 females) were harvested in the 2020/21 season (May 1 – April 30). Hunting seasons for mountain lions in South Dakota began in 2005; historical mountain lion harvest, season dates, and associated season data are depicted in Table 1. Mountain lion harvest peaked in 2011/12 at 73 total mountain lions, trended downward through 2018/19, and has increased the past 2 years (Figure 1). Harvest limits are established to ensure harvest levels do not exceed management objectives, but limits have not been reached since the 2011/12 season, allowing hunting opportunity the entire hunting season.

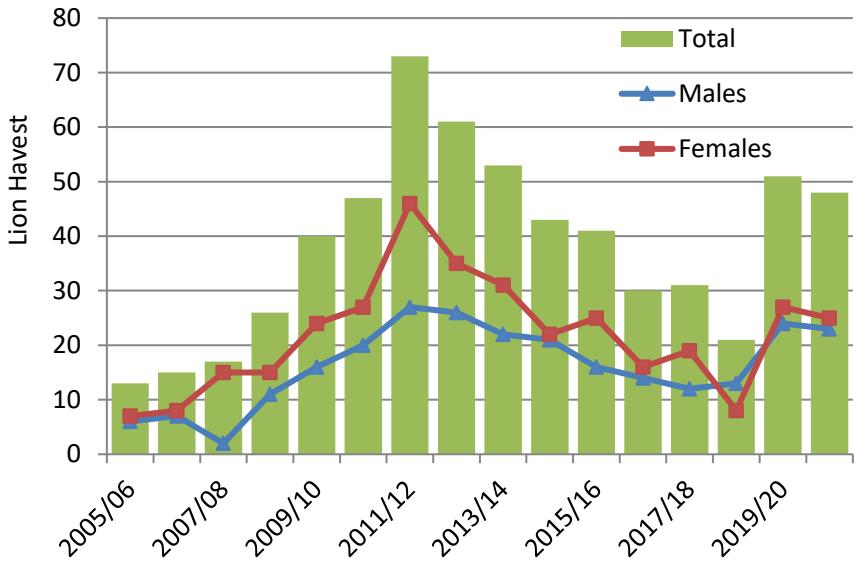

Figure 1. Mountain lion harvest in the South Dakota Black Hills Fire Protection District, 2005/06 – 2020/21.

Harvest composition

Trends in harvest age and sex proportions are evaluated annually in the Black Hills (Figure 2). Since the first regulated hunting season in 2005, 57% of all mountain lions harvested in the Black Hills of South Dakota have been females and 43% males. Conversely, more males (76%) were harvested than females (24%) during established harvest seasons on the prairie. Approximately 50%, 42%, and 8% of all Black Hills mountain lions harvested have classified as adult, subadult, or less than 1 year of age, respectively. No apparent trends in overall sex and age compositions are suggestive of population changes.

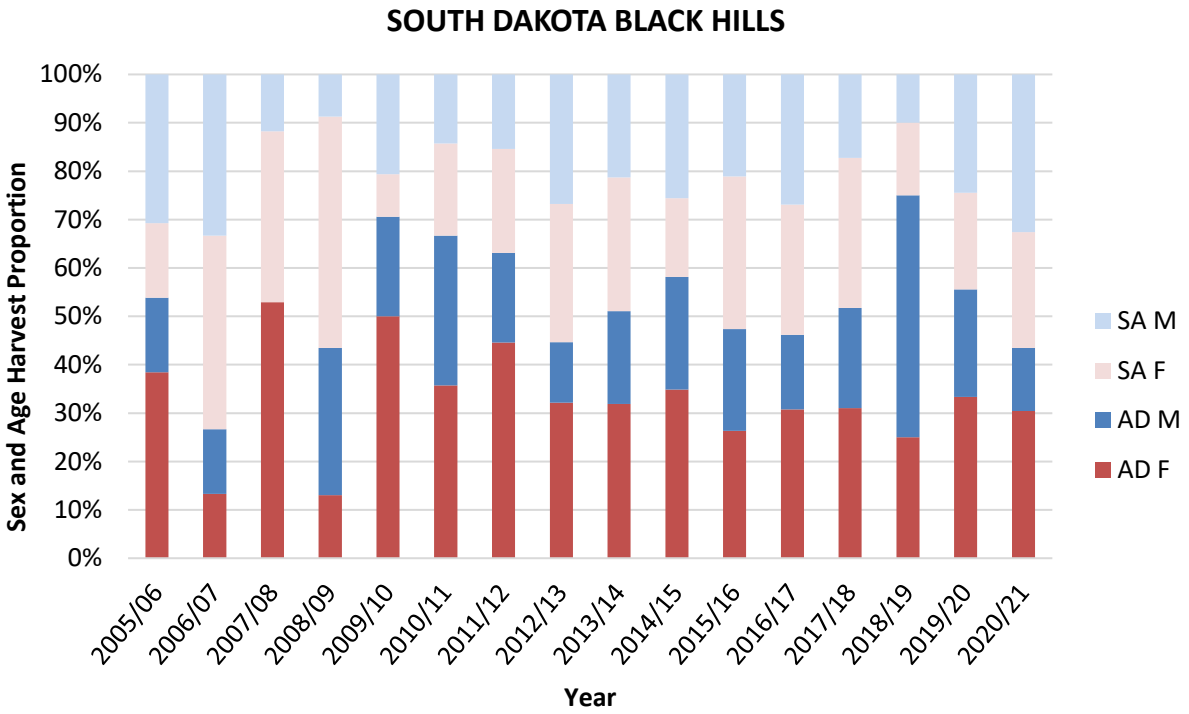

Figure 2. Sex and age harvest proportions of mountain lion harvest in the South Dakota Black Hills Fire Protection District, 2005/06 – 2020/21; SA = subadult, AD = adult, M = male, F = female).

When hunting season structure and hunting effort are consistent, age and sex composition of harvest has been found to be a useful index to mountain lion populations in Wyoming that are hunted primarily with the use of dogs (Anderson and Lindzey 2005). The majority of harvest in South Dakota, however, occurs without the use of dogs (dogs are only legal outside the BHFPD and in CSP during designated hunting intervals), and therefore interpretation of harvest composition trends may not be comparable. For example, after the state of Washington made it illegal to hunt mountain lions with dogs, subsequent harvest data showed that the median age of harvested mountain lions declined, and percentage of females increased (Martorello and Beausoleil 2003). In addition, SDGFP occasionally makes changes to hunting season structure and/or hunter effort changes, which can result in unreliable indices using only harvest age and sex composition. Finally, immigration and emigration rates to and from the Black Hills are unknown and could be different, resulting in unreliable indices from harvest age and sex composition trends.

Female age structure of harvested mountain lions is also evaluated, as research on some western mountain lion populations suggest relationships between mountain lion age or harvest age, and population trends (Anderson and Lindzey 2005, Stoner et al. 2006). The average age of harvested adult females in South Dakota since the 2005/06 hunting season has been 5.25 (n = 189), with most years averaging between 4 and 6 years of age (Figure 3). Evaluations of harvest age data suggest no apparent trend in age structure of adult females. Data will continue to be evaluated for long-term trends.

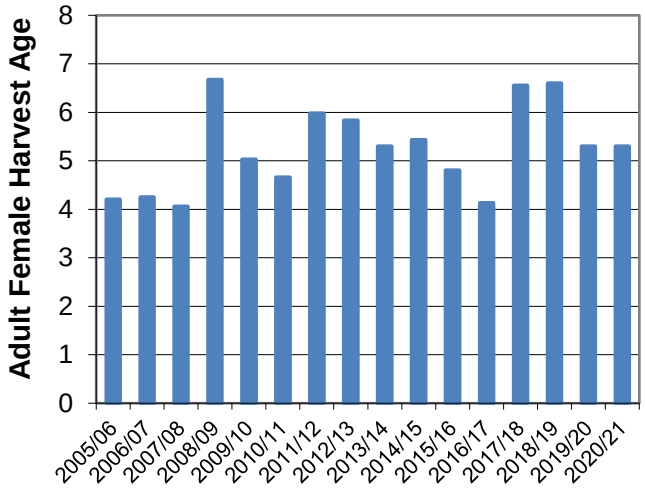

Figure 3. Average age of harvested adult female mountain lions in the South Dakota Black Hills Fire Protection District, 2005/06 – 2020/21.

Harvest per unit effort

Because mountain lion hunting in South Dakota is primarily conducted without the use of dogs, harvest success rates are low compared with other big game hunting seasons. Overall, hunting success for all licensed boot hunters in the BHFPD from 2005/06 – 2020/21 averaged 1.3%; hunting success for hunters using dogs in CSP averaged 57% during 2012/13 to 2020/21.

Hunting licenses for mountain lions in South Dakota were $28 in 2020/21, and each year hunter surveys conducted by SDGFP reveal that some hunters purchase licenses, but do not actually hunt; in the 2020/21 season, 38% of licensed hunters spent time hunting mountain lions in the BHFPD (Huxoll 2021; Table 2). Hunter surveys also collect hunter effort (# days hunted), which is used with active hunting participants to estimate Harvest per Unit Effort (HPUE) or Catch per Unit Effort (CPUE).

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

In terms of mountain lion population monitoring, CPUE may be defined as the number of mountain lions brought to bay in trees per day or as the number of mountain lions harvested per day. Some states use multiple CPUE indices in evaluation of mountain lion populations. For example, South Dakota monitors mountain lions treed per 100 hours of effort in DNA sampling surveys, as well as hunter harvest of mountain lions per 1,000 days hunted (HPUE), excluding hunter harvest with the aid of dogs.

The relationship between CPUE and mountain lion abundance may be confounded by other variables that affect hunter success, such as snow conditions, road closures, and harvest regulations. Choate et al. (2006) found that CPUE was a poor predictor of abundance of mountain lions in Utah, although some data suggested the relationship between CPUE and abundance was worth further investigation. Further evaluations of the same area over a longer time span by Wolfe et al. (2016) showed a strong positive relationship between the number of mountain lions treed per day during pursuit only seasons and an index to mountain lion abundance. CPUE estimators, however, require stringent assumptions that are likely violated at times (see discussion by Whittaker and Wolfe 2011), including demographic and geographic independence and constant catchability throughout the period of data collection. Regardless, the high correlation between mountain lions treed per day and mountain lion density found by Wolfe et al. (2016) suggest CPUE indices may be informative metrics in state management programs.

Table 2. Harvest per unit effort (HPUE) for South Dakota Black Hills Fire Protection District mountain lion hunting seasons, 2008/09 – 2020/21.

Year	Season Length (Days)	Lions Harvested	Licenses	Active Hunters	Average # Days	Man-Days Hunted	Harvest Per 1,000 Man-Days	% Change From Prior Year
2008/2009	45	26	2,428	1,646 (1,594, 1,698)	6.5	10,698 (10,003, 11,404)	2.43 (2.28, 2.60)	-
2009/2010	41	40	2,082	1,468 (1,423, 1,513)	6.2	9,100 (8,535, 9,678)	4.4 (4.13, 4.69)	81%
2010/2011	52	47	2,325	1,790 (1,749, 1,831)	6.6	11,814 (11,128, 12,508)	3.98 (3.76, 4.22)	-9%
2011/2012	61	69	3,482	2,646 (2,591, 2,701)	7.1	18,787 (17,831, 19,749)	3.67 (3.49, 3.87)	-8%
2012/2013	96	54	4,351	2,872 (2,804, 2,940)	7.3	20,966 (19,799, 22,143)	2.58 (2.44, 2.73)	-30%
2013/2014	96	44	3,293	1,861 (1,796, 1,925)	6.9	12,841 (11,920, 13,775)	3.43 (3.19, 3.69)	33%
2014/2015	96	38	3,210	1,689 (1,620, 1,758)	7.1	11,992 (11,053, 12,953)	3.17 (2.93, 3.44)	-8%
2015/2016	97	35	3,102	1,529 (1,462, 1,596)	7.1	10,856 (9,972, 11,759)	3.22 (2.98, 3.51)	2%
2016/2017	96	23	2,561	1,153 (1,093, 1,213)	6.9	7,956 (7,204, 8,727)	2.89 (2.63, 3.19)	-10%
2017/2018	96	22	2,878	1,199 (1,137, 1,261)	7.3	8,743 (7,973, 9,555)	2.52 (2.30, 2.76)	-13%
2018/2019	96	14	2,818	1,132 (1,066, 1,198)	6.9	7,810 (6,905, 8,746)	1.8 (1.60, 2.03)	-28%
2019/2020	127	40	2,907	1,144 (1,081, 1,207)	8.3	9,462 (8,460, 10,495)	4.24 (3.81, 4.73)	135%
2020/2021	126	39	3,208	1,214 (1,138, 1,290)	7.1	8,603 (7,488, 9,757)	4.55 (3.99, 5.21)	7%

* numbers in parentheses represent 95% confidence intervals; calculations do not include lions harvested or days hunted in CSP

For the 2020/21 South Dakota mountain lion season, HPUE was approximately 4.53 mountain lions per 1,000 hunted days. From 2009/10 to 2018/19, HPUE trended downward for most years, however, HPUE increased in each of the past 2 years (Figure 4, Table 2). CPUE data that are collected during biopsy darting surveys are reported in the *DNA Mark/Recapture section* of this report.

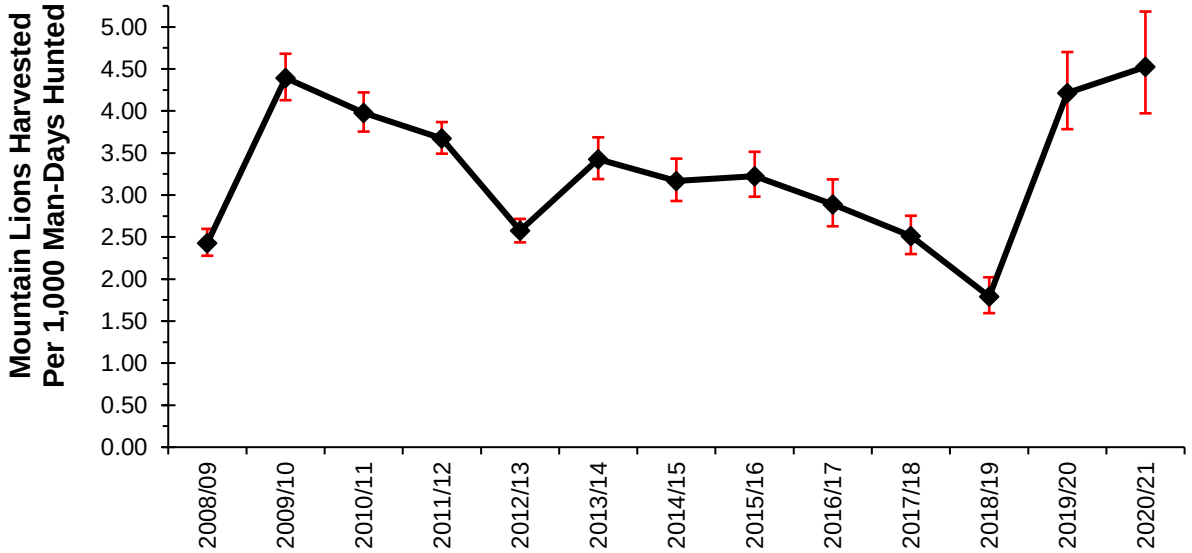

Figure 4. Mountain lion harvest per unit effort (HPUE) for the South Dakota Black Hills Fire Protection District seasons, 2008/09 – 2020/21. Red error bars represent 95% confidence intervals.

Documented Mortalities

Over the past 2 years (May 1, 2019 through April 30, 2021), a total of 145 mortality events were documented in the BHFPD. Mortalities were categorized as: hunter harvest (99), followed by vehicular accidents (14), SDGFP removal (12), unknown causes (10), public removal (6), incidental (2), mountain lion interaction (1), and research related (1). Of those, 74 were female (36 adults, 29 sub-adults, 9 kittens), 70 were male (17 adults, 36 sub-adults, 17 kittens) and 1 unknown sex died of unknown causes (Appendix A).

The majority of the mountain lion population in South Dakota occurs within the Black Hills. Mountain lions are occasionally observed outside of the Black Hills area, but most are likely transient young male mountain lions. Over the past 2 years, SDGFP has documented 35 mountain lion mortalities outside of the BHFPD. Of those, 7 were female (1 adult, 6 sub-adults) and 28 were male (6 adults, 22 sub-adults) Appendix A.

Variation in recovery or detection probability among cause-specific mortalities prevents comparison among categories. For example, vehicle mortalities have higher detection probabilities than illegal killing. Mortality due to interactions or infanticide amongst mountain lions is difficult to detect but has been shown to occur through research of radio-collared mountain lions (Jansen 2011) and documentation of facial scarring in resident males. Thompson (2009) documented 89% (10 of 11) of captured resident male mountain lions had moderate to severe scarring primarily across the face and skull along with scarring of the forelimbs.

All known mountain lion mortalities in South Dakota are recorded and the BHFPD mortalities are evaluated for population trend assessments. Mortalities that have been documented as a result of research and/or radio-collared animals are removed from trend datasets. For trend assessments of mountain lions in the BHFPD of South Dakota, SDGFP primarily evaluates total, harvest, non-harvest, and removal mortalities.

Harvest and Non-harvest Mortalities

The highest number of total mountain lion mortalities within the Black Hills was 104 in 2011/12 (Figure 5). In 2011/12, hunter harvest also peaked at 73 mountain lions. Harvest mortalities can be influenced by factors such as hunting season regulations and weather, which could influence trend assessments. However, the harvest limit has not been reached since 2011/12. Harvest decreased from 73 in 2011/12 to 21 in 2018/19, but has increased the past 2 hunting seasons (51 in 2019/20 and 48 in 2020/21).

Non-harvest mortalities peaked at 38 mountain lions in 2010/11, declined to six in 2016/17, and increased to 24 and 21 in 2019/20 and 2020/21, respectively (Figure 5). Non-harvest mortality trend may reflect increases or decreases in the mountain lion population. However, factors influencing non-harvest mortality can be variable and may influence trend assessments.

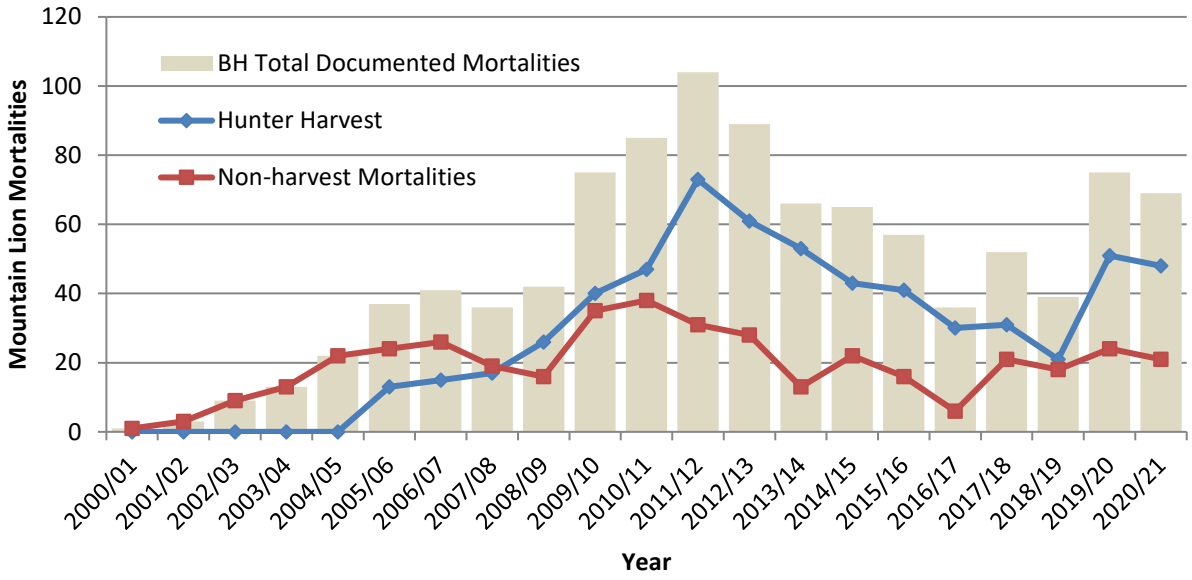

Figure 5. Harvest and non-harvest mountain lion mortalities documented in the South Dakota Black Hills Fire Protection District, 2000/01 – 2020/21 (May 1 – April 30).

Mountain lion removals

In South Dakota, mountain lions are removed by SDGFP due to concerns involving livestock depredation, attacks on pets or mountain lions that pose a substantial threat to public safety. The most mountain lions removed within the BHFPD by SDGFP was 21 in 2009/10, and the number of removals decreased to one in 2016/17 before increasing back up to six in both 2018/19 and 2019/20. SDGFP removals decreased to 4 in 2020/21. (Figure 6). SDGFP will remove a mountain lion for attacking domestic animals but may not remove a mountain lion for attacking or killing pets that are free-roaming or that provoke a mountain lion. Feeding of prey species, such as deer and turkey, in urban areas or near rural homes is discouraged as it can lead to an increased presence of mountain lions. SDGFP encourages problem prevention whenever possible when dealing with mountain lion incidents.

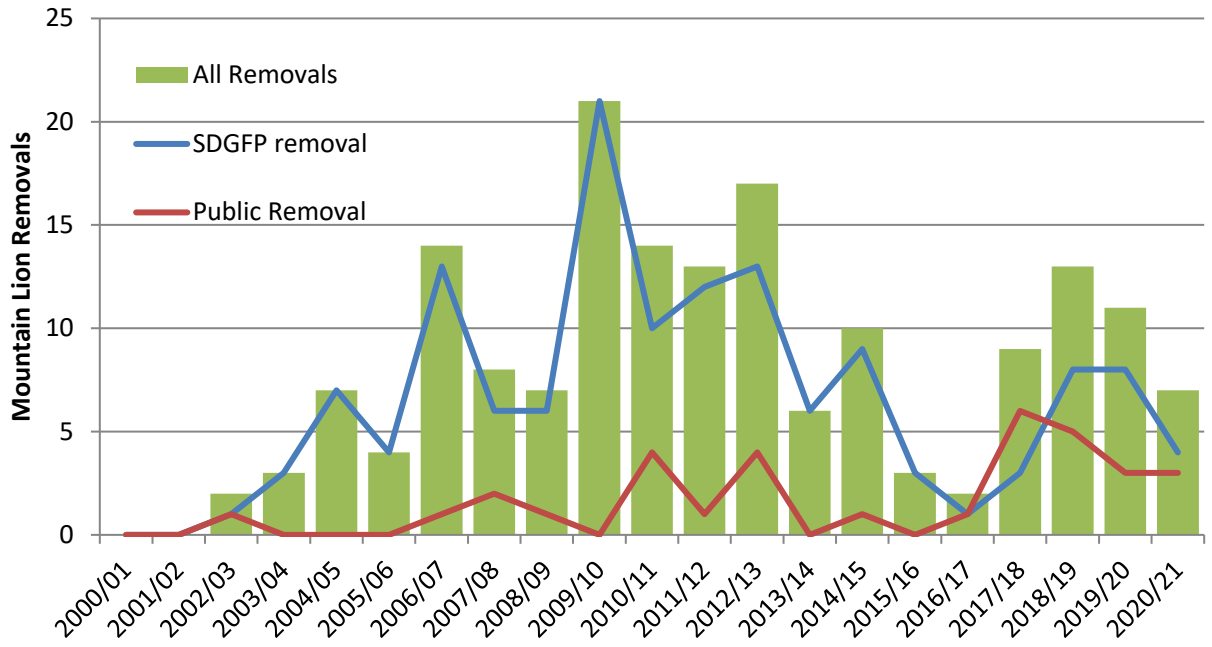

Figure 6. Mountain lion removals by South Dakota Game, Fish and Parks (SDGFP) and the public within the South Dakota Black Hills Fire Protection District, 2000/01 – 2020/21 (May 1 – April 30).

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 mountain lion is posing an imminent threat to a person's livestock or pets. If a person kills a mountain lion pursuant to state law, they must contact SDGFP within 24 hours of killing the mountain lion. Public removals of mountain lions within the BHFPD peaked at 6 removals in 2017/18 before declining again to 3 in each of the last 2 years (Figure 6). Within the BHFPD, total mountain lion removals recorded from 1995/96 to 2020/21 include 61% males and 39% females; ages of all removals includes 20% adults, 53% sub-adult, and 27% kittens (Table 3). This same trend followed on the prairie as removals have included 84% male and 16% female mountain lions; ages of all prairie removals includes 9% adults, 86% sub-adults, and 5% kittens.

Table 3. Age and sex of mountain lions removed in the South Dakota Black Hills Fire Protection District, 1995/96 – 2020/21.

Removal Type	Sex	Age AD	Age SA	Age K	Total
Public Removals	male	1	9	6	16
(n = 34)	female	5	8	5	18
SDGFP Removals	male	17	52	21	90
(n = 139)	female	11	23	15	49

Mortality densities

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

- Reduce lion population: > 8 lions/1,000 km^2
- Maintain lion population: 5-8 lions/1,000 km^2
- Increase lion population: < 5 lions/1,000 km^2

Human caused mountain lion mortality densities in the BHFPD are monitored by the state wildlife agencies of both South Dakota and Wyoming. Using criteria established in Wyoming, mortality densities in South Dakota have been sufficient to lower mountain lion populations in the BHFPD from approximately 2009/10 to 2014/15 (Figure 7). Mortality densities from 2015/16 to 2018/19 were low enough for a stable or increasing population. The past 2 years of harvest have been high enough to potentially stabilize or decrease populations based on research data from Wyoming. Inference about population growth based solely on

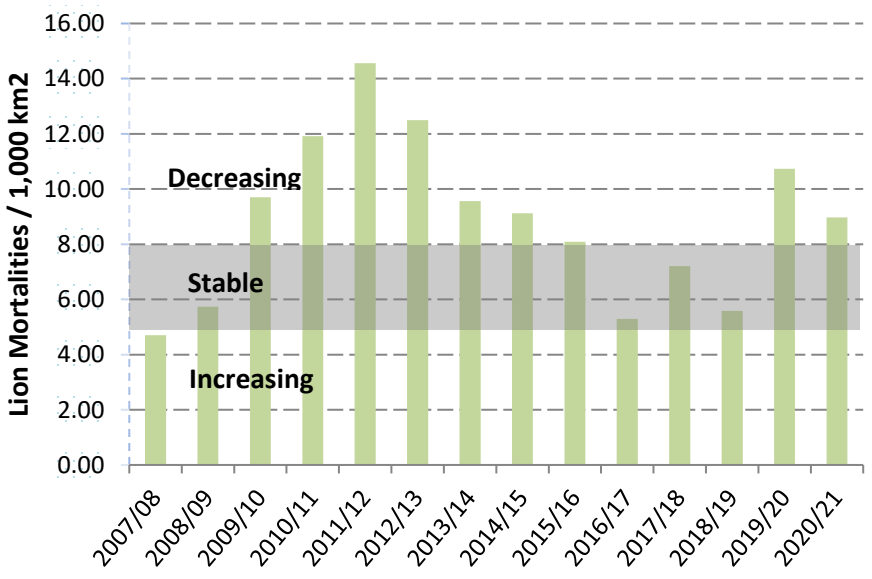

Figure 7. Human-caused mountain lion mortality densities (lions per 1,000 square kilometers) in the South Dakota Black Hills Fire Protection District, 2007/08 – 2020/21 (May 1- April 30). Potential stable population threshold (5-8 mortality density) identified by shaded horizontal bar.

harvest densities requires comparable mountain lion harvest age-structure, population age-structure and density, recruitment and non-harvest mortality rates to Wyoming, where the criteria was established.

DNA Mark/Recapture Survey

Mountain lion population estimates are derived using mark-recapture data and the Lincoln-Petersen estimator, with the Chapman modification to account for small sample sizes (Chapman 1951). Beginning in 2013/14, after completion and evaluation of research conducted by Juarez (2014), the SDGFP began using biopsy-darting as the primary method to DNA mark mountain lions immediately prior to the season; radio-collared mountain lions from previous research are also utilized to assess availability. In December of 2020, SDGFP used 3 houndsmen teams to collect 68 samples. After DNA analyses were conducted by the USFS National Genomics Center for Wildlife and Fish Conservation, there were DNA samples from 52 individual adult and sub-adult mountain lions that were considered available for harvest for the first day of the 2020/21 hunting season. The 126-day hunting season is considered the recapture event, and during that time, 46 adult and sub-adult mountain lions were harvested; 8 were previously DNA sampled. The inputs for the 2020/2021 estimate are as follows; *M* = 52, *C* = 46, *R* = 8, where:

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

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

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

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

Vital rates from radio-collared individuals and recruitment data from previous research studies in the Black Hills (e.g., Thompson 2009, Jansen 2011) were used as input variables to calculate the number of kittens and total mountain lion population. Age and sex composition of starting populations was based on the 3-year average composition of harvested mountain lions. The 2020/21 preseason population estimate for the Black Hills was approximately 361 total

mountain lions (95% CI: 174-558), of which 277 were adults/sub-adults. Population estimates have low precision but appear to be near management objective the past few years (Figure 8).

Catch per unit effort (CPUE) data are also recorded during DNA collection efforts and are evaluated annually (Table 4). During 2015-2020, CPUE has been very consistent at approximately 10-11 mountain lions treed per 100 hours but increased to over 13 in 2018.

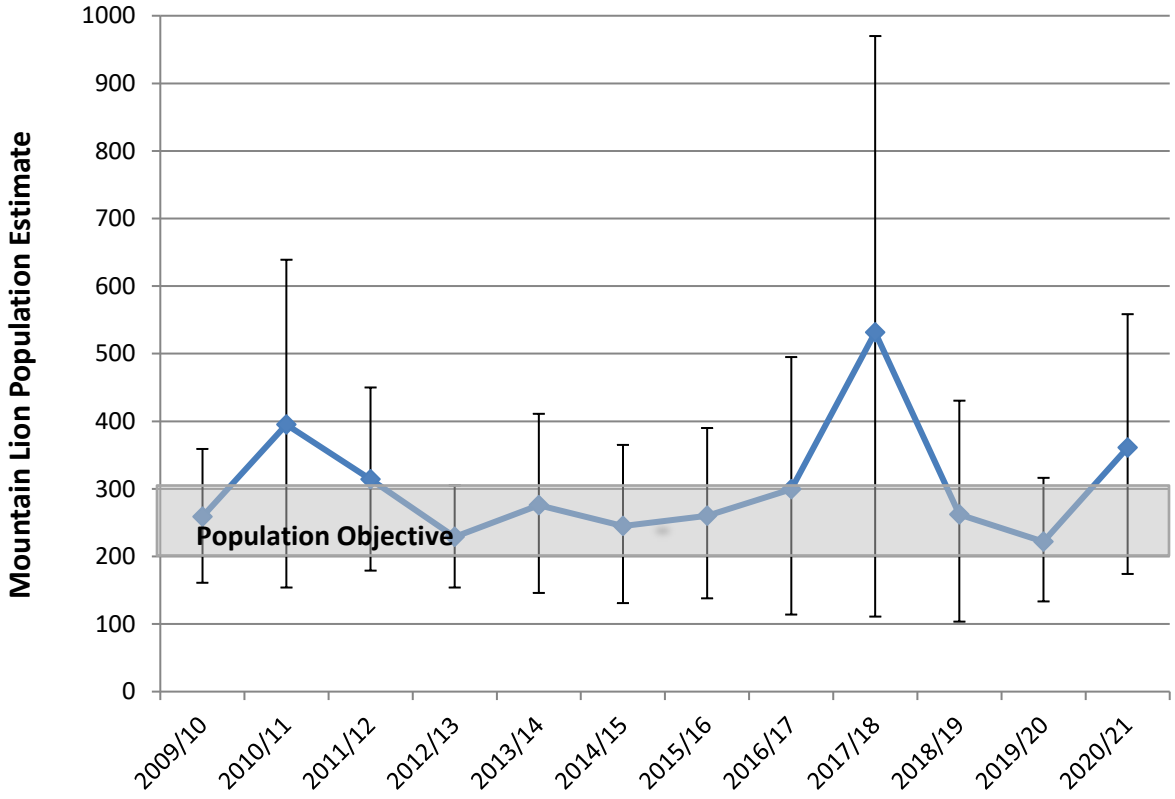

Figure 8. Mark/recapture estimates of the mountain lion population in the South Dakota Black Hills Fire Protection District, 2009/10 – 2020/21 (May 1 – April 30). Current population management objective (200-300) identified by shaded horizontal bar.

Table 4. Catch per unit effort data collected during annual biopsy surveys of mountain lions in the South Dakota Black Hills Fire Protection District, 2013 – 2020.

Year	Hours	Lions	Hrs/lion	Catch/100 hrs
2013	319	26	12.3	8.2
2014	615	31	19.8	5.0
2015	508	56	9.1	11.0
2016	578	63	9.2	10.9
2017	551	63	8.7	11.4
2018	565	75	7.5	13.3
2019	627	63	10.0	10.0
2020	625	68	9.2	10.9

Observation Reports

All mountain lion observations reported by the public are documented and evaluated for trend assessments along with other mountain lion population data. Observation reports have been generally decreasing since they peaked in 2004/05 at 406 total reports (Figure 9). Overall, verified reports have also trended downward since 2008/09, but have been increasing since 2016/17. Because SDGFP encourages the public to report any observations of mountain lions and documents all such observations, it is important to report these data. Interpretation of observational data is challenging, however, because reporting rates from the public are unknown and likely variable which impacts data trend evaluations. It is likely that only significant increases or decreases to the mountain lion population would be documented with observation report data.

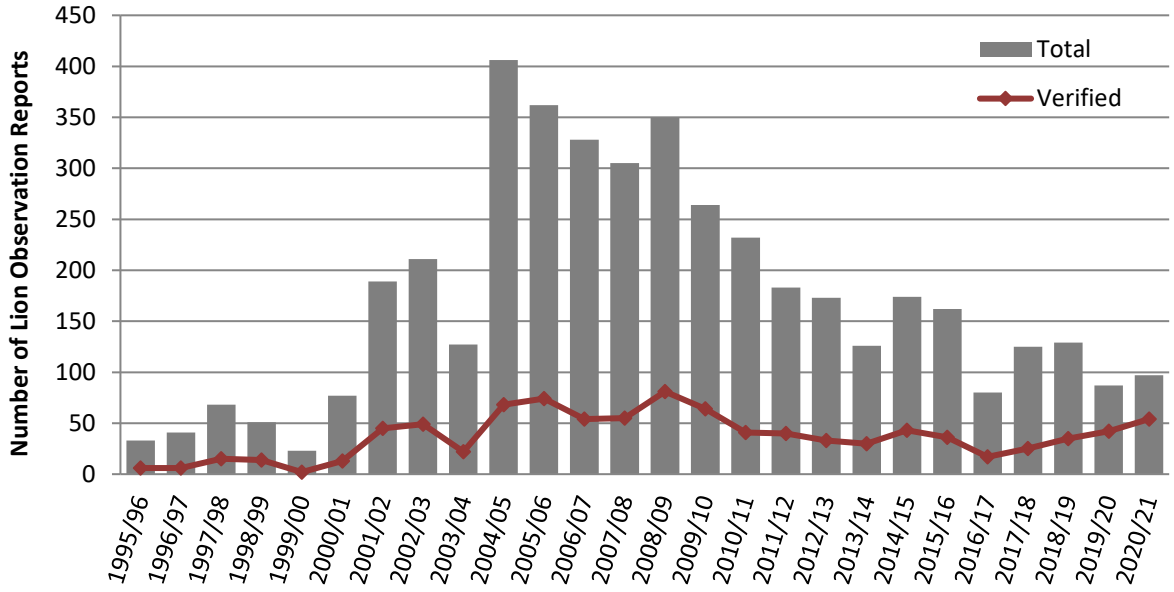

Figure 9. Mountain lion observation reports in South Dakota, including total number of reports and those verified by South Dakota Game, Fish and Parks, 1995/96 – 2020/21 (May 1 – April 30).

Projected Population Growth Rates

Population trajectories are an important management tool that enables a better understanding of harvest strategies needed to meet management objectives. Growth rates of mountain lion populations are primarily influenced by female survival and kitten recruitment. Evaluating a range of female and kitten survival rates allows managers to recommend appropriate female harvest rates in order to meet unit objectives. For example, in 2020/21, 144 subadult and adult females were estimated in the population based on mark/recapture estimates and harvest age and sex composition data, and 25 subadult and adult females were harvested. This resulted in a 17.4% subadult and adult female harvest rate. Assuming average recruitment and non-harvest survival, this harvest rate will decrease the current mountain lion population by 7% before the 2021/22 hunting season. If 25 subadult and adult female mountain lions are harvested again during the next 2 hunting seasons, the current population would decrease by 15% before the 2022/23 hunting season, and decrease by 24% to 274 before the 2023/24 hunting season (Table 5).

Table 5. Predicted mountain lion population growth rates (decrease [↓], stable [●], increase [↑]) based on recruitment, survival, and harvest rate. Recruitment rates were fixed using 57% birth rate of ≥3 year old females within the past year and litter size of 2.9.

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

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

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

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

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

SUMMARY

The SDGFP conducts several surveys and assessments to better understand mountain lion population abundance and trends in the BHFPD. Data from hunting seasons and hunter surveys are evaluated annually, such as harvest, harvest sex and age composition, female proportions in the harvest, and harvest per unit effort. Other mountain lion data, including non-harvest mortalities, removals and total mortality densities are also assessed for any apparent trends. In addition, DNA biopsy-darting surveys are conducted annually prior to each hunting season to provide mark/recapture population estimates and evaluations of catch per unit effort. Furthermore, all observation reports from the public are evaluated.

This report provides the most recent mountain lion survey data and analyses completed in South Dakota. Caution is warranted when comparing data in South Dakota with trend indicators developed for mountain lion populations in western states with substantially different habitats, predator and prey densities, and data collection methods (e.g., dog hunting vs. no dog hunting). Additionally, it should be noted that not all trend indices assessed by the SDGFP are in agreement. Given these considerations, however, several surveys and population projections suggest mountain lions increased following several years of low harvest rates through 2018/19. The past 2 years (2019/20 and 2020/21) of increased harvest and other

documented mortalities, however, are not sustainable and will result in a decreasing population.

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APPENDIX

Appendix A. Documented mountain lion mortalities in South Dakota, May 1, 2019 – April 30, 2021. (A=Adult, SA=Subadult, K=Kitten under 1 year of age).

Date Died or Reported	Adjusted Year	Sex	Age Class	Classification of Death	County	Black Hills or Prairie
05/10/2019	2019	M	SA	Removal	Pennington	Black Hills
05/26/2019	2019	M	A	Removal	Mellette	Prairie
06/14/2019	2019	F	SA	Hunter Harvest	Meade	Prairie
06/22/2019	2019	M	SA	Vehicle	Fall River	Prairie
08/08/2019	2019	F	SA	Removal	Custer	Black Hills
08/10/2019	2019	F	SA	Removal	Pennington	Black Hills
08/31/2019	2019	M	SA	Vehicle	Yankton	Prairie
09/05/2019	2019	F	A	Vehicle	Lawrence	Black Hills
09/09/2019	2019	F	A	Public Removal	Lawrence	Black Hills
10/07/2019	2019	F	SA	Vehicle	Davison	Prairie
10/09/2019	2019	F	SA	Vehicle	Custer	Black Hills
10/11/2019	2019	M	SA	Hunter Harvest	Meade	Prairie
10/24/2019	2019	M	SA	Removal	Lawrence	Black Hills
10/27/2019	2019	M	SA	Hunter Harvest	Meade	Prairie
11/02/2019	2019	M	SA	Hunter Harvest	Lawrence	Prairie
11/02/2019	2019	M	SA	Hunter Harvest	Meade	Prairie
11/02/2019	2019	M	SA	Public Removal	Harding	Prairie
11/05/2019	2019	M	SA	Vehicle	Meade	Black Hills
11/19/2019	2019	M	SA	Vehicle	Harding	Prairie
11/24/2019	2019	M	SA	Unknown	Custer	Black Hills
11/27/2019	2019	M	SA	Hunter Harvest	Yankton	Prairie
12/02/2019	2019	F	SA	Public Removal	Custer	Black Hills
12/18/2019	2019	M	K	Research	Pennington	Black Hills
12/20/2019	2019	M	K	Vehicle	Lawrence	Black Hills
12/25/2019	2019	F	A	Incidental	Meade	Black Hills
12/27/2019	2019	F	A	Hunter Harvest	Lawrence	Black Hills
12/28/2019	2019	M	SA	Hunter Harvest	Fall River	Black Hills
12/29/2019	2019	M	SA	Hunter Harvest	Custer	Black Hills
12/29/2019	2019	M	A	Hunter Harvest	Custer	Black Hills
12/29/2019	2019	F	SA	Unknown	Lawrence	Black Hills

Date Died or Reported	Adjusted Year	Sex	Age Class	Classification of Death	County	Black Hills or Prairie
12/30/2019	2019	F	SA	Hunter Harvest	Pennington	Black Hills
12/30/2019	2019	M	A	Hunter Harvest	Custer	Black Hills
12/31/2019	2019	F	A	Hunter Harvest	Pennington	Black Hills
12/31/2019	2019	F	A	Hunter Harvest	Custer	Black Hills
01/01/2020	2019	F	SA	Hunter Harvest	Pennington	Black Hills
01/02/2020	2019	M	SA	Hunter Harvest	Meade	Black Hills
01/04/2020	2019	F	A	Hunter Harvest	Pennington	Black Hills
01/04/2020	2019	M	A	Hunter Harvest	Lawrence	Black Hills
01/05/2020	2019	F	A	Hunter Harvest	Lawrence	Black Hills
01/08/2020	2019	M	SA	Hunter Harvest	Beadle	Prairie
01/10/2020	2019	F	SA	Hunter Harvest	Meade	Prairie
01/11/2020	2019	F	SA	Hunter Harvest	Lawrence	Prairie
01/12/2020	2019	F	SA	Hunter Harvest	Pennington	Black Hills
01/12/2020	2019	F	SA	Hunter Harvest	Meade	Black Hills
01/12/2020	2019	F	A	Hunter Harvest	Custer	Black Hills
01/13/2020	2019	M	SA	Hunter Harvest	Lawrence	Prairie
01/16/2020	2019	M	K	Removal	Lawrence	Black Hills
01/16/2020	2019	F	K	Removal	Lawrence	Black Hills
01/20/2020	2019	M	SA	Hunter Harvest	Lawrence	Black Hills
01/22/2020	2019	F	A	Hunter Harvest	Lawrence	Black Hills
01/24/2020	2019	M	SA	Vehicle	Pennington	Black Hills
01/27/2020	2019	F	A	Hunter Harvest	Custer	Black Hills
01/28/2020	2019	M	A	Hunter Harvest	Custer	Black Hills
01/28/2020	2019	M	A	Hunter Harvest	Meade	Prairie
01/28/2020	2019	M	A	Hunter Harvest	Pennington	Black Hills
01/29/2020	2019	F	SA	Hunter Harvest	Custer	Black Hills
01/31/2020	2019	M	A	Hunter Harvest	Meade	Black Hills
02/03/2020	2019	F	A	Hunter Harvest	Custer	Black Hills
02/04/2020	2019	F	SA	Hunter Harvest	Pennington	Black Hills
02/04/2020	2019	M	SA	Hunter Harvest	Meade	Prairie
02/04/2020	2019	F	SA	Hunter Harvest	Custer	Black Hills
02/04/2020	2019	M	SA	Hunter Harvest	Custer	Black Hills
02/08/2020	2019	M	K	Hunter Harvest	Lawrence	Black Hills

Date Died or Reported	Adjusted Year	Sex	Age Class	Classification of Death	County	Black Hills or Prairie
02/08/2020	2019	M	SA	Hunter Harvest	Mellette	Prairie
02/09/2020	2019	F	A	Hunter Harvest	Custer	Black Hills
02/11/2020	2019	M	SA	Hunter Harvest	Lawrence	Prairie
02/13/2020	2019	M	SA	Hunter Harvest	Pennington	Black Hills
02/13/2020	2019	M	SA	Hunter Harvest	Fall River	Black Hills
02/14/2020	2019	F	SA	Hunter Harvest	Pennington	Black Hills
02/14/2020	2019	F	A	Hunter Harvest	Custer	Black Hills
02/16/2020	2019	F	SA	Hunter Harvest	Lawrence	Black Hills
02/16/2020	2019	M	SA	Incidental	Fall River	Black Hills
02/26/2020	2019	M	SA	Hunter Harvest	Custer	Black Hills
02/26/2020	2019	M	K	Hunter Harvest	Pennington	Black Hills
02/27/2020	2019	M	SA	Hunter Harvest	Custer	Black Hills
02/26/2020	2019	F	K	Hunter Harvest	Custer	Black Hills
02/26/2020	2019	M	K	Public Removal	Custer	Black Hills
02/28/2020	2019	M	SA	Hunter Harvest	Custer	Black Hills
03/02/2020	2019	M	SA	Vehicle	Lawrence	Black Hills
03/05/2020	2019	F	K	Vehicle	Pennington	Black Hills
03/10/2020	2019	M	K	Unknown	Lawrence	Black Hills
03/15/2020	2019	M	K	Hunter Harvest	Pennington	Black Hills
03/15/2020	2019	M	SA	Hunter Harvest	Lawrence	Black Hills
03/21/2020	2019	M	K	Removal	Meade	Black Hills
03/25/2020	2019	M	A	Hunter Harvest	Lawrence	Black Hills
03/30/2020	2019	F	A	Removal	Meade	Black Hills
04/02/2020	2019	F	A	Hunter Harvest	Lawrence	Black Hills
04/03/2020	2019	F	K	Hunter Harvest	Custer	Black Hills
04/10/2020	2019	F	A	Hunter Harvest	Lawrence	Black Hills
04/16/2020	2019	F	A	Hunter Harvest	Lawrence	Black Hills
04/17/2020	2019	F	A	Hunter Harvest	Lawrence	Black Hills
04/16/2020	2019	M	A	Hunter Harvest	Lawrence	Black Hills
04/17/2020	2019	M	A	Hunter Harvest	Custer	Black Hills
04/17/2020	2019	F	K	Vehicle	Lawrence	Black Hills
04/19/2020	2019	F	K	Hunter Harvest	Pennington	Black Hills
04/24/2020	2019	M	A	Hunter Harvest	Custer	Black Hills

Date Died or Reported	Adjusted Year	Sex	Age Class	Classification of Death	County	Black Hills or Prairie
05/02/2020	2020	M	A	Hunter Harvest	Butte	Prairie
05/10/2020	2020	M	SA	Interaction	Bon Homme	Prairie
05/21/2020	2020	F	A	Unknown	Fall River	Black Hills
05/22/2020	2020	M	K	Public Removal	Lawrence	Black Hills
05/24/2020	2020	F	K	Removal	Lawrence	Black Hills
06/03/2020	2020	F	SA	Unknown	Lawrence	Black Hills
06/15/2020	2020	F	SA	Unknown	Custer	Black Hills
06/24/2020	2020	UNK	K	Unknown	Lawrence	Black Hills
07/16/2020	2020	M	SA	Public Removal	Jackson	Prairie
07/24/2020	2020	M	SA	Removal	Pennington	Black Hills
07/27/2020	2020	F	A	Vehicle	Pennington	Black Hills
08/12/2020	2020	M	A	Public Removal	Yankton	Prairie
08/28/2020	2020	F	A	Vehicle	Lawrence	Black Hills
09/26/2020	2020	F	SA	Vehicle	Custer	Black Hills
10/10/2020	2020	M	SA	Removal	Meade	Black Hills
10/25/2020	2020	M	SA	Hunter Harvest	Mellette	Prairie
12/10/2020	2020	F	SA	Hunter Harvest	Jackson	Prairie
12/15/2020	2020	M	SA	Public Removal	Mellette	Prairie
12/27/2020	2020	M	SA	Hunter Harvest	Custer	Black Hills
12/27/2020	2020	F	A	Hunter Harvest	Custer	Black Hills
12/27/2020	2020	F	SA	Hunter Harvest	Pennington	Black Hills
12/29/2020	2020	M	SA	Hunter Harvest	Pennington	Black Hills
12/30/2020	2020	M	A	Hunter Harvest	Custer	Black Hills
12/30/2020	2020	M	SA	Hunter Harvest	Pennington	Black Hills
12/30/2020	2020	M	SA	Hunter Harvest	Custer	Black Hills
01/01/2021	2020	M	SA	Hunter Harvest	Lawrence	Black Hills
01/01/2021	2020	M	A	Hunter Harvest	Custer	Black Hills
01/02/2021	2020	F	SA	Hunter Harvest	Pennington	Black Hills
01/04/2021	2020	M	K	Public Removal	Pennington	Black Hills
01/06/2021	2020	F	A	Hunter Harvest	Custer	Black Hills
01/06/2021	2020	M	SA	Hunter Harvest	Custer	Black Hills
01/07/2021	2020	F	A	Hunter Harvest	Lawrence	Black Hills
01/07/2021	2020	F	A	Hunter Harvest	Lawrence	Black Hills

Date Died or Reported	Adjusted Year	Sex	Age Class	Classification of Death	County	Black Hills or Prairie
01/09/2021	2020	F	SA	Hunter Harvest	Pennington	Black Hills
01/15/2021	2020	F	SA	Hunter Harvest	Lawrence	Black Hills
01/17/2021	2020	F	SA	Hunter Harvest	Meade	Black Hills
01/18/2021	2020	M	K	Hunter Harvest	Pennington	Black Hills
01/18/2021	2020	M	SA	Hunter Harvest	Pennington	Black Hills
01/22/2021	2020	F	A	Hunter Harvest	Pennington	Black Hills
01/24/2021	2020	F	SA	Hunter Harvest	Pennington	Black Hills
01/24/2021	2020	M	SA	Hunter Harvest	Custer	Black Hills
01/24/2021	2020	M	SA	Hunter Harvest	Fall River	Prairie
01/22/2021	2020	M	SA	Incidental	Oglala Lakota	Prairie
01/25/2021	2020	M	SA	Hunter Harvest	Custer	Black Hills
01/25/2021	2020	F	A	Hunter Harvest	Pennington	Black Hills
01/29/2021	2020	M	SA	Hunter Harvest	Lyman	Prairie
01/30/2021	2020	F	A	Hunter Harvest	Lawrence	Black Hills
01/30/2021	2020	F	A	Hunter Harvest	Lawrence	Prairie
02/07/2021	2020	F	A	Hunter Harvest	Pennington	Black Hills
02/07/2021	2020	M	SA	Hunter Harvest	Lawrence	Black Hills
02/07/2021	2020	F	A	Hunter Harvest	Pennington	Black Hills
02/08/2021	2020	F	SA	Hunter Harvest	Pennington	Black Hills
02/08/2021	2020	M	A	Hunter Harvest	Custer	Black Hills
02/09/2021	2020	M	SA	Hunter Harvest	Meade	Prairie
02/11/2021	2020	M	SA	Hunter Harvest	Pennington	Black Hills
02/13/2021	2020	F	SA	Hunter Harvest	Pennington	Black Hills
02/13/2021	2020	M	K	Removal	Pennington	Black Hills
02/15/2021	2020	M	SA	Hunter Harvest	Pennington	Black Hills
02/17/2021	2020	F	A	Hunter Harvest	Meade	Black Hills
02/17/2021	2020	M	A	Hunter Harvest	Custer	Black Hills
02/19/2021	2020	F	SA	Hunter Harvest	Lawrence	Black Hills
02/20/2021	2020	M	A	Hunter Harvest	Custer	Black Hills
02/20/2021	2020	F	A	Hunter Harvest	Pennington	Black Hills
02/21/2021	2020	M	A	Hunter Harvest	Meade	Prairie
02/24/2021	2020	M	K	Vehicle	Meade	Black Hills
02/27/2021	2020	F	SA	Hunter Harvest	Pennington	Black Hills

Date Died or Reported	Adjusted Year	Sex	Age Class	Classification of Death	County	Black Hills or Prairie
02/28/2021	2020	M	SA	Hunter Harvest	Lawrence	Black Hills
02/28/2021	2020	F	A	Hunter Harvest	Custer	Black Hills
02/28/2021	2020	F	K	Public Removal	Fall River	Black Hills
03/02/2021	2020	F	SA	Hunter Harvest	Lawrence	Black Hills
03/02/2021	2020	M	A	Unknown	Pennington	Black Hills
03/08/2021	2020	F	SA	Vehicle	Custer	Black Hills
03/11/2021	2020	M	SA	Hunter Harvest	Pennington	Black Hills
03/11/2021	2020	M	K	Hunter Harvest	Pennington	Black Hills
03/13/2021	2020	M	SA	Hunter Harvest	Lawrence	Black Hills
03/15/2021	2020	F	A	Hunter Harvest	Pennington	Black Hills
03/13/2021	2020	M	A	Hunter Harvest	Jackson	Prairie
03/16/2021	2020	F	SA	Hunter Harvest	Bennett	Prairie
03/21/2021	2020	F	A	Hunter Harvest	Custer	Black Hills
03/23/2021	2020	M	SA	Vehicle	Lawrence	Black Hills
03/27/2021	2020	M	K	Unknown	Pennington	Black Hills
03/27/2021	2020	M	K	Unknown	Pennington	Black Hills
04/20/2021	2020	M	A	Hunter Harvest	Custer	Black Hills
04/28/2021	2020	F	K	Unknown	Pennington	Black Hills