SOUTH DAKOTA ELK MANAGEMENT PLAN 2015-2019

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

WILDLIFE DIVISION REPORT 2015-01

APRIL 2015

This document is for general, strategic guidance for the Division of Wildlife and serves to identify what we strive to accomplish related to elk management. This plan will be utilized by Department staff and Commission on an annual basis and will be formally evaluated at least every 5 years. Plan updates and changes, however, may occur more frequently as needed.

ACKNOWLEDGEMENTS

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

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ACRONYMS AND ABBREVIATIONS

ASQ	Allowable Sale Quantity (of timber)
ARSD	South Dakota Administrative Rule
AUM	Animal Unit Month
BHNF	Black Hills National Forest
BLM	Bureau of Land Management within the USDI
CCF	Hundred cubic feet (timber volume)
CGNF	Custer Gallatin National Forest
CSP	Custer State Park
DBH	Diameter at Breast Height of a tree 4.5" from ground level
DOW	Division of Wildlife for SDGFP
FEIS	Final Environmental Impact Statement
FS	Forest Service within the USDA
HABCAP	Habitat Capability Model
HE	Habitat Effectiveness
MA	Management Area
MOU	Memorandum of Understanding
MPB	Mountain Pine Beetle
MUSYA	Multiple Use and Sustained Yield Act
MVUM	Motorized Vehicle Use Map
NEPA	National Environmental Policy Act
NGPC	Nebraska Game and Parks Commission
NWP	Norbeck Wildlife Preserve on BHNF
OHV	Off-highway motorized vehicle
OSPRA	Oglala Sioux Parks and Recreation Authority
OSV	Over-snow motorized vehicle
Plan	Reference to a Forest Service Land and Resource Management Plan
ROD	Record of Decision for a FEIS
RST	Rosebud Sioux Tribe
SDCL	South Dakota Codified Law
SDGFP	South Dakota Department of Game, Fish and Parks
SD	South Dakota
SS	Structural Stage. Size and canopy cover classification for ponderosa pine
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
VDT	Variable Density Thinning
WGFD	Wyoming Game and Fish Department
WICA	Wind Cave National Park
YNP	Yellowstone National Park

EXECUTIVE SUMMARY

The re-establishment of elk in South Dakota is a wildlife management success story, as today several thousand wild elk roam free, primarily in the Black Hills forested region along with several smaller herds occupying prairie and agriculture landscapes. Public demand for elk hunting and viewing opportunities is strong and continues to increase. According to a public opinion survey completed in 2013, 93% of elk hunter applicants and 62% of landowners prefer to see the elk population increase over the next five years.

This management plan provides important historical background and significant biological information for the formulation of sound elk management. Current elk survey methods and management tools are presented, along with a thorough discussion of objectives and strategies to guide management of this important resource into the future. This plan is intended to guide managers and biologists over the next five years, but should be considered a working document that will be amended as new biological and social data provide opportunities to improve management of elk resources in South Dakota.

The Black Hills population objective (excluding Custer State Park and Wind Cave National Park) is 7,000 wintering elk, ranging from 6,000 to 8,000 depending on habitat conditions. South Dakota Game, Fish, and Parks will adjust elk hunting licenses to gradually increase elk populations to this objective by 2019. The current population objective for Custer State Park (CSP) is 800 wintering elk, ranging from 700-900 depending on habitat conditions. These objectives were developed from the thorough analyses of elk population data, available habitat resources on public land, private land depredation issues, and substantial input from a wide variety of publics with an interest in elk management in South Dakota. While considering numerous factors that may impact population performance (e.g. available forage, drought, harvest, predation, human disturbance and landowner tolerance), SDGFP will adopt harvest strategies that will progressively allow the elk population to reach these population objectives.

Winter aerial surveys will occur every 3-4 years to assess population status and provide information about wintering elk densities and distribution in the Black Hills of South Dakota. Elk residing in the Black Hills are known migrators and often gather in large concentrations during winter months on established wintering grounds; approximately 75% of all elk counted during 2013 aerial surveys were observed in the Jasper fire burn area. Estimates of elk distribution in other seasons (i.e., spring, summer, fall) remain unknown, therefore elk management units will be managed to increase, maintain, or decrease elk populations. Management unit direction will be based on an annual collection and evaluation of biological data, population performance models, habitat conditions, and social data.

Population objectives for prairie elk units will also be specific to management unit direction and elk populations will be managed to abate substantial agricultural damages on private property while at the same time providing recreational hunting opportunity. Management directions

(increase, maintain, decrease) will be based on a qualitative assessment for each prairie elk unit and will be evaluated annually.

The management of elk and their habitats can be complex for wildlife and habitat managers. While not an exclusive list, the following topics were discussed during the plan development and include: habitat; additional forage since the 1997 Black Hills National Forest Land and Resource Management Plan; depredation; inter-state and tribal coordination; prairie elk management; elk-vehicle collisions; hunting regulations; disease; captive cervid game farming; predation management; multiple use; and mining, energy development and transmission. These challenges and opportunities serve as the foundation for the objectives and strategies outlined in the plan and will be addressed to ensure this plan is successfully implemented.

To achieve these population goals, the following objectives have been identified: 1) Maintain, manage, and protect existing elk habitat throughout the Black Hills; 2) Manage for biologically and socially acceptable elk populations in each elk management unit within the Black Hills, CSP, and Prairie units of South Dakota; 3) Manage elk populations in the Black Hills and CSP for quantity and quality recreational hunting opportunities, with an emphasis in CSP on view ability for visitors to the park; 4) Engage and collaborate with the public to manage elk populations and maintain acceptable ”elk unit management directions”; 5) Cooperatively work with private landowners to resolve elk depredation to growing crops, stored-feed supplies, and private property; 6) Monitor and evaluate risk and impact of disease in wild elk herds in South Dakota; 7) Provide the public with access to private and public land for quality hunting opportunities; 8) Evaluate research and management needs and prioritize frequently; 9) Promote public, landowner, and conservation agency awareness of elk and habitat management issues of highest conservation concern; and 10) Provide opportunities for public involvement in elk management. Time-specific and measurable strategies have been identified to ensure these objectives are delivered and achieved.

The “*Elk Management Plan for South Dakota, 2015-2019*” will serve as the guiding document for decision making and implementation of actions to ensure elk populations and their habitats are managed appropriately, addressing both biological and social tolerances, while considering the needs of all stakeholders. SDGFP will work closely with private landowners, Black Hills National Forest, Wind Cave National Park and sportsmen and women to overcome the challenges and take advantage of opportunities regarding the future management of elk in South Dakota.

South Dakota Elk Management Plan
2015-2019

INTRODUCTION

The elk (*Cervus elaphus*) is the largest hunted member of the deer family (Cervidae) residing in South Dakota. Prior to European settlement, elk once ranged over the entire state of South Dakota but were extirpated by the late 1800s due to unregulated harvest and market hunting. Cooperative transplant efforts between western state and federal agencies began in the early 1900s to re-introduce elk into the Black Hills of South Dakota.

The re-establishment of elk in South Dakota is a wildlife management success story, as today several thousand elk roam free, primarily in the Black Hills forested region along with several smaller herds occupying prairie and/or agriculture landscapes. Public demand for elk hunting opportunities is strong, with approximately 17,530 hunters applying for 3,029 available elk licenses at recent peak population levels in 2005. Current populations are likely most affected by available forage, drought, harvest, predation, and landowner tolerance.

The South Dakota Department of Game, Fish, and Parks (SDGFP) manages wildlife and associated habitats for their sustained and equitable use, and the benefit, welfare and enjoyment of the citizens of this state and its visitors. South Dakota's elk resources demand prudent and increasingly intensive management to accommodate numerous and varied public demands and growing impacts from people. This plan provides important historical background and significant biological information for the formulation of sound elk management. Current elk survey methods and management tools are presented, along with a thorough discussion of objectives and strategies to guide management of this important resource into the future. This plan is intended to guide managers and biologists over the next five years, but should be considered a working document that will be amended as new biological and/or social data provide opportunities to improve management of elk resources in South Dakota. Furthermore, this plan will aid in the decision-making process of our Division of Wildlife (DOW) and SDGFP Commission, and serves to inform and educate the sportsmen and women, landowners, and other publics of South Dakota to whom it will ultimately benefit.

HISTORICAL BACKGROUND

In the early 1800s, elk (*Cervus Spp.*) were one of the most common native ungulates in North America (Bryant and Maser 1982). Manitoban elk (*Cervus elaphus manitobensis*) was the subspecies found in the Dakota's and throughout the central plains (Bryant and Maser 1982). Available records for South Dakota, although not voluminous, are sufficient to indicate statewide distribution of elk and showed that in the early part of the nineteenth century, elk

were abundant especially in the Black Hills (Murie 1951). Long before early European settlers and explorers, elk were an important part of North American Indians' subsistence economy, and although the elk was less essential than the bison and deer, it often served as a vital source of food, clothing, implements, weapons, decorations, spiritualism, and sources of currency (McCabe 2002). Millspaugh and Brundige (1996a) noted that the Oglala Sioux tribe of the Great Plains recognized elk as a spirit animal associated with courage, persistence, strength, love and passion. The canine teeth were prized by Native Americans as ornaments, and as recognition of status.

Elk were a prominent food source during the exploration and early settlement of much of the United States and southern Canada (O'Gara and Dundas 2002). In the early 1800s, the Lewis and Clark expedition reported an abundance of elk in what is now southeastern South Dakota. Elk were well distributed along the Missouri River corridor, and as the expedition continued northward into what is now North Dakota, elk sightings became common-place. Murie (1951) also reported elk were abundant in the early 1800s, especially in the Black Hills. Parkman (1910), chronicling the journeys of travelers to California via the Oregon Trail, called the Black Hills a hunter's paradise and wrote of "the broad dusty paths made by the elk, as they filed across the mountain-side". With the onset of white settlers into South Dakota and the Black Hills, elk populations were extirpated across the state and in the Black Hills by the late 1800s. By the 1870s, only scattered herds of Manitoban elk remained east of the Missouri River in South Dakota, and by 1875, only a few elk remained outside of the Black Hills (Dodge 1877). Following the gold rush into the Black Hills in 1876, elk populations decreased drastically (O'Gara and Dundas 2002). The last native elk in South Dakota was believed to be killed in 1888 (Rice 1988). The natural range of elk in North America was reduced to Manitoba, Saskatchewan, and the Rocky Mountains and West Coast provinces and states of Canada and the United States (O'Gara and Dundas 2002).

Conflicting reports exist pertaining to when elk were released and where they were reintroduced in the Black Hills area of South Dakota. Rice (1988) reported that elk reintroduction efforts into South Dakota were initiated in the early 1900s. Most of the elk that were used to repopulate the elk herds in the Black Hills region were transplanted from western states, including Idaho, Montana, and Wyoming and consisted of the Rocky Mountain subspecies (*Cervus elaphus nelsoni*). Records indicate that the first release was conducted in the Northern Black Hills of Wyoming when approximately 100 head of Rocky Mountain elk were released in 1911 by Wyoming and South Dakota State agencies (Rice 1988). In 1912, 21 elk from Idaho were released, and in 1913, the same number was again released in the Northern Black Hills of Wyoming (Rice 1988). The last recorded transplant of elk into the Black Hills region of South Dakota occurred in 1916 when 50 elk were transplanted to Custer State Park (CSP) and 25 elk were released into Wind Cave National Park (WICA) from Gardiner, Montana (Millspaugh and Brundige 1996a, Lovaas 1973). Rice (1988) stated that by 1928, herds in the Black Hills area had grown to an estimated 1,000 elk, and damage to agricultural crops required population control. As a result, the first elk season was held in 1928.

All known reintroductions and transplants of elk into, within, or out of the Black Hills Region from 1911 to 2014 can be found in Appendix 1. Most transplants occurred in what are now WICA and CSP. Once populations in those areas increased, transplants to other parts of the Black Hills were conducted (1970-1972, 1980, 1985-1986, and 1990) (Appendix 1). From 1971 to 1994, an estimated 754 elk were moved from WICA to various tribal entities across South Dakota as WICA was known as the source for elk for both State and Tribal agencies in South Dakota to enhance population needs. The most recent translocation of elk into South Dakota occurred in 1993, when 161 elk were moved to three Indian reservations in South Dakota from Theodore Roosevelt National Park in North Dakota. Elk in the prairie regions of South Dakota are likely expansions of those transplanted elk.

ELK HUNTING

Historical Harvest

Management strategies for elk populations in South Dakota have changed throughout the years. As early as 1920 intermittent hunting seasons were started within CSP and the surrounding areas. In 1928 the management direction was to eradicate elk outside of WICA and CSP with the use of hunting seasons (Rice 1988). The first structured elk hunting season began on November 1st 1931 and ran until the 20th of the month within three hunting units located in the Black Hills. These units were arranged to specifically target elk herds near WICA and CSP. With a few exceptions, firearm seasons continued through 1952 with some years having very liberal seasons of over 800 licenses available (Table 1). Season closures occurred in 1933, 1938, 1940, and 1950. In 1953 hunters were allowed to harvest an elk on a Black Hills deer tag with no records kept of the harvest results. The elk season was closed from 1960-1964. In 1965 the season was opened with 120 licenses issued to manage the elk herd to minimum levels outside of WICA and CSP. The elk season was closed in 1969 and reopened in 1970. In 1971, the firearm elk units were restructured into two units (Appendix 2), replacing varying unit structures and territories used to intensively control specific elk herds. In 1975, the direction was to manage for an aesthetic elk herd, not a huntable population, allowing deer hunters and tourists to observe an elk sporadically but to limit the agricultural damages caused by elk.

Table 1. Black Hills Firearm elk season.

Year	Licenses Sold	Total Harvest	Harvest Success (%)	Applications
1940			Firearm Season Closed	
1941	917	250	-	-
1942	150	128	87	-
1943	-	109	-	-
1944	304	144	-	-
1945	633	231	-	-
1946	523	192	37	-
1947	834	225	23	-
1948	146	35	-	-
1949	934	355	38	-
1950			Firearm Season Closed	
1951	1,197	250	21	-
1952	350	80	23	-
1953			Included in Hills Deer Season	
1954			Included in Hills Deer Season	
1955			Included in Hills Deer Season	
1956			Included in Hills Deer Season	
1957			Included in Hills Deer Season	
1958			Included in Hills Deer Season	
1959			Included in Hills Deer Season	
1960			Firearm Season Closed	
1961			Firearm Season Closed	
1962			Firearm Season Closed	
1963			Firearm Season Closed	
1964			Firearm Season Closed	
1965	120		23	-
1966	300	92	46	-
1967	130	70	55	-
1968	350	80	23	-
1969			Firearm Season Closed	
1970	50	26	52	-
1971	180	63	35	-
1972	199	73	37	-
1973	170	65	38	-
1974	145	53	37	-
1975	145	58	40	-
1976	160	0	0	-
1977	160	29	18	-
1978	140	39	28	-

Year	Licenses Sold	Total Harvest	Harvest Success (%)	Applications
1979	140	27	19	-
1980	180	40	22	1,321
1981	230	65	28	-
1982	270	60	22	-
1983	342	103	30	-
1984	495	104	21	-
1985	488	173	35	-
1986	472	155	33	3,061
1987	479	161	34	-
1988	308	100	33	-
1989	249	107	43	-
1990	231	104	45	-
1991	222	134	61	-
1992	253	155	61	-
1993	324	219	68	6,026
1994	449	293	65	6,770
1995	548	368	67	7,730
1996	670	413	62	9,068
1997	805	508	63	9,708
1998	752	510	67	10,514
1999	1,019	669	66	11,120
2000	1,083	747	69	11,953
2001	1,124	721	64	12,114
2002	1,229	886	72	11,998
2003	1,572	1,056	67	11,852
2004	1,798	1,101	61	13,538
2005	2,670	1,395	52	14,687
2006	2,470	1,358	55	13,392
2007	2,075	1,064	51	13,916
2008	1,675	863	52	13,083
2009	1,366	783	57	12,915
2010	1,059	560	53	12,197
2011	866	472	55	11,031
2012	570	416	73	9,665
2013	620	374	60	11,274

Starting in 1980, SDGFP was managing the elk herd for an increasing population. The population was estimated at 1,000 animals and the population objective was set at 1,400 to 1,600 elk, to be reached by 1996 (Rice 1982). This initiated an effort to transplant elk from WICA to several locations throughout the Black Hills. A three harvest unit structure was developed in 1980 that started to resemble the current firearm hunting unit boundaries

(Appendix 2). In 1984 Unit 4 was added, by 1986 Unit 5 was included along with the addition of an archery season occurring in Unit 2 (Appendix 3). By 1993 the firearm hunting unit boundaries changed again to include Unit 7 and further resemble current harvest units (Appendix 2). One year later, in 1994, licenses were sold for Unit 6, which later became Prairie Firearm Unit 15 in 2004. The prairie elk season began in 1995 to manage the elk populations outside of the Black Hills Fire Protection District (Appendix 4).

By 1996 the elk population estimates had tripled in size and continued to grow, nearly doubling again by 2001. Severe drought conditions affected the Black Hills from 2001-2007 and these conditions, along with the increasing elk herd, led to elk depredation issues and increased landowner complaints (Figure 1). Ultimately the numbers of elk licenses were increased to address the growing impact of elk depredation on private land. In 2001 elk license sales totaled 1,124 firearm licenses, 140 archery licenses, and 42 prairie licenses. In 2005 the drought conditions continued, with the most drastic elk depredation impacts observed in Unit 3 which consists of extensive private land holdings. While the elk populations were beginning to level off, they weren't yet at socially acceptable levels given the prolonged drought conditions. In 2005 the highest number of licenses were issued totaling 2,670 firearm licenses, 267 archery licenses and 89 prairie licenses (Table 2). By 2006 the elk population estimates indicated a decline.

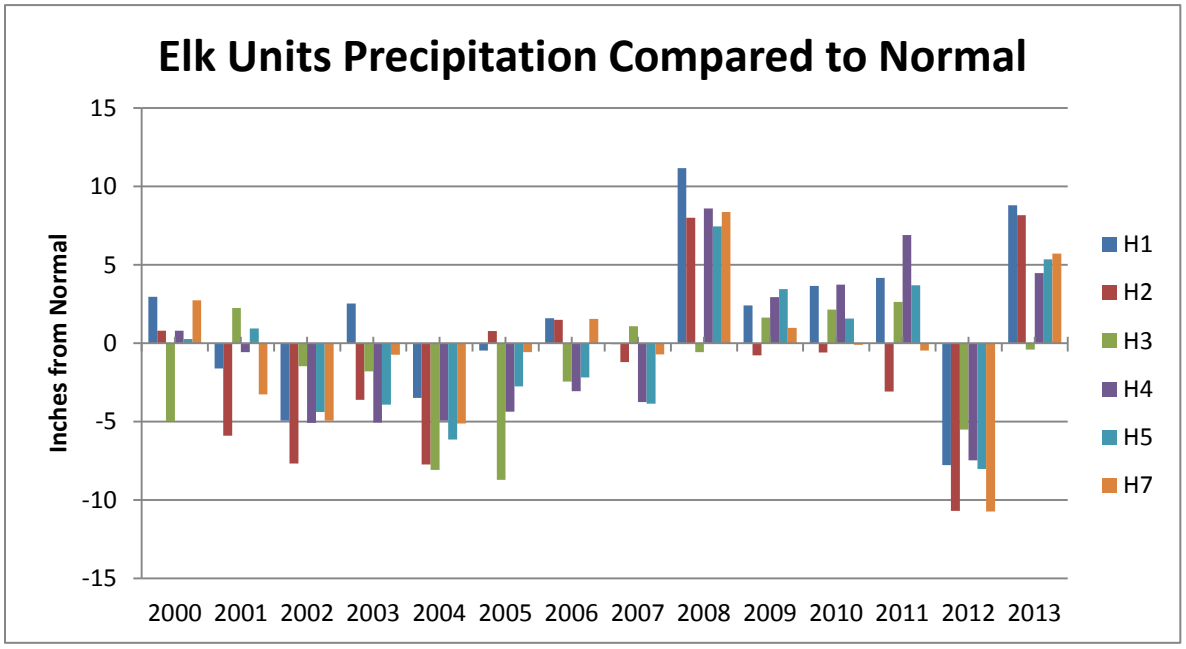

Figure 1. Precipitation levels in the Black Hills elk hunting units of South Dakota.

Table 2. Black Hills and Prairie elk unit license sales in South Dakota, 1990-2013.

Year	Firearm Licenses	Archery Licenses	Prairie Licenses	Total Licenses Sold
1990	231	60	-	291
1991	222	50	-	272
1992	253	50	-	303
1993	324	60	-	384
1994	449	74	-	523
1995	548	85	-	633
1996	670	105	-	775
1997	805	115	27	947
1998	752	120	38	910
1999	1,019	130	44	1,193
2000	1,083	123	37	1,243
2001	1,124	140	42	1,306
2002	1,229	151	306	1,686
2003	1,572	192	82	1,846
2004	1,798	192	90	2,080
2005	2,670	267	89	3,026
2006	2,470	247	79	2,796
2007	2,075	237	76	2,388
2008	1,675	202	76	1,953
2009	1,366	185	133	1,684
2010	1,059	144	134	1,337
2011	866	126	128	1,120
2012	570	97	97	764
2013	620	107	96	823

SDGFP has offered various tag types and their distributions have changed over the years. In 1989, only a ”any elk” tag type and a “bull elk” tag type were used to harvest elk in the firearm season, and only the ”any elk” tag type was used in the archery season. In 1994, the addition of an antlerless tag type was introduced in present day Unit 2 and Prairie Unit 15. By 1996 all firearm units had antlerless tags available. The archery season continued to only have ”any elk” tag types until 2001 when the Gregory Prairie Elk Unit added an antlerless tag type. The next year the majority of the archery seasons had an antlerless tag type (excluding present day Unit 5 and Unit 7). Since 2002 the “bull elk” tag type has been replaced with “any elk” tags.

Season Structure

All elk hunting seasons are only open to residents of South Dakota. If a hunter is drawn for their first choice elk tag (Firearm, Prairie, or Archery) they must wait 9 years to apply for that drawn elk license again. Hunters are not able to get multiple elk licenses within one season, and licenses are non-transferable. In the Black Hills of South Dakota, the 3-year average (2011 to 2013) hunter density for both archery and firearm seasons combined within each hunting unit is below 0.35 hunters per square mile (Figure 2). The average 2014 Black Hills elk hunter density was 0.14 hunters per square mile.

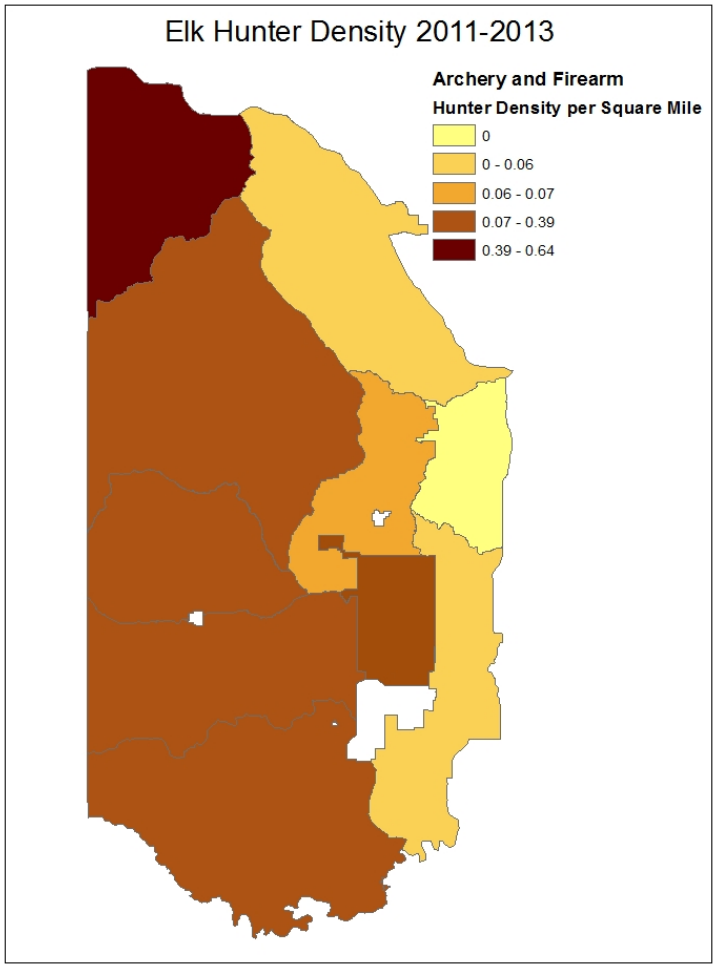

Figure 2. Hunter density in the Black Hills of South Dakota.

Black Hills Firearm Season

From 1953 to 1959 the firearm seasons were open with no limits and harvest information was not documented. In the 1970s elk hunting seasons, the implementation of structured harvest surveys provided game managers with essential data to manage the amount of harvest pressure applied to the elk population. In the 1980's goals were set to increase the elk population and by the early 2000's the goal was to decrease the population.

Since the 1940's, harvest information has been collected with the exception of 1953-1959. Hunter success rates ranged from an average of 40% in 1940-1950, 30% in 1970-1990, 63% in 1990-2000, and 59% in 2000-2010 (Table 1). Dramatic increases in license sales in 2005 brought a harvest of just under 1,400 elk but subsequently lowered hunter success rates by 10 percentage points (Figure 3). The number of applicants for each tag available has ranged from 18.6 in 1993 to a low of 5.4 in 2006, and has risen back up to 18.2 in 2013 (Figure 4). Current firearm season dates are October 1st – 31st, with the antlerless season opening October 15th and reopening December 1st-15th.

Prairie Season

Beginning in 1995 the Prairie Elk seasons were initiated to address elk depredation issues outside of the Black Hills Fire Protection District. The first hunting unit to be created was located in the northeastern corner of Bennett County to address elk movement off the Pine Ridge and Rosebud Reservations. This season began with two "bull elk" licenses and hunters reported 100% success. By 2003, the tag sales increased to 72, with a total of 41 elk harvested, to address increasing elk depredation to private lands (Table 3). License sales peaked again in 2011. Hunter success rates fluctuated from >80% for the first couple years, to an average of 51% over the remainder of the years. Antlerless harvest consisted of 38% of the total harvest from initiation to 2002 and increased to 47% from 2003-2013. The unit boundaries have changed through the years from a small corner of Bennett County, to the entire county, and now extend into Mellette County (Appendix 4).

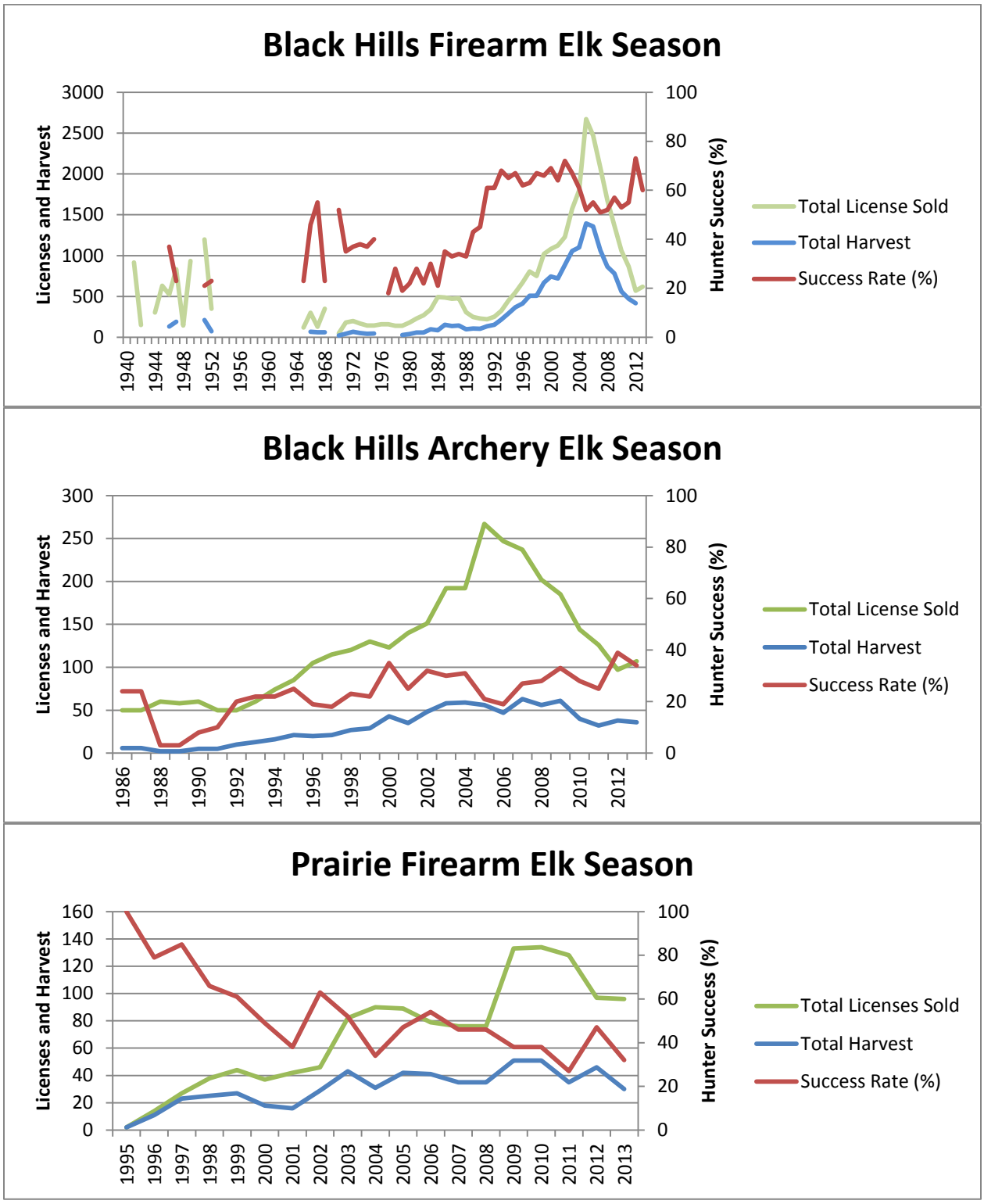

Figure 3. Black Hills and Prairie elk harvest, success, and license sales.

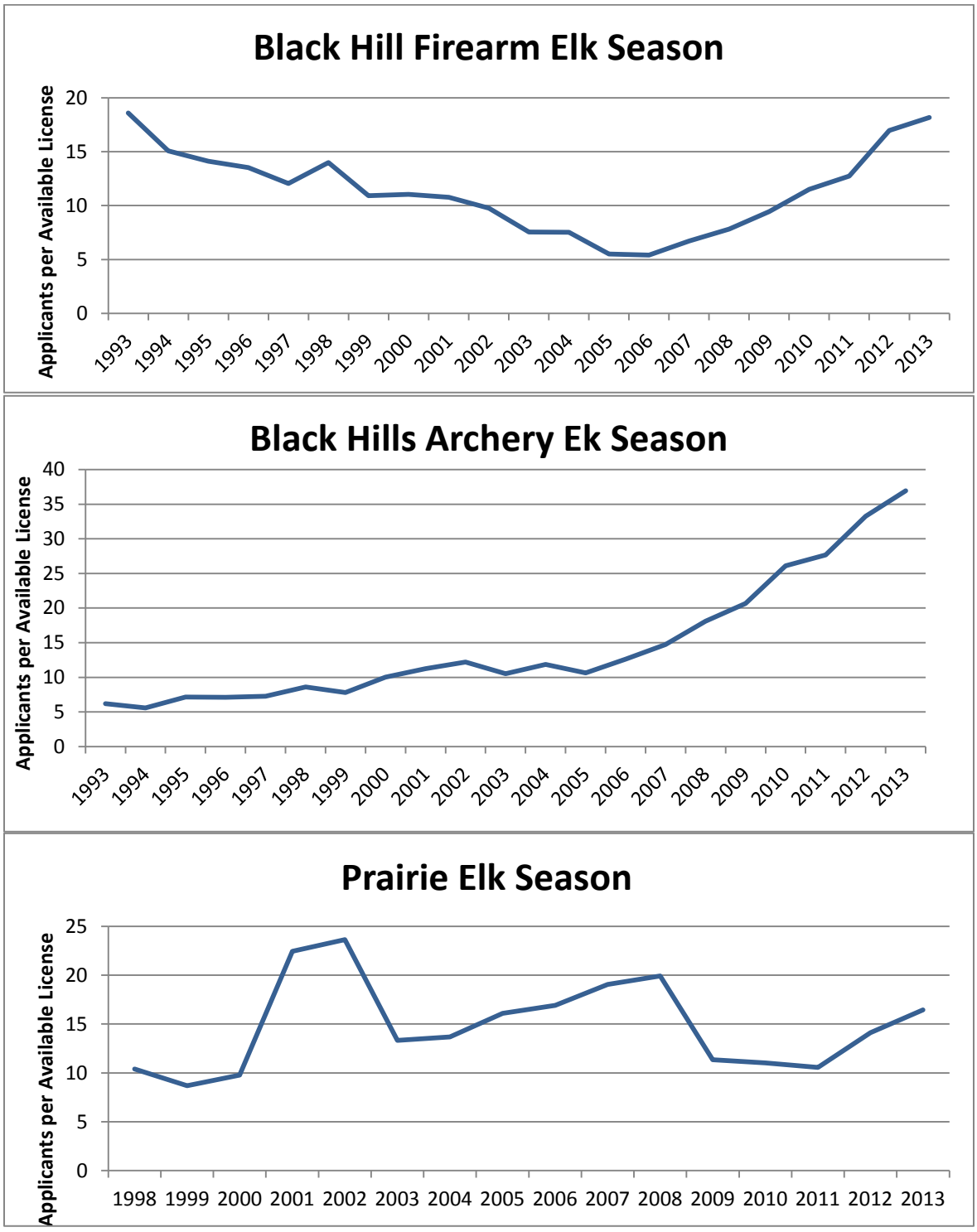

Figure 4. Hunter demand, measured as applicants per available limited elk license, for Black Hills firearm, Black Hills archery, and prairie elk seasons in South Dakota.

Table 3. Harvest statistics for Unit 11 (Bennett County) Firearm Prairie Elk Management Unit, 1995-2013.

Year	Applicants	Licenses Sold	Harvest Success	Bull Harvest	Antlerless Harvest	Total Harvest
1995	-	2	100%	2	0	2
1996	-	6	83%	4	1	5
1997	-	18	94%	7	10	17
1998	268	32	69%	8	14	22
1999	278	36	61%	16	6	22
2000	263	27	48%	9	4	13
2001	607	32	44%	11	3	14
2002	745	36	72%	18	8	26
2003	811	72	57%	24	17	41
2004	706	56	36%	8	12	20
2005	742	53	38%	10	10	20
2006	634	36	64%	12	11	23
2007	614	36	58%	14	7	21
2008	593	36	67%	10	14	24
2009	537	57	37%	13	8	21
2010	530	55	42%	9	14	23
2011	510	60	32%	12	7	19
2012	447	35	63%	11	11	22
2013	559	35	37%	7	6	13

In 1996, the Gregory County prairie elk season began with a limited harvest of elk that moved between Nebraska and South Dakota. This season was aimed at addressing elk damage to private row crops that began in 1992. Gregory County is approximately 60% cultivated crops, and the remainder of the land use is hay land and pasture, with the majority of land being privately owned. A maximum of 10 licenses were issued for this season in the past, with the past two years (2012 and 2013) having only 4 licenses (Table 4). Hunter success averages 36% and an average of 37% of the harvest is antlerless elk. An archery season was also held in this unit between 2001 and 2011 with 2-6 licenses sold annually (Table 5). In 2007 one bull elk was harvested during this archery season; this is the only successful harvest for this archery season. Variable unit boundaries for this season included areas in Nebraska and hunters from both states were able to hunt this unit prior to the 2013 season (Appendix 4).

Table 4. Harvest statistics for Unit 30 (Gregory County) Firearm Prairie Elk Management Unit, 1996-2013.

Year	Applicants	Licenses Sold	Harvest Success	Bull Harvest	Antlerless Harvest	Total Harvest
1996	-	8	75%	4	2	6
1997	-	8	75%	4	2	6
1998	127	6	50%	2	1	3
1999	105	8	63%	3	2	5
2000	99	10	50%	3	2	5
2001	335	10	20%	0	2	2
2002	342	10	40%	2	2	4
2003	281	10	20%	1	1	2
2004	249	10	20%	2	0	2
2005	311	10	50%	1	4	5
2006	266	10	10%	1	0	1
2007	275	10	20%	1	1	2
2008	260	10	20%	2	0	2
2009	239	10	40%	3	1	4
2010	208	10	20%	2	0	2
2011	200	8	0%	0	0	0
2012	178	4	75%	3	0	3
2013	174	4	0%	0	0	0

Table 5. Harvest statistics for Unit 30 (Gregory County) Archery Prairie Elk Management Unit, 2001-2011.

Year	Applicants	Licenses Sold	Harvest Success	Bull Harvest	Antlerless Harvest	Total Harvest
2001	1	5	0%	0	0	0
2002	0	4	0%	0	0	0
2003	2	2	0%	0	0	0
2004	3	5	0%	0	0	0
2005	0	6	0%	0	0	0
2006	6	5	0%	0	0	0
2007	3	6	17%	1	0	1
2008	8	6	0%	0	0	0
2009	31	6	0%	0	0	0
2010	35	4	0%	0	0	0
2011	28	2	0%	0	0	0

In 1994 Prairie Unit 6 in Butte County, which later became Unit 15 in 2004, opened to address depredation issues caused by elk moving from Wyoming and a growing resident herd within this area. The number of licenses allocated ranges from 24-30 depending on the amount of damage and estimated size of the elk herd each year. Hunter success averages 39% with an average of 52% of the harvest being antlerless elk (Table 6). Unit boundaries have remained consistent with small additions to the northern extent (Appendix 4).

Table 6. Harvest statistics for Unit 15 (Butte County) Firearm Prairie Elk Management Unit, 2004-2013.

Year	Applicants	Licenses Sold	Harvest Success	Bull Harvest	Antlerless Harvest	Total Harvest
2004	277	24	38%	5	4	9
2005	379	26	65%	9	8	17
2006	436	30	57%	7	10	17
2007	558	30	40%	4	8	12
2008	661	30	33%	7	3	10
2009	318	31	16%	3	2	5
2010	231	29	41%	5	7	12
2011	267	30	33%	4	6	10
2012	222	26	31%	4	4	8
2013	271	26	35%	4	5	9

Prairie Unit 9 was initiated in 2009. An expanding herd of elk, that likely originated from elk moving north out of the Black Hills, began causing damage on private property near St. Onge, SD creating a need for a harvest season. License sales ranged from 30-40 during the first 3 years and have recently been cut in half as the population reached a manageable size (Table 7). Hunter success averages 33% with 44% of the harvest being antlerless elk (Table 7). Unit size has remained consistent in the area around St. Onge; however, in 2013 an additional area that was formerly part of Unit 7 in the Black Hills Firearm Season was added to Prairie Unit 9 to continue to manage a migrating herd of elk that established across Interstate 90 near Tilford, SD (Appendix 4).

Table 7. Harvest statistics for Unit 9 (Meade County) Firearm Prairie Elk Management Unit, 2009-2013.

Year	Applicants	Licenses Sold	Harvest Success	Bull Harvest	Antlerless Harvest	Total Harvest
2009	414	35	57%	10	10	20
2010	508	40	33%	8	5	13
2011	375	30	17%	4	1	5
2012	190	17	29%	2	3	5
2013	170	16	31%	3	2	5

Unit 27 was the most recent addition to the prairie elk season. This unit was established in 2012 to address property damage caused by an elk herd that likely originated from elk moving south out of the Black Hills Unit 3. License sales were 15 (10 "any elk" and 5 "antlerless elk") in 2012 and 2013. In 2012, harvest success for "any elk" tags were 70% and in 2013 success rates of 29% were reported.

The prairie firearm season dates are variable and include seasons running from July 15-Aug 31, September 1-October 31, September 15-October 31, October 20-December 31 and December 1-31. Yearly harvest for all prairie seasons range from 16-51 elk (Table 8). Total prairie licenses sales peaked in 2009-2011 (Figure 3).

Table 8. Prairie Firearm Elk season harvest statistics, 1997-2013.

Year	Applicants	Licenses Sold	Harvest Success (%)	Total Harvest
1997	268	27	85	23
1998	395	38	66	25
1999	383	44	61	27
2000	362	37	49	18
2001	942	42	38	16
2002	1,087	46	63	29
2003	1,092	82	52	43
2004	1,232	90	34	31
2005	1,432	89	47	42
2006	1,336	79	54	41
2007	1,447	76	46	35
2008	1,514	76	46	35
2009	1,508	133	38	51
2010	1,477	134	38	51
2011	1,352	128	27	35
2012	1,369	97	47	46
2013	1,580	96	32	30

Archery Season

The archery elk season began in 1986, with one unit in the central Black Hills. By 2005, unit boundaries matched the rifle season unit structure (Appendix 3). Current season dates are September 1st-30th. Archery harvest has declined since 2010 due to decreased license sales, but the hunter success rate has remained relatively stable averaging 28.5% for the past 10 years (Figure 3). The demand for archery licenses has grown from just over 2,200 applicants in 2004 to nearly 4,000 in 2013 demonstrated by the number of 1st choice applicants (Table 9). The demand for these limited archery licenses has reached a high of almost 37 applicants for each available license (Figure 4).

Table 9. Black Hills Archery Elk season harvest statistics, 1986-2013.

Year	Applicants	Licenses Sold	Hunter Success (%)	Total Harvest
1986	-	50	24	6
1987	-	50	24	6
1988	-	60	3	2
1989	-	58	3	2
1990	-	60	8	5
1991	-	50	10	5
1992	-	50	20	10
1993	372	60	22	13
1994	413	74	22	16
1995	609	85	25	21
1996	748	105	19	20
1997	834	115	18	21
1998	1,034	120	23	27
1999	1,016	130	22	29
2000	1,232	123	35	43
2001	1,573	140	25	35
2002	1,846	151	32	48
2003	2,020	192	30	58
2004	2,277	192	31	59
2005	2,844	267	21	56
2006	3,116	247	19	47
2007	3,491	237	27	63
2008	3,660	202	28	56
2009	3,826	185	33	61
2010	3,761	144	28	40
2011	3,486	126	25	32
2012	3,228	97	39	38
2013	3,952	107	34	36

Hunter Access

There are over 1.1 million acres of land open to public hunting access within the Black Hills elk hunting units and over 130,000 acres in the Prairie Elk hunting units. A majority of this public land is managed by the US Forest Service – Black Hills National Forest (BHNF), with smaller portions managed by the US Bureau of Land Management, South Dakota Office of School & Public Lands, and SDGFP. A large portion of the land made publicly accessible for hunting elk by SDGFP is leased from private landowners through the Walk-In Area (WIA) program. The WIA

program pays a flat rate of $1 or less/per acre to allow all types of hunting during all legal hunting seasons.

SDGFP also leases land through the Controlled Hunting Access Program (CHAP) and the Elk Hunting Access Program (EHA). The CHAP program pays between $6 and $10 per hunter day and if the private landowner provides access to over 1,000 acres of land an additional $250 base payment is made. The range in pay per hunter day is dependent on how many restrictions are placed on the CHAP area. If all seasons of hunting and all legal methods of take are allowed they receive $10 per hunter day. If a landowner only allows archery elk hunting they would receive $6 per hunter day.

The EHA program started in 2006 in response to landowners requesting assistance for depredation by elk on their properties largely due to elk coming out of WICA. South Dakota Game, Fish, and Parks developed the EHA program to increase hunter harvest on private lands that have higher than landowner tolerable elk use. The EHA provides a flat lease rate per acre plus an additional 10% for every 5 elk harvested. A range of 13,200 to 19,500 acres of private land have been enrolled in EHA to date (Table 10), which equals approximately 2.5% to 3.6% of the total acreage of elk management Unit 3. Elk harvest on lands enrolled in the EHA are relatively high, however, with approximately 17% to 36% of the total Unit 3 elk harvest occurring on EHA lands from 2006-2013 (Table 10). Up until 2014 this program was utilized only in the southern Black Hills in the area around WICA. The program has been expanded to the entire Black Hills beginning in 2014.

Table 10. Land enrolled in Elk Hunting Access program (EHA) and elk harvested on those lands in relation to elk harvested within entire Unit 3 (536,646 acres) including EHA lands.

Year	2006	2007	2008	2009	2010	2011	2012	2013
Acres Enrolled in EHA	15,995	13,234	14,554	19,534	19,534	17,990	18,960	16,560
Unit 3 Elk Tags Available	690	640	505	380	295	280	200	200
Unit 3 Total Elk Harvest	277	237	176	180	138	131	110	90
Elk Harvested on EHA	91	41	43	50	44	42	40	29
% of Elk Harvested on EHA	33%	17%	24%	28%	32%	32%	36%	32%

All lands open to public hunting access except the EHAs are depicted in the annually published South Dakota Hunting Atlas, through interactive maps on the SDGFP website, downloadable layers for Garmin Global Positioning System (GPS) units, and on maps within the SDGFP Android and Apple smartphone app (http://gfp.sd.gov/hunting/areas/default.aspx). The EHA lands are currently only made available to elk hunting license holders upon request, but SDGFP will

continue to evaluate methods to fairly distribute this opportunity among hunters while at the same time not overwhelming landowners with more hunters than needed to address the elk depredation.

POPULATION SURVEYS

Harvest Surveys

Hunter survey cards are emailed and/or mailed to all elk license holders to obtain information on the number of hunting recreation days, gender and age (adult/calf) of elk harvested, type of land hunted (public vs. private), the number of elk shot but not recovered, and mean satisfaction of the hunt. All license holders who list an email in their licensing profile receive an email at the end of the season followed by two reminder emails over a 2-week period. All license holders that do not list an email, and those that do not respond to the email survey, are sent paper surveys followed by two or three subsequent mailings at 12-14 day intervals in order to maximize response rate and precision by limiting non-response bias.

Responses to email surveys are received through an Internet link using the Qualtrics survey website. Postage paid survey cards are returned to the SDGFP office in Pierre, South Dakota, where the data are compiled and analyzed. Hunters may also report harvest information to mailed surveys through an internet response system, which records answers directly to the database.

Returned hunter surveys are entered and summarized and harvest statistics are generated for each unit. Proportional statistics from the sample are then accepted as representative of the unit population of hunters and applied to the total number of hunters in that unit. Hunters who do not respond to the survey are included in the hunter population when estimating harvest statistics. The minimum acceptable response rate has been established at 85%. Confidence intervals are calculated to monitor precision and accuracy.

A total of 107 resident licenses were issued for the 2013 Archery Elk season. All license holders were sent a survey at the end of the season and 92 responded for an 86% response rate. Approximately 77% of responding hunters used the Internet. Respondents reported hunting an average of 11.97 days for a total of 1,281 days of recreation (Table 11). The projected harvest was 33 bulls and 3 cows for an overall success rate of 34% (Table 11). Hunter satisfaction was based on a numerical scale from 1 (very dissatisfied) to 7 (very satisfied) and averaged 5.59 for the season (Table 14). Approximately 95% of responding hunters reported hunting on public land, 2% on private land they did not own, and 3% on private land they owned.

A total of 620 licenses were issued for the 2013 Black Hills Firearm Elk season. All license holders were sent a survey at the end of the season and 531 responded for an 86% response rate (3 surveys were undeliverable). Approximately 77% responded using the Internet.

Respondents reported hunting an average of 6.63 days which projects to a total of 4,111 days of recreation for the season (Table 12). The projected harvest was 272 bulls and 103 cows for an overall success rate of 60% (Table 12). Hunter satisfaction was based on a numerical scale from 1 (very dissatisfied) to 7 (very satisfied) and averaged 4.65 for the season (Table 14). Approximately 84% of responding hunters reported hunting on public land, 8% on private land they did not own, and 8% on private land they owned.

A total of 96 licenses were issued for the 2013 Prairie Firearm Elk season. All license holders were sent a survey at the end of the season and 84 responded for an 88% response rate. Approximately 77% responded using the Internet. Respondents reported hunting an average of 4.81 days for a total of 462 days of recreation (Table 13). The projected harvest was 18 bulls and 13 antlerless elk for an overall success rate of 32% (Table 13). Hunter satisfaction was based on a numerical scale from 1 (very dissatisfied) to 7 (very satisfied) and averaged 4.15 for the season (Table 14). Approximately 25% of responding hunters reported hunting mostly on public land, 49% on private land they did not own, and 25% on private land they owned.

Table 11. 2013 Black Hills Archery Elk season harvest statistics by unit.

2013 Archery Elk Harvest Projections

Last Revised: 28 Feb 2014

	Resident Licenses					Harvest Projections										Land Hunted Most		
Unit Type	Appl. 1st Choice *	Avail.	Sold	Resp.		Success	Bulls	Cows	Bull Calves	Cow Calves	Total Elk Harvest	CI (95%)	Elk Shot Not Recover	Average Satisfctn Score	Average Days Hunted	Public	Own	Other Private
H1A-21	555	20	20	85%		35%	7	0	0	0	7	+/-2	4	5.8	12.1	20	0	0
H1A-23	3	5	5	60%	#	33%	0	2	0	0	2	+/-2	3	6.7	10.3	5	0	0
H2A-21	2,854	50	50	88%		45%	23	0	0	0	23	+/-3	9	5.9	12.9	48	1	1
H2A-23	17	5	5	80%	#	25%	0	1	0	0	1	+/-1	0	5.7	4.8	4	0	0
H3A-21	401	15	15	93%		14%	2	0	0	0	2	+/-1	1	4.9	10.8	12	2	1
H3A-23	7	5	5	80%	#	0%	0	0	0	0	0	+/-0	0	3.5	8.3	5	0	0
H5A-21	37	2	2	100%		0%	0	0	0	0	0	+/-0	0	1.5	15.0	2	0	0
H7A-21	78	5	5	80%	#	25%	1	0	0	0	1	+/-1	0	7.0	15.8	5	0	0
	3,952	**107**	**107**	**86.0%**		**33.7%**	**33**	**3**	**0**	**0**	**36**	**+/- 9**	**17**	**5.59**	**11.97**	**100**	**3**	**2**
																95%	3%	2%

The response rate for all units combined is: 86.0%

Satisfaction scale of 1=very dissatisfied to 7=very satisfied.

Harvest projections were developed for units where response rate was less than 85% and may not be within +/- 15% of the sample statistic.

* Number of 1st drawing applicants with that unit as 1st choice.

Table 12. 2013 Black Hills Firearm Elk season harvest statistics by unit.

2013 Black Hills Firearm Elk Harvest Projections

Last Revised: 28 Feb 2014

	Resident Licenses					Harvest Projections										Land Hunted Most		
Unit Type	Appl. 1st Choice *	Avail.	Sold	Resp.		Success	Bulls	Cows	Bull Calves	Cow Calves	Total Elk Harvest	CI (95%)	Elk Shot Not Recover	Average Satisfctn Score	Average Days Hunted	Public	Own	Other Private
H1A-21	1,102	75	74	90%		38%	26	0	2	0	28	+/-3	1	3.06	7.5	65	5	3
H1C-23	34	40	40	88%		11%	0	5	0	0	5	+/-2	0	3.13	7.4	35	0	0
H2A-21	8,045	250	249	88%		83%	186	19	1	0	206	+/-4	9	5.58	6.4	239	7	1
H2C-23	134	25	25	80%	#	85%	0	20	0	1	21	+/-2	1	6.11	3.8	24	0	0
H2E-23	97	25	25	92%		78%	0	17	1	1	20	+/-1	2	5.67	3.1	23	0	0
H3A-21	1,497	100	101	83%	#	55%	48	7	0	0	55	+/-4	2	3.98	7.8	53	34	14
H3E-23	77	80	81	80%	#	41%	0	30	1	1	33	+/-5	1	4.19	5.6	47	1	25
H5A-21	84	10	10	100%		20%	2	0	0	0	2	+/-0	0	2.50	15.1	7	2	1
H7A-21	199	10	10	70%	#	43%	4	0	0	0	4	+/-2	0	5.17	5.4	4	3	3
H7C-23	5	5	5	60%	#	0%	0	0	0	0	0	+/-0	0	3.67	4.3	3	0	2
	11,274	**620**	**620**	**86.1%**		**60.4%**	**266**	**99**	**6**	**4**	**374**	**+/- 23**	**17**	**4.65**	**6.63**	**504**	**50**	**47**
																84%	8%	8%

The response rate for all units combined is: 86.1%

Satisfaction scale of 1=very dissatisfied to 7=very satisfied.

Harvest projections were developed for units where response rate was less than 85% and may not be within +/- 15% of the sample statistic.

* Number of 1st drawing applicants with that unit as 1st choice.

Table 13. 2013 Prairie Elk season harvest statistics by unit.

2013 Prairie Firearm Elk Harvest Projections

Last Revised: 28 Feb 2014

	Resident License				Harvest Projections										Land Hunted Most		
Unit Type	Appl. 1st Choice *	Avail.	Sold	Resp.		Success	Bulls	Cows	Bull Calves	Cow Calves	Total Elk Harvest	CI (95%)	Elk Shot Not Recover	Average Satisfctn Score	Average Days Hunted	Public	Own	Other Private
09A-21	167	8	8	100%		25%	2	0	0	0	2	+/-0	0	4.3	5.4	0	5	2
09A-23	3	8	8	100%		38%	1	2	0	0	3	+/-0	0	5.6	3.0	0	1	5
11A-23	22	10	10	90%		33%	0	3	0	0	3	+/-1	1	3.6	1.7	2	1	4
11B-21	381	10	10	80%	#	63%	6	0	0	0	6	+/-2	0	4.6	8.4	4	4	1
11C-21	134	5	5	100%		20%	1	0	0	0	1	+/-0	0	3.5	4.4	0	2	2
11D-23	22	10	10	80%	#	25%	0	3	0	0	3	+/-1	0	3.9	6.1	0	1	9
15A-21	259	10	10	90%		44%	4	0	0	0	4	+/-1	0	5.0	6.2	0	4	4
15A-23	12	16	16	81%	#	31%	0	5	0	0	5	+/-2	0	4.7	3.6	2	2	11
27A-21	400	10	10	70%	#	29%	3	0	0	0	3	+/-2	0	4.2	9.7	4	1	3
27A-23	6	5	5	100%		0%	0	0	0	0	0	+/-0	0	1.3	6.6	4	0	0
30A-21	170	2	2	100%		0%	0	0	0	0	0	+/-0	0	1.0	22.5	0	1	0
30A-23	4	2	2	100%		0%	0	0	0	0	0	+/-0	0	2.0	1.0	1	0	0
	1,580	**96**	**96**	**87.5%**		**31.6%**	**18**	**13**	**0**	**0**	**30**	**+/- 8**	**1**	**4.15**	**4.81**	**17**	**17**	**33**
																25%	25%	49%

The response rate for all units combined is: 87.5%

Satisfaction scale of 1=very dissatisfied to 7=very satisfied.

Harvest projections were developed for units where response rate was less than 85% and may not be within +/- 15% of the sample statistic.

* Number of 1st drawing applicants with that unit as 1st choice.

Table 14. Summary comparison of Archery, Black Hills Firearm, and Prairie Elk season from 2009-2013.

Archery Elk Season

Year	# Apps 1st Choice	Licenses Sold	Harvest Bulls	Harvest Cows	Harvest Total	Success Rate	Avg. Days Hunted	Average Satisfaction
2009	3,826	185	52	9	61	33%	10.29	5.52
2010	3,761	144	34	6	40	28%	11.88	5.16
2011	3,486	126	24	8	32	25%	11.42	5.01
2012	3,228	97	33	4	38	39%	11.94	5.34
2013	3,952	107	33	3	36	34%	11.97	5.59

Black Hills Firearm Elk Season

Year	# Apps 1st Choice	Licenses Sold	Harvest Bulls	Harvest Cows	Harvest Total	Success Rate	Avg. Days Hunted	Average Satisfaction
2009	12,915	1,366	404	379	783	57%	6.38	4.70
2010	12,197	1,059	300	260	560	53%	6.64	4.47
2011	11,031	866	299	173	472	55%	6.80	4.64
2012	9,665	570	291	125	416	73%	6.37	5.30
2013	11,274	620	272	103	374	60%	6.63	4.65

Prairie Firearm Elk Season

YEAR	# Apps 1st Choice	Licenses Sold	Harvest Bulls	Harvest Cows	Harvest Total	Success	Avg. Days Hunted	Average Satisfaction
2009	1,508	133	29	22	51	38%	5.31	4.17
2010	1,477	134	24	27	51	38%	3.92	4.00
2011	1,352	128	20	15	35	27%	4.03	4.02
2012	1,369	97	26	20	46	47%	5.22	4.72
2013	1,580	96	18	13	30	32%	4.81	4.15

A total of 3 resident licenses were issued for the 2013 CSP Early Archery Elk season which was open from September 1-30. There was no Late CSP Archery season in 2013. Respondents reported hunting an average of 9.3 days for a total of 28 days of recreation (Table 15). All hunters reported harvesting adult bulls. Historic early and late season archery data for CSP can be found in Appendices 5 and 6.

Table 15. Summary comparison of the 2009-2013 Custer State Park Early Archery Elk seasons.

Year	Applications	Licenses	Bull Harvest	Cow Harvest	Success	Avg. Days Hunted
2009	5,141	58	5	3	15%	10.4
2010	4,898	35	0	0	0%	11.2
2011	3,863	18	1	0	6%	7.8
2012	2,077	3	0	0	0%	14.0
2013	2,740	3	3	0	100%	9.3

A total of 4 resident licenses were issued for the 2013 CSP Firearm Elk season which was open from September 21 – October 6. There was no Antlerless CSP Firearm season in 2013. Respondents reported hunting an average of 2.0 days for a total of 8 days of recreation (Table 16). Three hunters reported harvesting adult bull elk and one reported harvesting a cow calf. Historic CSP firearm elk season table can be found in Appendices 7 and 8.

Table 16. Summary comparison of the 2009-2013 Custer State Park Firearm Elk seasons.

Year	Applications	Licenses	Bull Harvest	Cow Harvest	Success	Avg. Days Hunted
2009	14,364	56	30	20	89%	4.10
2010	13,342	26	14	6	80%	3.80
2011	8,019	11	10	0	91%	5.50
2012	6,582	4	4	0	100%	1.75
2013	7,860	4	3	1	100%	2.00

Incisor Tooth Surveys

Successful hunters are required to check-in harvested elk at numerous check stations throughout the Black Hills, at which time the bottom two incisor teeth are removed from the harvested elk for aging purposes. Age structure data were analyzed for each Black Hills elk season in 2014 with 509 incisor teeth submitted. Forty-five percent and 44% of bull elk harvested in the Black Hills firearm and archery seasons, respectively, were 4 years of age or older (Figure 5). In the past 10 years, ages of bulls harvested during the Black Hills firearm

season averaged 3% calves, 6% yearlings, 51% 2-3 year olds, and 41% 4+ year olds. Since age data collection began in the Black Hills units in 1991, overall 31% of bulls harvested during the firearm season have been 4+ years of age. Age structure data are used to assess herd status and evaluate harvest strategies.

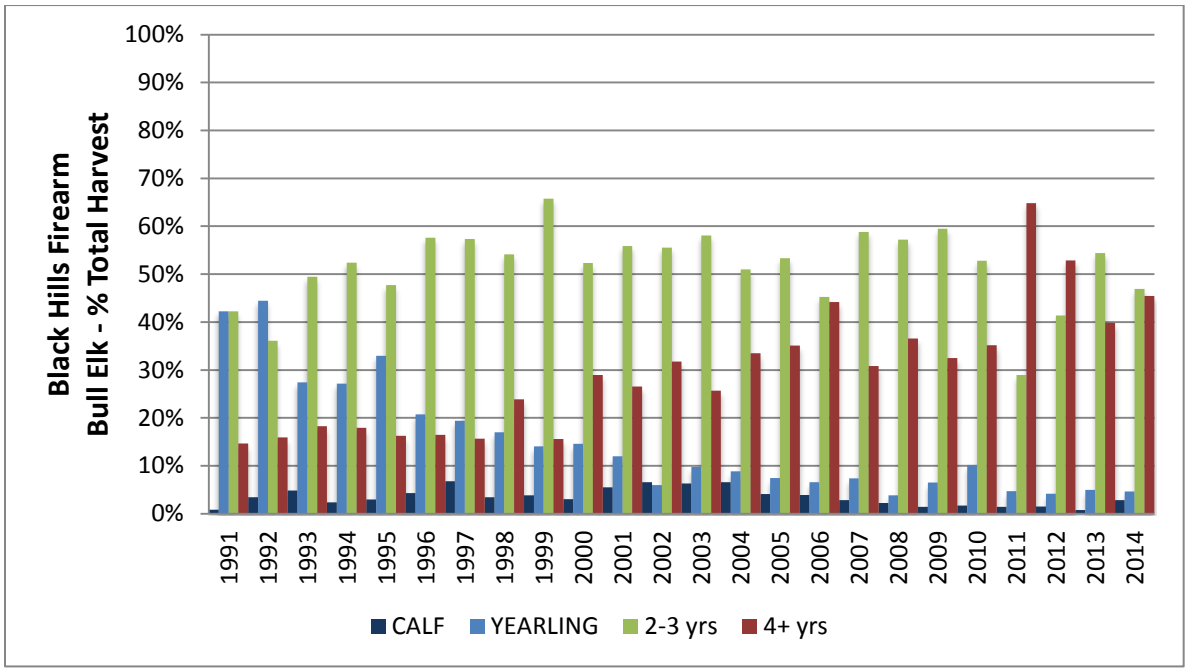

Figure 5. Age distribution of hunter harvested bull elk in the Black Hills firearm season, 1991-2014.

Age structure data are also collected for all elk harvested in CSP. Because elk in CSP are managed for an older age structure for both consumptive and non-consumptive recreational opportunities, harvest age categories differ from Black Hills units and are as follows: calf/yearling, 2-5 years of age, and 6+ years of age. In 2014, 100% and 50% of elk harvested during the CSP firearm season and archery season, respectively, were 6+ years of age (Figure 6). In the past 10 years, ages of bulls harvested during the CSP firearm season averaged 1% calves/yearlings, 69% 2-5 year olds, and 30% 6+ year olds. Since age data collection began in CSP in 1979, overall 11% of bulls harvested during the firearm season have been 6+ years of age.

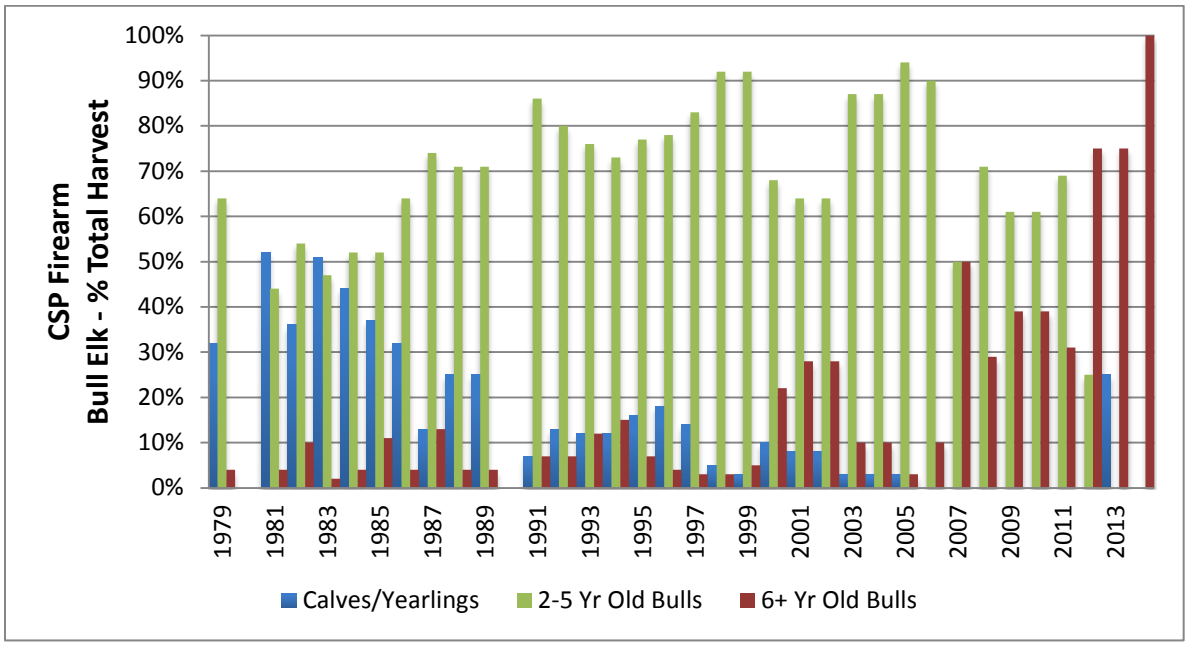

Figure 6. Age distribution of hunter harvested bull elk in the CSP firearm season, 1979-2014.

Aerial Surveys

Elk populations in the Black Hills of South Dakota have been surveyed using aerial survey methodology as early as the 1950s (Appendix 9). Early projections of elk were based on assumed detection probabilities from the aircraft, whereas later projections were based on sightability models developed in Idaho (Unsworth et al. 1991). Early aerial survey efforts were usually restricted to sampling efforts within a single hunting unit, and although they may have represented elk densities in a few limited areas they were not sufficient to estimate elk numbers across the Black Hills.

In 2009 efforts began to develop an elk aerial sightability model specific to the Black Hills of South Dakota (Jarding 2010, Phillips 2011). Sightability trials using radio-collared individuals were conducted during January and February when elk were concentrated on wintering areas during 2009-2012. During model development the survey was flown using an R-44 helicopter with two observers and a pilot. The helicopter survey crews flew systematic search patterns following transects spaced 650-1,000 ft. apart, at speeds of 40-50 mph, and heights of 100-150 ft. above the ground. During the four years of data collection, survey crews flew over 176 groups of elk that contained at least one radio-collared individual. Crews detected 107 of the 176 groups on the first pass, indicating an overall sightability rate of 60.8%. Once an elk group was sighted, the search pattern was interrupted to collect information on group size, activity, % visual obstruction, % snow cover, light intensity, terrain ruggedness and to record a GPS location. If a group of elk was missed during the survey trial, the survey crew would then use radio telemetry to locate the group and collect the needed information.

Eighteen different logistic regression models were formulated in Program R using different combinations of predictor variables. The top two models, carrying 92% of the weight included: % visual obstruction, group size, % snow cover and activity. However, the p-value for activity was >0.05; thus indicating an insignificant variable. As a result, model averaging was performed for the variables % visual obstruction, group size and percent snow cover. The final model estimated elk sightability as $\mu = 0.1446 – 0.0361$(% visual obstruction) + 0.1001(group size) + 0.0158(% snow cover) and was selected to correct for elk missed during the 2013 aerial survey work in the Black Hills.

In 2013, following declining elk populations and public discontent, SDGFP committed to surveying the entire Black Hills elk population. Surveys within the Black Hills were conducted from 8 February – 9 March, 2013, and were flown using an R-44 helicopter with 2 observers and a pilot. A total of 173.52 survey hours were flown. Survey protocol that was used during model development was followed precisely. The entire Black Hills was broken into 254 subunits and 100% of these subunits were flown. Helicopter survey crews flew systematic search patterns (i.e., transects) within each subunit, spaced 650-1,000 ft. apart. Subunit maps were uploaded onto GPS devices to ensure transect widths were followed precisely. To avoid double sampling, adjacent subunits were flown with minimal time delays. Once a group of elk was detected the search pattern was interrupted to record information and to get an accurate group count. Pictures were taken and analyzed for groups that exceeded 50 individuals to ensure accurate counts.

A total of 5,609 elk were counted in the 2013 aerial survey of the entire Black Hills. Aerial survey efforts provided great information on the winter distribution of elk in the South Dakota portion of the Black Hills (Figure 7). The Program R "sightability model package" was used to formulate the corrected population estimate for the entire Black Hills (*N*= 6,067; includes WICA and CSP) and 95% confidence interval (*CI*= 5,794 – 7,115) using the Wong variance estimator. The population estimate for only the Black Hills management units was 5,077 (4,807-6,116).

Future aerial surveys will be conducted again at the 100% coverage level. Because of time and expenses required to accomplish this task, however, complete aerial surveys will only be conducted every 3-4 years. The next survey of the Black Hills will be in the late winter of 2016. Population estimates from aerial surveys will be compared with modeled population projections to validate modeling efforts in years without surveys. Depending on aerial and projection model comparisons, and desired model projection precision and accuracy, aerial survey schedules may be modified to fly more or less frequently.

The first aerial survey conducted in CSP was in January of 1948 using a fixed-wing aircraft. Survey results estimated 603 elk were present. Aerial surveys were discontinued and it was not until 1979 that continuous annual surveys were conducted. Elk populations were surveyed using helicopter survey methodology from 1979-2013 (Appendix 10). The entire park was flown at 300 feet AGL along transects ranging from 500-800 m apart. Park staff would fly three

consecutive days in September for fall estimates and three consecutive days between January-March for winter estimates. Early projections (1979- winter 2010-11) of elk were based on a maximum subherd count with an assumed detection probability of 90% from the aircraft, whereas later projections (fall 2011-2013) were based on a Poisson Mark-Resight model using radio-telemetry detection probabilities. Using the maximum subherd count method, the maximum number counted within each subherd during the three consecutive surveys was used in the final estimate. Fall counts were used primarily for determining demographic ratios (i.e., calf:cow, bull:cow) and the winter counts were used primarily to determine winter abundance following the hunting season. Future surveys will be concurrent with helicopter flights outside of CSP. Custer State Park will also use Program R and the "sightability model package" to estimate future populations to compare with matrix model projections.

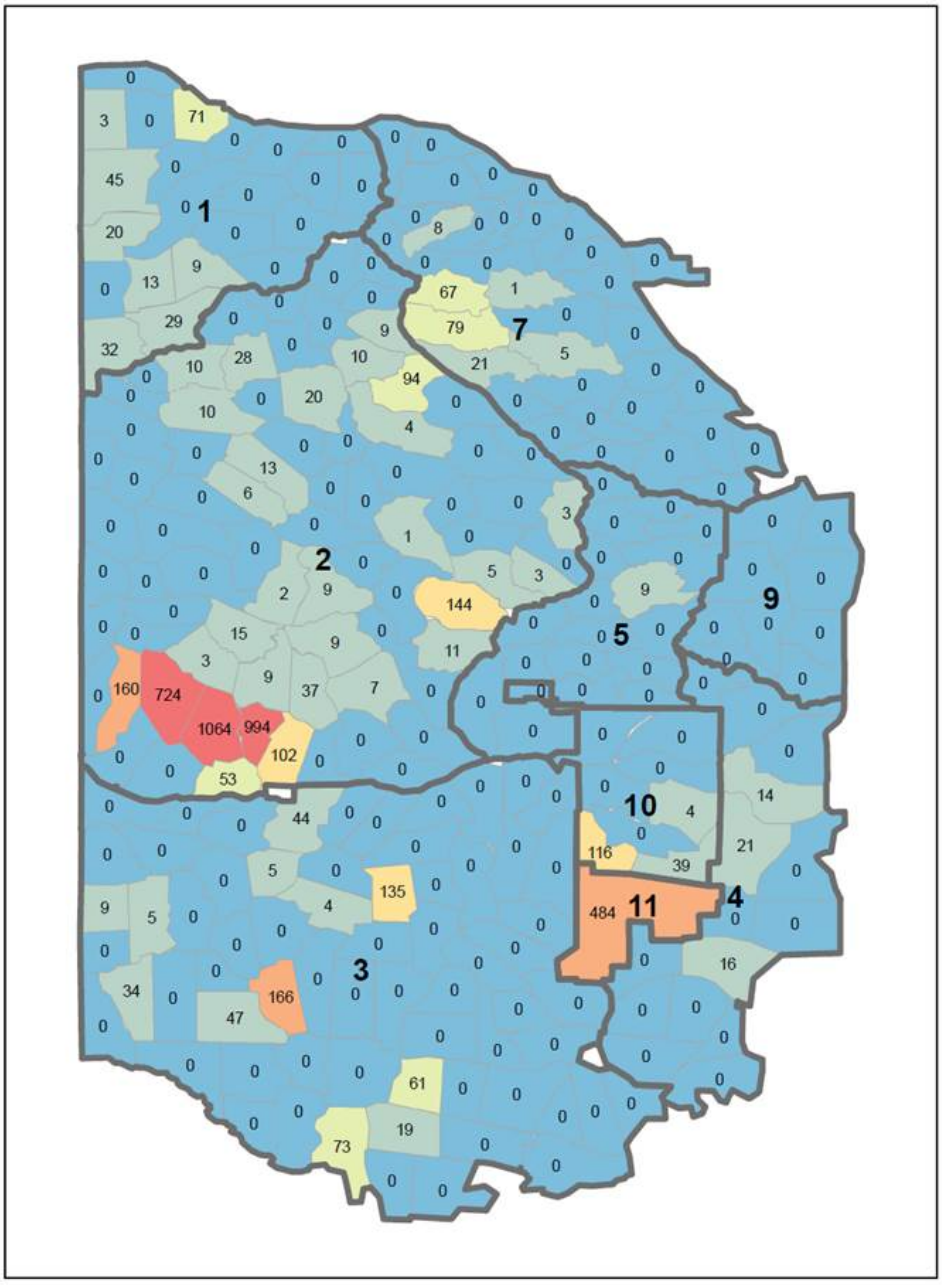

Figure 7. Aerial survey observations from winter sightability survey in 2013, Black Hills, South Dakota.

Herd Composition Surveys

Pre-firearm hunting season herd composition surveys have been conducted annually throughout the Black Hills since the early 2000s (Table 17). These ground surveys are completed by driving roads or hiking in areas of known elk concentrations in August and September. Surveys are haphazardly distributed according to wherever elk observations can be completed. All elk herds that are observed in their entirety are classified to numbers of calves,

cows, and bulls. Bulls are further classified as spikes, raghorns (2-4 points each antler), or mature ($\geq$ 5 point branched antlered). Spatial data are also recorded for each observation in order to reduce double-counting occurrences.

Data are analyzed to assess sex and age ratios. Sex ratios are calculated as bulls:100 cows, but likely under-represent bulls as large calf/cow groups are likely more detectable during this time of year. Unfortunately, sex-specific sightability rates are not available to correct for any biases in sex ratio data, so trend data analyses are most useful for this data set.

Age ratios are calculated as calves:100 cows and are used as an indicator of fall recruitment into the population. Survival data on radio-collared calves from 1 October thru 1 June are used to adjust fall recruitment estimates in order to estimate annual recruitment rates.

In 2014, 995 elk were classified throughout the Black Hills (excluding CSP) during the fall herd composition survey. Age and sex ratios, along with binomial (95%) confidence intervals were calculated for each statistic. Herd composition counts resulted in an average calf to cow ratio of 49 (95% CI: 40-52) calves per 100 cows and an average bull to cow ratio of 24 (95% CI: 24-33) bulls per 100 cows (Table 17). Overall trends of age ratios have been consistently near 50 calves:100 cows (Table 17).

In the spring of 2012, SDGFP began to explore the utility of conducting herd composition surveys in late winter as a better way to determine annual recruitment of elk in the Black Hills. Herd composition surveys, using the same ground survey methodology used in the fall, were completed in March of both 2012 and 2014 (Table 17). Additional surveys will be conducted in future years both pre-season and late winter and thorough statistical analyses will be completed to evaluate survey timing after 5 years of data have been collected.

Table 17. Herd composition surveys (excluding CSP).

Year	Time	Method	Units	Total Classified	Bulls	Cows	Calves	Bull:100 Cow	Bull:Cow lower CI	Bull:Cow upper CI	Calf:100 Cow	Calf:Cow lower CI	Calf:Cow upper CI
2003	Pre-season	Ground	Black Hills	748	88	436	224	20.2	16.1	25.4	51.4	43.7	60.3
2004	Pre-season	Ground	Black Hills	816	140	454	222	30.8	25.5	37.3	48.9	41.7	57.4
2005	Pre-season	Ground	Black Hills	529	104	288	137	36.1	28.9	45.2	47.6	38.8	58.3
2006	Pre-season	Ground	Black Hills	222	30	129	63	23.3	15.7	34.5	48.8	36.2	65.9
2008	Pre-season	Ground	Black Hills	361	103	179	79	57.5	45.2	73.3	44.1	33.9	57.5
2009	Pre-season	Ground	Black Hills	1,208	165	685	358	24.1	20.3	28.5	52.3	46.0	59.4
2010	Pre-season	Ground	Black Hills	1,079	201	596	282	33.7	28.7	39.6	47.3	41.1	54.5
2011	Pre-season	Ground	Black Hills	1,140	145	651	344	22.3	18.6	26.7	52.8	46.4	60.2
2012	March	Ground	Black Hills	525	14	354	157	4.0	2.3	6.7	44.4	36.8	53.5
2012	Pre-season	Ground	Black Hills	1,283	209	718	356	29.1	25.0	34.0	49.6	43.7	56.3
2013	Pre-season	Ground	Black Hills	1,131	190	636	305	29.9	25.4	35.1	48.0	41.8	55.0
2014	March	Ground	Black Hills	1,399	151	838	410	18.0	15.2	21.4	48.9	43.5	55.1
2014	Pre-season	Ground	Black Hills	995	137	575	283	23.8	19.8	28.7	49.2	42.7	56.7

Herd composition surveys have been conducted annually in CSP using fall helicopter surveys from 1979-2013 (Appendix 11). In 2014, elk were surveyed via ground counts. Gender ratios are calculated as bulls/cows, and age ratios are calculated as calves/cows. Age and gender ratios, along with binomial (95%) confidence intervals were calculated for each statistic. From 1979-2014, herd composition counts resulted in an average calf to cow ratio of 35 calves per 100 cows (95% CI: 31-39) and an average bull to cow ratio of 30 bulls per 100 cows (95% CI: 24-36) (Appendix 11). The range includes a low of 13 calves and a high of 60 calves per 100 cows; for bulls the range includes a low 7 bulls and a high of 96 bulls per 100 cows. For fall helicopter surveys, the entire park was flown at 300 feet AGL along transects ranging from 500-800 m apart. CSP staff would fly three consecutive days in September and record calf:cow and bull:cow ratios. Ground surveys are completed by driving roads or hiking in areas of known elk concentrations in September. Ground surveys were completed based on known elk use areas and were taken opportunistically. All elk herds that are observed in their entirety were classified as calves, cows, and bulls; bulls are further classified as spikes, raghorns (2-4 points each antler), or mature ($\geq$ 5 points).

Population Models

Aerial surveys of elk in the Black Hills are not conducted on an annual basis; therefore population and rate of change (λ) estimates are modeled during years when aerial estimates are not available. Aerial surveys in 2013 provided data to estimate the total population size of elk wintering in the Black Hills (N = 5,077, 95% CI = 4,807–6,116; excludes CSP and WICA), and the approximate distribution of winter elk herds.

Black Hills population projections are then formulated using a spreadsheet model incorporating age and sex ratio data obtained through the 2013 fall herd composition survey which estimated an overall calf:100 cow ratio of 46 and a bull:100 cow sex ratio of 28. Overwinter calf survival (80%, SE = 0.05) is used to adjust the estimated number of calves that are recruited. Annual survival estimates for adults are quantified separately between sexes (i.e., females = 85%, SE= 0.05; males = 70%, SE = 0.08), and those estimates are calculated from radio-collared elk in the Black Hills. Confidence intervals for the Black Hills estimate are developed using Markov Chain Monte Carlo (MCMC) simulation methods in Program R, incorporating standard errors for all input variables. To predict how different tag recommendations may impact λ, change in harvest is assumed to be additive, and the potential number of animals added or removed from the population is derived from the previous 3-year average success rate for that tag type.

Future aerial surveys of elk in CSP will be completed every 3-4 years when other Black Hills units are surveyed, therefore population and rate of change (λ) estimates are modeled during years when aerial estimates are not available. Aerial surveys in 2013 provided data to estimate the total population size of elk in CSP (N = 396, 95% CI = 324–512). These initial data collected in 2013 will be used to estimate population status through time using a Lefkovitch matrix projection model in Program R. The matrix model is a post-breeding model which includes

male and female calves, male and female yearlings, 2+ year old males, 2-7 year old females, and 8+ year old females. Survival rates, pregnancy rates, and fecundity were used to estimate future abundance. Confidence intervals for annual abundance estimates are developed using Monte Carlo simulation methods in Program R, which fully accounts for uncertainty in all input variables. To predict how different tag recommendations may impact λ, change in harvest is assumed to be additive, and simulations with given numbers of animals being removed through harvest are conducted to ensure CSP is maintaining the elk population objective.

ELK RESEARCH IN SOUTH DAKOTA

Resource Selection

Elk habitat use was quantified by Rice (1988) via six radio-collared cow elk (598 locations) released from WICA into the BHNF. The majority of feeding sites were almost exclusively devoid of ponderosa pine overstory. When limited canopy did exist, it was in areas characterized by either bur oak (*Quercus macrocarpa*) or quaking aspen (*Populus tremuloides*). These areas were heavily utilized especially when such habitats comprised less than 1% of home range. The edge of openings experienced the greatest elk use and the level of use decreased with increasing distance from the forest interface. During the spring, summer and fall seasons, elk seldom ventured more than 90 meters (98 yards) from forest edges during daylight hours. However, during the onset of the rut and hunting seasons, use of forest edge openings changed drastically and elk use shifted to smaller openings (<5 acres) surrounded by forested cover. Observations during the winter months indicated elk use of openings greatly expanded and elk were often observed in the middle of openings over a 1/4 mile from forested areas. Openings created or maintained by both wild land fire and prescribed burns were extensively used year round (Rice 1988). Millspaugh (1995) documented similar findings where 24 adult radio-collared elk within CSP exhibited high proportional use of meadows and burned areas especially during the winter months. Loafing and resting habitat use was highly variable and depended greatly on the weather conditions. In general, milder weather conditions resulted in greater elk use of more open canopy habitats. Conversely, adverse weather conditions (e.g., strong winds, extreme cold or extreme heat) caused elk to utilize habitats with a greater percentage of canopy closure (Millspaugh 1995). During July and August, feeding/loafing areas were selected within 800 meters of a water source (Rice 1988). Escape cover utilized was also variable and depended mainly on type, duration and repetitiveness of disturbance. Elk generally selected for dense stands of ponderosa pine (>75% canopy cover) in relatively rugged terrain during long or repetitive disturbance events (Rice 1988). Within CSP, Millspaugh (1995) noted elk exhibited high use of pine stands in the summer, which may have been related to thermoregulatory and human disturbance factors.

Millspaugh et al. (1998) investigated 131 diurnal bed sites from 26 elk within CSP from 5 June – 30 August 1994 - 1996. Greater overstory canopy closure, tree basal area and lower microsite temperature were the variables contributing most to elk microsite use, all which corresponded

to north facing slopes. These data suggest that thermoregulatory factors do influence where elk select summer diurnal bed sites within the Black Hills and management of sufficient thermal cover should be considered (Millspaugh et al. 1998). A similar study conducted by Rumble and Gamo (2011a) was conducted from 1998 – 2001. During this time, 412 locations from 52 radio-collared elk in the northern and central Black Hills were investigated; 225 of which were classified as bed sites and 187 as feeding sites. Stand and microhabitat were also quantified at 509 random sites for the resource selection analysis. Western snowberry was the most important variable for classifying bedded or feeding elk from random sites. Roads were the most definitive variable in separating random sites from elk sites, indicating the avoidance of roads. Rumble and Gamo (2011a) stated that as the BHNF continues to become a more open forest, increased forage for elk will become available; however, an open to moderate canopy forest could be negated by the increased human disturbance associated to the high density of roads (Rumble and Gamo 2011a).

Within the central Black Hills, Stubblefield et al. (2006) investigated 28 environmental attributes potentially associated with elk summer range occupancy (773 locations) from 1998 – 2001. Within the entire study area, research findings indicated that elk concentrated in landscapes that emphasized forage potential. Summer elk locations were positively correlated with elevation, proportion of non-road-dissected habitat, shape complexity of meadows, proportion of forest stands with ≤ 40% overstory canopy cover, and proportion of aspen (*Populus tremuloides*). Elevation had the greatest association to elk locations which was thought to be related to increased forage potential via precipitation and the productive soil type (i.e., Stovho Soil Complex) present there. The proportion of intact habitat not divided by roads was the second highest ranked variable suggesting that elk avoided areas near roads open to motorized vehicles. Stubblefield et al. (2006) suggested making landscapes available where elk have the potential to distance themselves > 500 m (545 yards) from improved roads.

Within CSP, Benkobi et al. (2004) collected 12,067 locations of 21 female and 15 male elk from 1993 - 1997. From this a spatially explicit deterministic habitat model (Arc-Habcap) was developed to predict the habitat effectiveness for elk within the boundaries of CSP. Habitat effectiveness was best calculated using an arithmetic average of all model components (i.e., forage, cover and cover-forage proximity) and weighting the forage value by 3 because it was discovered that good forage habitats were used 3-6 times more than good cover habitats. It was also discovered that elk selected forage and cover areas ≤ 100 m from cover-forage edges and as a result areas 100 m (109 yards) or less from cover-forage edges received an optimum (i.e., 1) cover-forage proximity (HDV) rating. Arc-Habcap predicted that the areas in close proximity to roads was ineffective elk habitat; however, elk used these areas of ineffective habitat in the same proportion they were available; thus eliminating areas adjacent to roads was not supported by the data. Roads were further categorized into primary, secondary and primitive roads and it was noted that areas immediately adjacent to primary and secondary roads received relatively less elk use then habitats that were further away. Primary roads were found to have the greatest negative effects out to a distance of approximately 300-350 m (327-382 yards). Model predictions of habitat effectiveness did not depict elk dispersion patterns in

CSP and the authors suggested substantial modifications are necessary in order to improve model performance (Benkobi et al. 2004). Further model testing was conducted by Rumble et al. (2007) using telemetry data collected in the Black Hills. From 1998 to 2001, Rumble et al. (2007) obtained 1,235 VHF daytime elk locations from forty-six cow elk and an additional 2,676 night locations via six GPS collared cow elk. The distribution of elk predicted by the ArcHSI model, relative to proximity of forage and cover, differed from the telemetry locations. Telemetry locations and the predicted distribution of elk relative to primary roads were similar; however, elk were located further from secondary roads than the model predicted. The predicted habitat suitability index (HSI) was also tested and output from the model was categorized as good (> 0.7), fair (0.42 to 0.7) and poor (≤ 0.42). Elk selected these areas in proportion to availability during summer but not winter. In both summer and winter, elk strongly selected areas that the model predicted to have good forage HSI and avoided areas that the model predicted to be fair or poor. Selection for areas predicted to have better forage was more pronounced during winter. Throughout the summer months, elk selected grasslands, aspen, and white spruce (< 40 percent canopy closure) for forage and use did not exceed availability for all structural stages of ponderosa pine. During winter, elk selected grasslands and ponderosa pine (< 40 percent canopy closure) for foraging while avoiding ponderosa pine that obtained 40 to 70 percent canopy closure (Rumble et al. 2007). Schmitz (2011) documented similar findings where elk selected for canopy cover ≤ 38% and avoided areas that had ≥ 86% canopy cover.

To assist in the National Environmental Policy Act (NEPA) process which mandates environmental analysis for land management projects that are likely to have a significant impact on wildlife and their habitats, Juntti and Rumble (2006) developed the Arc Habitat Suitability Index (ArcHSI) model, a geographical information system (GIS) model that estimates the ability of an area to meet the food and cover requirements of an animal species. The program uses the Rocky Mountain Region Resources Inventory System (RMIS Data Dictionary 1988) to describe the potential of habitats based on the food (FV) and cover (CV) values for certain wildlife species, namely deer and elk. The habitat distribution of feeding and cover (HDV) and road effects are also incorporated into the model. The Habitat Suitability Index (HSI) is then calculated using the formula: $HSI = \frac{3FV+CV+HDV}{5}$. Effects of roads are modeled based on road classification (i.e., primary, secondary and primitive). ArcHSI model outputs include an ArcINFO coverage, INFO summary and an open ArcVIEW project. Generated HSI values are categorized as poor (0 – 0.33 HSI), fair (>0.33 – 0.67 HSI), or good (>0.67 HSI).

From August 1998 through October 2001, 76 radiocollared elk were monitored several times per month in an effort to determine vegetative characteristics of habitat use by male and female elk in the western Black Hills of South Dakota (Rumble and Gamo 2011b). Six hundred and fifteen elk use sites and 509 random sites were characterized according to vegetation type. When elk utilized aspen stands, they utilized the stands for bedding and foraging equally. They were also more likely to select sites with less than 70% canopy cover. While utilizing grasslands, 98% of elk observations were recorded as foraging. When located in ponderosa pine stands with canopy cover from 0-40% (n=232), elk were equally likely to be bedded or

foraging. In pine stands with 41-70% (n=180) canopy cover, elk were bedded 60% of the time and foraging 40% of the time. Elk utilized pine stands with greater than 70% (n=20) canopy cover for bedding and foraging 65% and 35% of the time, respectively. Rumble and Gamo (2011b) reported that elk selected sites that provided 50-60% obstruction of a standing elk at 61 m which is less than what was reported for random sites.

As an effort to investigate resource selection pertaining to parturition sites, Lehman (unpublished data) captured and radio-marked 58 female elk ≥2 years of age and 125 calves during the parturition season from 2011 -2013 within CSP. At the largest macrohabitat scale Lehman (unpublished data) observed no evidence that female elk selected parturition sites to reduce risk of predation; rather they selected sites in areas with greater proportions of open canopy stands, intermediate rugged topography, and lower road densities. This suggests that parturient elk may be fundamentally influenced by forage availability and human disturbance, rather than predation risk, at larger scales. At the microhabitat scale female elk selected areas closer to water and avoided roads. Further, at the microhabitat scale, there was some evidence of selection for different predator avoidance strategies depending upon landscape characteristics. Within coniferous forests, females selected parturition sites with security cover exhibiting intermediate obscurity which might allow elk to better visually detect approaching predators. However, in grasslands, females selected parturition sites with less visibility which might provide hiding cover for dam and calf. Selection of macrohabitat primarily for forage availability may have been required to meet the nutritional demands of lactation. Management which promotes open canopied habitat for foraging and implements travel policies which restrict road access and human disturbance during May and June will provide favorable conditions for female elk during parturition (Lehman unpublished data). Similar findings were documented by Rice (1988) where five calving sites were investigated to quantify habitat use. The five sites had three similar characteristics: 1) all were located in openings less than 1 acre in size; 2) ground cover consisted of herbaceous vegetation, shrubs and downed timber; 3) at least one side of the opening was adjacent to a stand of dense ponderosa pines with virtually 100% canopy closure.

Roads and Human Disturbance

The BHNF has the greatest road density (2.2 mi/mi^2) of any other national forest in the country (USDA 1997). To quantify the potential impacts of high road densities and increased human activity towards elk, Rumble et al. (2005) equipped GPS telemetry collars onto two bulls and six cow elk to quantify movements during three consecutive hunting seasons (i.e., limited entry archery elk, limited entry firearm elk, and limited entry firearm deer). Movements increased on the opening weekends of each hunting season and an increase of activity was also observed the day after Thanksgiving during the firearm deer season. Throughout the three hunting seasons, elk dispersion patterns relative to roads varied. Elk were closer to primary and secondary roads during the archery season. As human disturbance increased during the firearm deer and elk seasons, elk movement increased and avoidance of primary and secondary roads was observed. The greatest distance between successive daytime elk locations occurred the last week of the

firearm deer season which coincided with the highest quantified hunter-days. Foraging behavior also changed once the hunting seasons began. Before the hunting seasons, elk selected open grassland meadows during daylight periods and avoidance of open meadows was documented when hunting seasons began. Elk responded to increased human disturbance most notably by increasing movements. Weight loss by elk during the late fall and winter could occur as a result of the additional energy expenditures caused by human disturbance, and elk occupying the BHNF could benefit from additional road closures and reduced human disturbance (Rumble et al. 2005).

Elk and hunter space-use sharing in CSP was investigated from 1993 – 1996 via 36 adult radio-collared elk (21 cows and 15 bulls). Space-use sharing was negatively correlated to increased hunter density, secondary road-use and tertiary road density (Millspaugh et al. 2000a). Also, space-use sharing occurred less in areas dominated by overstory-killed habitat and more in areas dominated by heavily forested habitats. Over the four seasons analyzed (i.e., early archery, trophy rifle, antlerless rifle, and late archery) space-use sharing for cow elk and hunters was lowest during the late archery season while bull elk exhibited the lowest space-use sharing during the trophy rifle hunt. Space-use sharing was highest for both bulls and cows during the early archery season which is thought to be a bi-product of the lower hunter densities (Millspaugh et al. 2000a). Elk avoidance of roads was found to be correlated with season, time of day, and amount of traffic. Elk were most tolerant of roads in winter and least tolerant during the summer months when human disturbance was greatest. Elk avoided areas that were occupied by humans and selected those areas when humans were not present (Millspaugh 1995). Flight response during daylight hours was generally one mile from any human caused disturbance. During the night, flight response toward human disturbance decreased to around ¼ mile (Rice 1988).

Rice (1988) noted via anecdotal observations, hunter disturbance had the greatest effect on elk movements and habitat use. Feeding areas used just prior to the hunting seasons were either abandoned or used exclusively at night and use on small openings next to escape cover increased greatly. Thick stands of ponderosa pine with virtually 100% canopy closure were utilized greatly during the hunting seasons. Presence of cattle also caused alterations in movements and habitat use. Visual observations indicated when cattle were introduced into a pasture used by elk; the elk either vacated the pasture or used areas within those pastures not occupied by cattle. Changes in feeding behavior appeared to be the result of space competition rather than forage. Elk responses to timber harvest was variable as some individuals vacated areas of logging disturbance entirely and others returned to areas periodically when disturbance ceased (e.g., weekends) or immediately after logging activity was completed. However, timber harvest occurring during the study was limited; as a result few observations were recorded.

Movements and Home Range

From June 1973 to February 1975, 32 elk were marked with ear flags, color banded collars, or radio collars within WICA as an attempt to document herd organization, movements and distribution. Marked elk were observed 713 times and located 113 times via telemetry. Three relatively distinct cow-calf herds were identified. The three herds were classified as northwestern (Beaver Creek), east (Boland Ridge), and southwestern (Gobbler Knob), occupying areas between 4.5 mi^2 - 10.0 mi^2. Intermingling between herds occurred during brief periods in January and February and it was documented that only a few elk crossed the west fence into the BHNF during spring, summer and early fall. Elk use appeared to be greater on east and south facing slopes and elk seemed to avoid steep slopes during all seasons (Varland et al. 1978).

In 1980, 1985 and 1986, 85 elk were transplanted from WICA to 6 different release sites within the BHNF. Release site locations included CSP, Mud Springs, Pass Creek, Deerfield Lake, Medicine Mountain and the Castle Creek drainage. Released individuals were marked with ear-tags, neck collars or radio collars. Data collected through visual observations and six radio-collared individuals, indicated no capture myopathy occurred as a result of the transplants. Approximately 83% of all transplanted elk joined existing resident elk herds. The remaining 17% returned to WICA after being released (Rice 1988). Of those that were released at the CSP site (*n*=20), 7 returned back to WICA. Of the 13 that remained within or adjacent to CSP, annual home range size varied between 6 - 15 mi^2. From 1981 to 1986, 7 were legally harvested and one was poached, resulting in an overall harvest rate of 61.5%. Elk released in 1980 near Mud Springs (*n*=10) demonstrated increased movements resulting in larger home range sizes, ranging from 18 – 30 mi^2. Three of the 10 elk were harvested over the five year period. In 1985, an additional 17 elk were transplanted to the same release site and 6 of the 17 (35%) were harvested during the 1985 and 1986 hunting seasons. Of the 11 elk originally released at the Castle Creek drainage site, three returned to their original home range in WICA and four were legally harvested from 1981 through 1986, resulting in a 50% harvest rate. Elk released near Medicine Mountain (*n*=10) also demonstrated extensive movements, establishing numerous small home ranges between movements. Harvest rates over the 5 year period were 40%. In 1985, 17 elk were released in the Pass Creek/Martin Draw area, of which, two returned to WICA. Seven of the remaining 15 were legally harvested during the 1985 and 1986 hunting seasons. In 1986, four previously marked elk that had returned to WICA were re-released to Deerfield Lake. No observations from this transplant were made (Rice 1988).

Within CSP, twenty-four adult elk (14 cows and 10 bulls) were captured and fitted with VHF radio collars from 1 July – 30 August 1993. From July 1993 through September 1994, radio-collared individuals were relocated 2-5 times per week resulting in 3,145 telemetry locations (Millspaugh 1995). Throughout the study, elk in CSP were segregated into five distinct cow-calf herds and five bull herds with annual home ranges overlapping 18% (*n*= 5, SE= 3.2) for cows and 27% (*n*=6, SE = 5.8) for bulls. Mean 95% annual home range size was 19.5 mi^2 for cows and 23.5 mi^2 for bulls. Home range sizes differed ($P<0.05$) for bulls between fall and winter, fall and

summer, spring and winter, and spring and summer. Sizes of home ranges for cows differed between fall and winter, fall and spring, and fall and summer. Radio-collared individuals did not exhibit migratory behavior and were considered residents (Millspaugh 1995). Herd organization of cow elk in CSP was further investigated from 1994 – 1997; research findings indicated five distinct resident cow herds remained within CSP, each utilizing a specific area within the park. Throughout the duration of the study, subherd range sizes were variable ranging between 5.9 mi^2 – 25.9 mi^2 in size. Minimal range overlap was observed among subherds during any season and range sizes varied across years. Low site fidelity in both summer and winter was observed along with changes in use patterns within herd ranges. This was attributed to habitat alteration (e.g., logging), human activity (e.g. hunting, hiking, wildlife viewing), changes in matriarchal leadership of elk and differences in sampling approach (Millspaugh et al. 2004).

Within WICA, twenty elk (10 males, 10 females) were radio-collared and monitored from May 1996 to August 1997. From the 1,595 locations collected, two distinct cow herds were identified. 95% home range size for cows during winter averaged between 8.8 mi^2 – 16.2 mi^2. Summer 95% home range size averaged between 10.2 mi^2 – 21.6 mi^2. Summer 95% home range size of bulls within the park did not differ. Back and forth movements of elk across the WICA boundary fence and the BHNF in the south west corner of WICA were equal and frequent. Using the line/weight method, reports of elk moving into the park were 582 and reports moving out were 554. Movement across the boundary fence was greatest in spring, with 52.1% of total movements out of the park occurring between May - July (Bauman et al. 1999). Through the analysis of photographs, video footage, and visual observations, Bauman et al. (1999) noted that if elk were not disturbed they would spend considerable time (i.e., several minutes) at the fence before jumping. Three experimental one-way gates were installed in 1999 and monitored. Results indicated that the one-way gates were an effective tool to allow elk to leave WICA but not return (Bauman 1998).

Benkobi et al. (2005) investigated elk movements and home range size by monitoring 48 radio collared cow elk in the northern and central Black Hills between August 1998 and October 2001. Females occupying the northern study area tended to move in a northeasterly direction during winter; however, migratory behavior was not consistent or definitive, as some elk remained on portions of their established summer range. This was contrary to elk occupying the central part of the Black Hills where a more distinctive migration pattern from north to south existed between summer and winter ranges. Mean migration dates from summer to winter range was 23 November (95%CI = 11 days) and from winter to summer, 18 April (95%CI = 6.5 days). The migration by elk in the central study area coincided with snow depths of approximately 20 cm or greater and variation in migration dates to the winter range was attributed to annual variation in snow accumulation. Little evidence of interstate movements between South Dakota and Wyoming existed during the duration of this study and elk that resided on the Wyoming side appeared to be year round residents (Benkobi et al. 2005).

Home range sizes varied greatly between the northern and central study areas in both winter and summer seasons. In the northern Black Hills, winter home range size averaged 40.3 mi^2 (SE= 2.0) and in the central study area average winter home range size was 137.0 mi^2 (SE= 7.8). Summer home range size averaged 38.5 mi^2 (SE = 1.6) in the northern study area and 63.0 mi^2 (SE = 2.3) in the central study area. Larger summer home ranges of elk were correlated to greater road densities because human disturbance increases elk movements and alters behavior. Summer home ranges in the northern and central Black Hills were 2.8 to 4.5 times larger than home ranges of elk in CSP which may be explained by the total road densities being two times greater in the central and northern Black Hills compared to road densities in CSP (Benkobi et al. 2005). Furthermore, site fidelity was investigated for 25 (20 cows and 5 bulls) elk that were available during three consecutive summers. Findings indicated only one of the 25 elk used a significantly different summer range within the 3-years (Stubblefield et al. 2006).

From 1 January 2007 – 1 May 2010, 105 elk were captured and fitted with VHF (*n* = 83), store-on-board GPS (*n* = 17) and live-uplink GPS (n = 5) radio-collars in the Black Hills of South Dakota. In an effort to document movements relative to management unit boundaries and cause-specific mortality factors, 51,737 locations were collected and for accuracy purposes 50,486 GPS locations were used to determine movements. Results indicated 73% of collared elk utilized more than one game management unit (GMU) throughout the year and 30% were located in multiple GMU during the hunting seasons. Cow elk annual home range size averaged 54.2 mi^2 (*n*= 10, SE = 14.9). Cow seasonal home range size was 16.9 mi^2 (*n*= 17, SE = 2.9) during summer and 21.2 mi^2 (*n*= 10, SE = 5.8) for winter (Schmitz 2011).

Survival

Mortality and recruitment of elk occupying WICA were investigated as an effort to quantify the effects of CWD and cougar predation. From 2005 – 2009, 202 elk (83 subadult males and 119 subadult/adult females) were fitted with GPS collars. Twenty eight mortality events were documented involving collared individuals and an additional 42 mortalities from unmarked elk were investigated throughout the course of the study. Of the 70 deceased elk investigated, 53 were tested for CWD (16 natural causes, 14 cougar predation, 8 vehicle collisions, 9 hunting/wounding loss, 2 fence entanglements, 2 rut-related injuries and 2 unknowns); of which, 18 were positive. Twelve of the 16 (75%) elk that died from natural causes tested positive for CWD. Annual survival rates were similar for males and females and averaged 86% (SE = 0.025). Leading causes of annual mortality (0.14) included hunting (0.07, SE = 0.019), CWD (0.03, SE = 0.012) and cougar predation (0.03, SE = 0.012). Pregnancy rates for subadults was 9.5% (*n* = 21, SE = 6.6%) and adults 76.9% (*n* = 104, SE = 4.2%). Average calf perinatal survival rates (1 February – 1 September) were 0.49 (SE = 0.085) (Sargeant et al. 2011).

Sargeant et al. (2011) emphasized that CWD was not known to occur within WICA until 2002; thus, 3% annual loss associated to the disease is a noteworthy statistic and greatly exceeds rates quantified in the greater Black Hills. It is believed that high elk densities are facilitating the rapid spread within WICA. It was further noted that the effects of CWD, increased

predation, and reduced recruitment have reduced the rate of increase for elk occupying WICA to approximately λ = 1.00 (SE = 0.027) during the past decade (2000 – 2010) (Sargeant et al. 2011). Jacques et al. (2003) investigated elk CWD prevalence during the 1998-99 and 2001 elk hunting seasons. A total of 537 hunter-harvested elk collected primarily from the southern Black Hills and CSP were tested for CWD and overall prevalence of infection was 0.0%.

From 1 January 2007 – 1 May 2010, 105 elk (76 females, 29 males) were monitored throughout the Black Hills of South Dakota. Cow elk annual survival rates in 2007, 2008 and 2009 were 56% (*n* = 39, SE = 0.06), 68% (*n* = 41, SE = 0.06) and 62% (*n* = 45, SE = 0.06) respectively. Annual survival rates for radio-collared bull elk in 2007, 2008 and 2009 were 90% (*n*=10, SE = 0.09), 57% (*n* = 14, SE = 0.1) and 53% (*n* = 19, SE = 0.1), respectively. Throughout the duration of the study, 62 mortalities were documented, of which hunter harvest accounted for 77% (66% harvest, 11% wounding loss; *n*=48), predation 11% (*n*=7), road-kills 3% (*n* = 2) and unknown 8% (*n*=5) (Schmitz 2011).

As an effort to investigate the declining elk population in CSP and adjacent elk management units, Lehman (unpublished data) captured and radio-marked 58 female elk ≥2 years of age and 125 calves during the parturition season. Yearlings (n=14) were monitored for annual survival one year after they survived their initial year of life as a calf. Annual survival for female elk ≥2 years of age varied from 80% (*n* = 40, SE = 0.06) in 2011 to 93% (*n* = 42, SE = 0.04) in 2013. Yearling survival was 94% (*n* = 14). Calf survival varied from 7% (*n* = 30, SE = 0.04) in 2011 to 27% (*n* = 37, SE = 0.08) in 2012. Lambda varied from 0.87 in 2011 to 1.01 in 2013 (Lehman unpublished data).

In a companion study to Lehman (unpublished data), Simpson (unpublished data) radio-marked 40 female elk ≥2 years of age during the winter of 2012. Thirty-four of these radio-marked elk were recaptured in the winter of 2013 and an additional 9 female elk ≥2 years of age were radio-marked. During the two parturition seasons, a total 71 calves were radio-collared and monitored throughout the study. Annual female elk survival ≥2 years of age was 87% (*n* = 40, SE = 0.06) in 2012 and 83% (*n* = 43, SE = 0.04) in 2013. Annual calf survival was 65% (*n* = 37, SE = 0.04) in 2012 and 76% (*n* = 34, SE = 0.08) in 2013. Pregnancy rates of adult elk varied significantly between years with 93% (n=40) in 2012 and 66% (n=43) in 2013.

Sightability

Lanka et al. (1993) attempted to determine if the winter sightability model developed in Idaho by Samuel et al. (1987) could produce accurate elk population estimates in Black Hills habitats during the summer. A systematic drive count took place within WICA on 29 August 1992 utilizing 65 stationary line observers and 165 drivers. Due to logistical reasons (e.g., gaps within the drive line, poor communication, loss of daylight), a portion of WICA was not sampled. The 364 elk counted during the survey was considered a minimum count. Aerial surveys were flown in September 1992; the areas sampled by the drive count were flown twice and the estimates for trial one were 241 (+/- 55), and trial two were 302 (+/-57). Lanka et al. (1993) noted that

the variability was likely caused by elk behavior (e.g., bedded elk in forested habitats) during late morning and early afternoon and the fact that the model being tested was developed during winter when elk are more active, in larger groups and occupied more open habitats. Model accuracy between surveys was below expected at 73% (Lanka et al. 1993).

Anderson et al. (1998) examined the precision and accuracy of two summer helicopter sightability models that were developed for elk in Wyoming. Significant variables in model A included group size, activity and percent canopy cover where Model B used two variables, elk group size and percent canopy cover. Both models A and B were also compared to a winter elk sightability model developed in Idaho that incorporated group size, percent vegetation cover, and percent snow cover. The models were tested and compared against well-documented populations of elk in Wind Cave National Park and Starkey Experimental Forest and Range. Model estimates of elk abundance were more accurate and precise from Model B, suggesting elk activity had little influence on summer elk detection. Comparisons of the Idaho model and Model B were similar for small groups of elk (≤ 10 elk); however, the Idaho model overestimated detection of large groups (30-45 elk/group) in moderate canopy cover (> 30% vegetation cover); thus the authors recommended using Model B during summer elk surveys where elk occurred in larger groups (i.e., >20) and suggested using the Idaho model during summer surveys where elk occurred in smaller groups (i.e., < 20).

In January 2007, 40 adult female and 10 adult male elk were captured and radio-collared as part of an elk movement study being conducted by SDGFP personnel. During the study, survey crews flew over 63 groups of elk that contained at least one radio-collared individual. Crews detected 40 of the 63 groups on the first pass, indicating an overall sightability rate of 63.5%. Logistic regression analysis indicated that combined percent vegetative cover and group size had the greatest impact on sightability (Jarding 2010).

As an effort to increase sample size of elk sightability observations from Jarding (2010) and improve model selection, sightability trials were flown in the winters 2010 and 2011 when variable snow conditions existed. The helicopter survey crew (a pilot and two observers) followed the survey protocol developed by Jarding (2010). Throughout the three years, 89/152 groups were detected that included at least one radio-collared elk. Overall sightability was 58.6%. The best selected model included percent vegetation, group size, and percent snow cover, which correctly classified 73.7% of the 152 observations. Group size had the greatest effect on elk sightability and groups containing > 50 individuals had detection probabilities >95%. Percent vegetation cover had a negative effect on detection while snow cover had a positive effect (Phillips 2011). Sightability trials continued in 2012 by SDGFP personnel to improve model selection when snow cover existed. Twenty-four observations were added to the analysis, with an average detection probability of 75%. During the four years of data collection, survey crews flew over 176 groups of elk that contained at least one radio-collared individual. Crews detected 107 of the 176 groups on the first pass, indicating an overall sightability rate of 60.8%. The top two models, carrying 92% of the weight included: percent visual obstruction, group size, percent snow cover and activity. However, the p-value for

activity was >0.05; thus indicating an insignificant variable. As a result, model averaging was performed for the variables percent visual obstruction, group size and percent snow cover. The final model estimated elk sightability as $\mu = 0.1446 – 0.0361$(percent visual obstruction) + 0.1001(group size) + 0.0158(percent snow cover) and was selected to correct for elk missed during the 2013 aerial survey in the Black Hills (Robling unpublished data).
Furthermore, ground detection was investigated by Jarding (2010) via spotlight surveys from 10-21 August of 2008 and 2009 between Hill City and Deadwood. During the two years of surveys, 29 groups containing 88 elk were observed. Distance sampling analysis could not be performed because of small sample sizes and it was noted that road transects and distance sampling procedures are not practical techniques for indexing elk populations within the Black Hills (Jarding 2010).

Diet

Between July 1976 to August 1977, food habitats of elk were determined in WICA by examining 92 feeding sites and 30 rumen samples. During spring and summer, graminoids (grasses, sedges and rushes) were the most common forage class in rumen samples. Forbs were the most prevalent forage class consumed during fall and winter. Elk use of browse throughout the study was generally low (Table 18, Wydeven and Dahlgren 1983).

Table 18. Elk forage use in WICA as determined by examining feeding sites and rumen samples, 1976-1977 (Wydeven and Dahlgren, 1983).

	Percent Elk Use			
Plant taxa	**Fall**	**Winter**	**Spring**	**Summer**
Graminoids	34.8%	38.3%	73.6%	86.7%
Forbs	58.4%	52.6%	18.4%	5.4%
Browse/Shrubs	6.8%	9.1%	8.0%	7.9%

As an effort to evaluate elk winter and summer diet composition and quality between years, seasonally (summer and winter), and intraseasonally (summer), a minimum of 15 elk fecal samples were collected on winter and summer ranges at 2-week intervals from June-August and from January-March of 1995 and 1996. In the winters of 1995 and 1996 elk consumed 47% grass, 31% shrubs, 20% ponderosa pine and 2% forbs (Hippensteel 2000). Throughout the study, summer diets on average consisted of 37% grasses, 32% shrubs, 16% ponderosa pine, and 15% forbs. The most common shrubs eaten by elk in both the summer and winter were Oregon grape (*Berberis repen*) and fringed sagewort (*Artemisia frigida)*. Blue grama (*Bouteloua gracilis*) and needle-and-thread grass (*Hesperostipa comata*) were the most common grasses, and old-man's beard (*Usnea spp.*) and red clover (*Trifolium pretense*) were the most common forbs (Hippensteel 2000).

To assess the potential dietary overlap between deer and elk, fecal samples were collected from both species on five deer winter and summer ranges at 2-week intervals from June –

August of 1994 and 1995 and from January – March of 1995 and 1996. Summer dietary overlap of elk and deer was approximately 44% and winter dietary overlap averaged 49.1%. Plants commonly eaten by both deer and elk included three grasses; redtop (*Agrostis stolonifera*), blue grama, and needle-and-thread grass and five shrubs/browse; serviceberry (*Amelanchier spp.*), fringed sagewort, paper birch (*Betula papyrifera*), ponderosa pine (*Pinus ponderosa*), and woods rose (*Rosa woodsia).* Throughout the duration of the study, elk ate a larger amount of grasses than deer and deer ate more ponderosa pine, forbs, and shrubs. According to the fecal nitrogen and fecal phosphorus concentrations, deer consumed a higher quality diet than elk throughout the study (Hippensteel 2000).

A similar study was conducted by Zimmerman (2004), where fecal samples of white-tailed deer, mule deer, elk and cattle were collected at 2-week intervals in burned and unburned habitats (Table 19). Research findings indicated that total graminoids was evident in elk diets more in the winter than summer, contrary to what Wydeven and Dahlgren (1983) documented in WICA. Major plants consumed by elk in burned vs. unburned areas were not significantly different; however, forage digestibility was greater in burned areas. Summer dietary overlap of elk and white-tailed deer were similar in burned and unburned areas but competition between elk and white-tailed deer throughout all seasons heightened in unburned habitats due to the poorer quality habitat available. Summer dietary overlap of elk and cattle was greater in burned areas (36.7%) vs. unburned areas (30.4%); however, the greatest dietary overlap between elk and cattle occurred in the fall (50.2%) in burned areas (Zimmerman 2004).

Table 19. Elk forage use as determined by fecal sampling in the Southern Black Hills, 2002-2003 (Zimmerman 2004).

	Percent Elk Use	
Plant taxa	**Winter**	**Summer**
Graminoids	70.0%	42.5%
Forbs	8.7%	28.6%
Browse/Shrubs	19.4%	26.4%

Keller (2011) evaluated the factors affecting temporal and spatial selection of resources by the large herbivore community in CSP. Habitat overlap among all species was highest during winter and lowest during the summer. Female bison and pronghorn, both sexes of bison and elk, and white-tailed deer and elk used habitat in a similar manner during most seasons. For all seasons except summer, habitat overlap was most associated with high forage biomass and water at the edges of habitat patches. During fall and winter, habitat overlap among all species increased at areas of high forage biomass and diversity and areas of high patch edge density. During spring, habitat overlap among all species increased near intermittent streams at areas of high patch edge density. During summer high habitat overlap among all species was found close to intermittent streams, and away from flowing streams and ponds. Seasonal carrying capacity estimates incorporating all factors were highest during the winter (2,864 ungulates), intermediate during spring (1,636 ungulates) and fall (1,353 ungulates), and lowest during the

summer (1,012 ungulates). The model optimized seasonal stocking densities at 25% allocation of total forage production at 500–659 bison, 212–699 elk, 100–584 mule deer, 100–795 white-tailed deer, and 100–541 pronghorn. Comparison of current stocking densities to forage production suggest utilization of many forage species may be above 25% but generally below 50%. The incorporation of resource selection greatly decreased carrying capacity estimates for some species. Total seasonal carrying capacity estimates that did not incorporate resource selection were 84–144% higher (Keller 2011).

Elk population estimates within CSP were constrained by the amount and allowable use of certain grasses and forbs. Little bluestem (*Schizachyrium scoparium)* was a particularly important species constraining elk population estimates, the amount of spatially available little bluestem constrained elk population estimates during all seasons. However, this species comprised <2.8% of elk diets during any season, so it is not likely to limit elk populations. The only graminoid that constrained elk populations was the allowable use of sedge during the spring, which is an important forage species to both bison and elk during this season. The allowable use of forbs including northern bedstraw (*Galium boreale)*, indianwheat (*Plantago patagonica)*, and common yarrow (*Achillea millefolium)*, were limiting constraints on elk populations during all seasons.

In general, tradeoffs existed between maximizing bison and elk, elk and white-tailed deer, and pronghorn and mule deer populations. Coexistence of bison and elk populations was dependent on the availability of palatable grasses, while forbs and shrubs were important for white-tailed deer, elk, mule deer and pronghorn. Keller's results will be useful in examining theoretical relationships related to stocking densities and forage production, and tradeoffs in optimizing ungulate population numbers within CSP, rather than a strictly applied estimate of ungulate carrying capacities (Keller 2011).

Capture Techniques

From 1969 through 1972, 657 elk were trapped in WICA using a modified bison corral trap and a single helicopter to herd the animals into the trap. Lovaas (1973) recommended the use of two helicopters to improve efficiency and effectiveness of trapping elk.

Ten elk were successfully immobilized using a combination of 500 mg Telazol and 60 mg Xylazine Hydrochloride (HCI) within CSP. Yohimbine HCI was used as the antagonist and 40 mg were administered intravenously resulting in a mean recovery time of 14.0 minutes. Weight and dosage of Yohimbine resulted in varied recovery times (Millspaugh et al. 1995).

Twenty four elk were trapped in 117 trap nights (7.4 trap nights/elk) from 1 July to 30 August 1993 within CSP. One, side collapsible modified Clover trap and eight "scissor" folding Clover traps were baited with salt blocks. Captures included 13 calves, 5 bulls (4 spikes and 1 branch-antlered bull) and 6 cows. Disadvantages to summer trapping elk included potential overheating, damage to antlers, and cows and calves becoming separated; however,

advantages were less risk to pregnant cows, high trap success, small field crew needed, and fewer weather logistics to overcome (Millspaugh et al. 1994).

Twenty-five free ranging elk were captured using three separate techniques (helicopter net-gunning, *n*=7; Clover trapping, *n*=7; and, corralling *n*=11) for an on-going study evaluating the behavioral and physiological effects of human disturbances on elk (Millspaugh et al. 2000b). Once captured, blood samples were collected to quantify numerous serological parameters as an effort to measure potential tissue and muscle damage caused by capture related stressors. Results indicated that capture techniques requiring less time from capture to release (i.e., helicopter net-gunning) greatly reduced tissue and muscle damage. Millspaugh et al. (2000b) suggested that corralling and Clover trapping elevates several biochemical parameters that are indicative of tissue and muscle damage potentially resulting in capture myopathy (Millspaugh et al. 2000b).

General Elk Research within South Dakota

During the fall of 1993 and 1994, chest girth and eviscerated weight were recorded from 57 harvested elk in CSP. Logistic regression equations were developed for estimating both eviscerated ($y = 0.024x^{1.81}$) and intact body weight ($y = 2.76x - 128.46$) from chest girth (Millspaugh and Brundige 1996b).

From 1995 – 1997, 558 fecal samples were collected to measure fecal glucocorticoid levels to determine physiological responses of elk to various stressors. Fecal glucocorticoid levels peaked in the summer for both bull and cow elk subherds which were explained independently by high vehicle use along primary roads, high road densities and mean temperatures. Concentrations were lowest in the winter; however, more research is needed to determine if annual glucocorticoid secretion may be related to seasonal metabolic rhythms (Millspaugh et al. 2001).

In an attempt to compare data from GPS and very high frequency (VHF) collars, six GPS and 44 VHF collars were attached to cow elk from August 1998 – December 2000. Two GPS collars malfunctioned and did not operate correctly. Four of the GPS collars were store-on-board and obtained locations on 88% of attempts. Researchers noted that they obtained more data from each GPS collar that was deployed for 10 months than was obtained in 2.3 years from three technicians tracking 10 times as many elk with VHF telemetry collars (Rumble et al. 2001a).

In 2011, it was documented that one of the 34 pregnant cow elk (3%) being monitored within CSP experienced dystocia while giving birth and died approximately 4 days after the cow was visually observed exhibiting labor. A field necropsy revealed a fully developed calf lodged in the birth canal (Lehman et al. 2012).

Cook et al. (2013) examined 861 female elk from 21 herds across the western United States including South Dakota from 1998 to 2007. In South Dakota; age, pregnancy rates, and

lactation status were examined for 18 adult females during the spring (late Feb. – early April) of 2007. Of the 18 elk sampled, 17 were tested for pregnancy and 82.4% were pregnant. Across all study herds, pregnancy rates varied from 68.6-100% and lower pregnancy rates were documented for females greater than 15 years of age.

Lehman (unpublished data) captured and radio-marked 58 female elk ≥2 years of age and 125 calves during the parturition season from 2011 – 2013. Over the three-year study period 100 parturition sites were measured. Median dates for parturition were 1 June in 2011, 28 May in 2012, and 3 June in 2013. Ninety percent of births occurred by 15 June over the 3-year period of the study.

PUBLIC LAND MANAGEMENT

Game Production Areas

SDGFP owns and manages 12 Game Production Areas (GPAs) encompassing 20,940 acres in the Black Hills. Elk may occasionally occur on any of these GPAs, but none truly possess habitat of a quantity or quality enough for them to be considered a significant contribution to elk habitat in the Black Hills. General habitat management objectives on Black Hills GPAs are designed to benefit a wide array of wildlife species and public uses. Practices such as pine thinning are used to encourage hardwood and browse species; prescribed burning, haying, and limited grazing are used to manage grassland species; and annual cropping used to produce food habitat plots for resident wildlife. Of the 12 GPAs in the Black Hills, two – Harrison-Badger-Trucano GPA in Lawrence County and Pleasant Valley GPA in Custer County - are managed primarily to provide seasonal elk habitat in the form of thermal cover and planted forage (i.e. food habitat plots), with the principal management objective to hold elk on the GPA for private land depredation abatement.

SDGFP's current land acquisition efforts across the state – including the Black Hills - focus on securing in fee-title native habitat types that support resident and migratory wildlife species while providing various wildlife related recreational opportunities. This approach has resulted in a widely distributed land inventory of high quality habitat types that is both biologically sound and publicly acceptable. Land acquisition priorities include parcels that provide a connection or corridor between other public lands; additions to existing GPAs, parcels that enhance or facilitate public access to GPAs and other public lands, in-holding and round-out parcels that consolidate or connect existing GPAs, and parcels that provide buffers or are necessary for maintaining or enhancing the integrity of existing GPAs and other public lands.

Custer State Park

Custer State Forest became Custer State Park after action by the state legislature in 1919. Custer State Park encompasses 70,750 acres of forests and grasslands in the Black Hills of South Dakota (Figure 8). Geography varies from steep granitic spires in the northwest part of the

park, forested rolling topography in the main body and grading eventually into grasslands on the eastern and southern boundaries. Elevation ranges from 3,760 to 6,700 feet above sea level. Vegetation is dominated by white spruce/ponderosa pine mix on north slopes at higher elevations, by pure ponderosa pine on most forestlands, and by mixed-grass prairie on grasslands. Elk were reintroduced into Custer State Park in 1915.

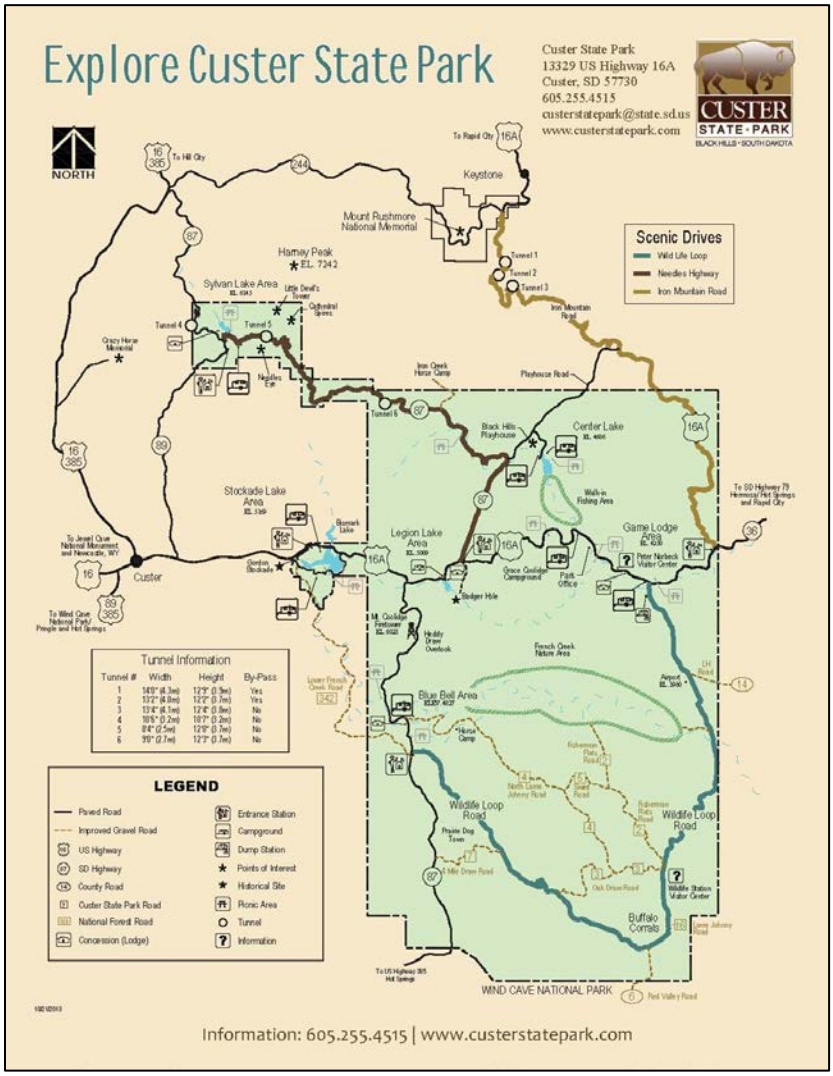

Figure 8. Location of Custer State Park in the southern Black Hills, South Dakota.

CSP manages elk for species diversity, visitor view ability and watchable opportunities, and to provide a high quality recreational hunting opportunity. The elk population objective takes into account viewing and recreational opportunities as well as social aspects such as landowner tolerance from adjoining landowners to the east of CSP. But most importantly, the population objective takes into account precipitation data and forage production, elk resource selection, as well as historical trend information and demographic data.

Determining the size and composition of ungulate communities that landscape can support is difficult, especially when ungulate communities are diverse such as in CSP where several large ungulates exist and potentially compete for forage. Theoretical carrying capacity models can be useful tools to guide management decisions; however, these models may make some assumptions about forage production, forage availability, and diet overlap. Spatially-explicit information of forage production, diet, space-use, and resource overlap was developed that used linear optimization to optimize stocking densities of bison (*Bison bison*), elk (*Cervus elaphus*), pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), and white-tailed deer (*Odocoileus virginianus*) (Keller 2011). Results of the theoretical optimization model indicated that during the spring season with 25% allocation of forage that carrying capacity for CSP would be 698 elk (Keller 2011). It was noted in Keller (2011) that elk and bison population numbers were a problem for the carrying capacity model as the minimum population constraint was often violated during the initial model runs. Elk compete with both bison and white-tailed deer for forage and space in CSP, which likely confounded the linear optimization model (Keller 2011). As presented in Keller (2011) forage production was best predicted by current annual spring precipitation, previous year spring precipitation, and ordinal date of last spring frost. This model explained 40% of the variation in forage biomass in CSP.

Additionally, when evaluating forage production under normal precipitation conditions (Keller 2011), CSP has 62,830,016 lbs. of dry herbaceous biomass available (Table 20). CSP allocates 25% of that biomass for wildlife use, and 25% would equate to 15,707,504 lbs. of dry herbaceous biomass. Based upon recent evidence of resource selection of rangeland versus forestland (n = >240,000 satellite locations), elk selected forested habitats 79% of the time and rangelands 21% of the time. Extrapolating a value of 12.2 lbs./day for elk use in CSP (Keller 2011), and projecting 800 elk for a population objective, elk are estimated to consume 3,548,142 lbs. of dry herbaceous biomass on rangelands and forests. Landowner tolerance east of CSP declined when elk were between 950-1100 animals from 1999-2003, and management for a population >950 animals should be avoided. Based on past demographic trend data, landowner tolerance, theoretical carrying capacity models, and allocation for other large ungulates, we have set the winter population objective for CSP to be between 700-900 elk. Elk will be managed towards 800 animals during years when precipitation conditions are normal, towards 700 when precipitation conditions are below normal, and towards 900 elk when conditions are above normal. It should be noted that under optimal foraging conditions, with increased forage production through use of activities such as prescribed fire and timber management, population objectives for all the species listed in (Table 20) could be increased due to increased carry capacity.

Table 20. Dry forage (lbs.), population objectives, and allocation table for large ungulates in Custer State Park (modified from Keller 2011).

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

[a]Pounds of dry forage available in CSP during a normal precipitation year. The 15,707,504 lbs. would be 25% of the annual production for CSP.
[b]Winter population objective for each species in CSP.

Wind Cave National Park

WICA was established in 1903 as the eighth national park in the United States and is located in the southern Black Hills. Expansions to the park over time have resulted in the park's current size of 33,614 acres. WICA is bordered by CSP to the north, BHNF to the west and private land to the south and east (Figure 9).

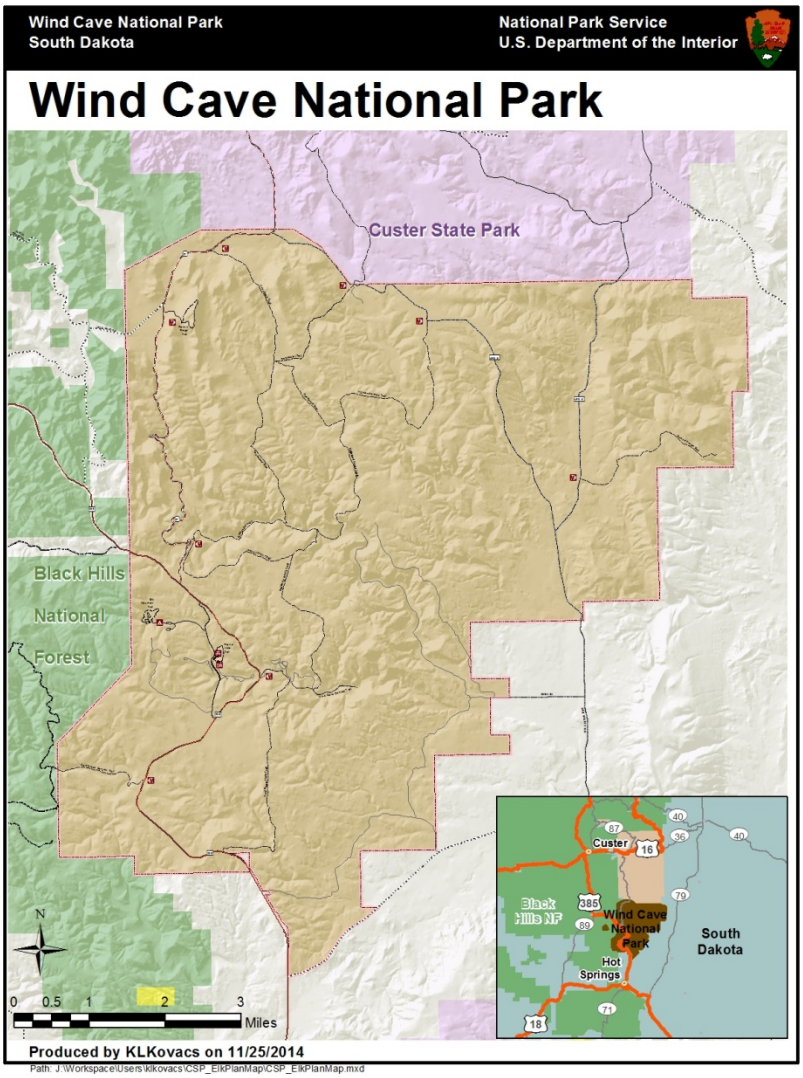

Figure 9. Map of Wind Cave National Park (WICA).

The landscape of WICA is predominately mixed-grass prairie and ponderosa pine (*Pinus ponderosa*) forest. Elk were reintroduced to WICA between 1914 and 1916 after extirpation from the Black Hills. Due to its classification as a National Park (no hunting allowed) and the high fence associated with the perimeter of WICA, this semi-isolated elk population has grown over time. Over the years, elk from WICA were transplanted to other areas within South

Dakota and throughout the west (Appendix 1) to establish elk herds in suitable habitat. These translocations served as a tool to also manage the elk population within WICA.

In July 2002, the National Park Service Director issued a memo stating "deer or elk will not be translocated from areas where chronic wasting disease (CWD) is known to occur". In November 2002, CWD was documented in a cow elk in WICA. At this point, WICA was no longer able to use live translocation of elk as a management tool. Since the confirmation of CWD with cervids, a total of 60 elk, 2 white-tailed deer, and 8 mule deer have been confirmed with the disease in WICA through November 1, 2014. With a high-fenced park containing an elk herd with limited movement outside of WICA, no allowable hunting harvest, and limited mortality caused by natural death, disease and predation, WICA identified a need to revise the existing elk management plan for future actions.

In 2009, WICA made available to the public the "Final Elk Management Plan and Environmental Impact Statement" (NPS 2009; http://www.nps.gov/WCNP/parkmgmt/current-managementplans.htm). Through this process, WICA considered the following alternatives for future management directions: 1) hunting outside of WICA; 2) roundup and live shipment to or euthanasia; 3) sharp shooting; 4) contraception (sterilization); 5) fertility control agent. Other alternatives considered but dismissed from further analysis: 1) hunting inside of WICA; 2) translocation of elk; 3) habitat alterations; 4) fencing in elk; 5) aerial sharp shooting; 6) predator reintroduction. Hunting outside of WICA was selected by the National Park Service as the preferred management alternative.

To facilitate the preferred management alternative, WICA increased the height of 4.5 miles of fence on the west side from four feet to 7 feet and completed the installation of 20 "jump gates" on the west and north sides of WICA to allow for movement of elk outside of WICA (Figure 10). When lowered, the height of the jump gates range from 4-5 feet, easily allowing elk to exit or enter the boundaries of WICA (Figure 11). For a specified time period before the elk hunting seasons outside of WICA, the jump gates are lowered to facilitate elk dispersal into Management Unit 3. Prior to the start of the elk seasons (late June), the jump gates are then raised to prohibit elk traveling back into WICA, thus making these elk available for hunter harvest. The jump gates are then lowered after the December antlerless elk season to allow for seasonal movement.

The jump gates were first used as a management tool in 2011. Trail cameras are positioned at some locations to determine the effectiveness of the jump gates. While difficult to quantify, elk have been observed both exiting and entering WICA. SDGFP has responded to this passive movement of elk by adjusting the number of antlerless elk licenses, primarily in Management

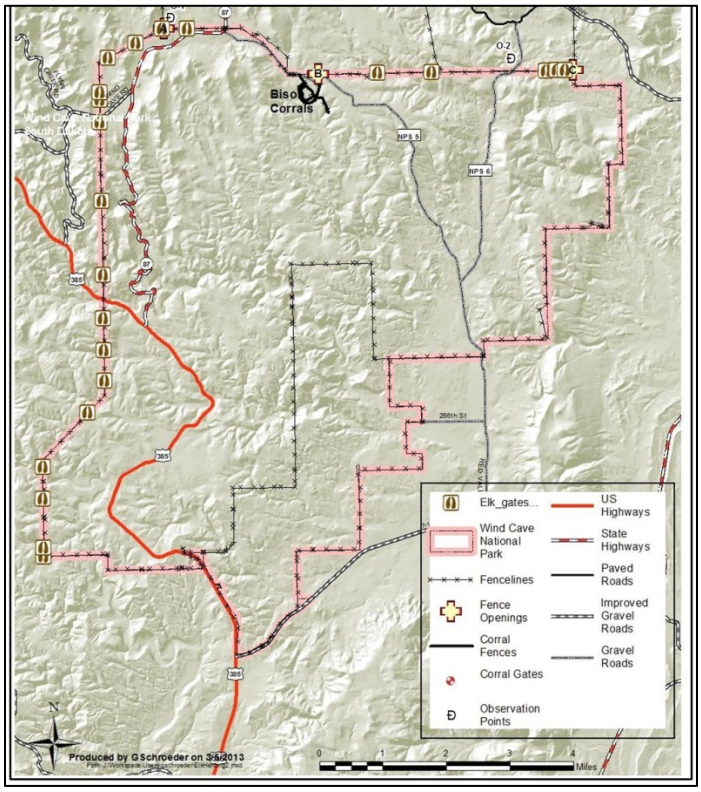

Figure 10. Elk jump gate locations on north and west perimeter fences at Wind Cave National Park.

Figure 11. Photo of double wide elk jump gate in lowered position (Photo Credit: Wind Cave National Park).

Unit 3 to manage within the population objective and landowner tolerance of this unit and to assist WICA in reducing this elk population to a manageable level. WICA has identified a population objective of 232-475 elk in the park. The 2014 winter elk population is estimated at 550-600 elk (Greg Schroeder, personal communication).

In cooperation with the U.S. Geological Survey, WICA is studying elk survival, movement and effectiveness of the jump gates. The results and management implications of this study will assist WICA in the evaluation of their preferred alternative in the use of jump gates and hunter harvest outside of WICA in their elk management.

As a result of continued growth in the WICA elk herd that far exceed the population objective, additional management activities were implemented in 2012-2014. On December 15, 2012, sixty-nine horseback riders moved 14 elk from WICA into the southeastern portion of CSP.

To increase the number of elk moved, WICA, SDGFP and the Rocky Mountain Elk Foundation cooperatively worked together to facilitate the movement of elk using helicopters as a hazing technique. Designated locations of the perimeter fence were identified and temporarily opened to move elk into Management Unit 3 and CSP. On March 1, 2013, 197 elk (6 mature bulls, 5 spike bulls, and 186 cows and calves) were hazed into CSP. On March 8, 2013, 192 elk (19 mature bulls, 3 immature bulls, 1 spike bull and 169 cows and calves) were hazed into CSP. In total, 26 radio-collared elk were moved from WICA to CSP, which allowed biologists an opportunity to monitor movements.

Again on March 12-13, 2014, helicopter were used to move 39 elk (27 mature bulls and 12 cows and calves) into CSP and another 122 elk (2 mature bulls and 120 cows and calves) into Management Unit 3. WICA staff monitored the movements of these elk after they left the park.

Aside from the installation and use of jump gates to facilitate the natural movement of elk, there has been limited population management of the WICA elk herd since the discovery of CWD terminated the translocation of elk as a management tool. The use of helicopters to facilitate the movement of elk outside of WICA is expensive and not a cost-effective tool for managing elk within WICA on a regular basis. SDGFP will continue to work closely with WICA, however, additional management alternatives should be implemented by WICA for long-term management of this elk population. SDGFP supports the reevaluation of hunter harvest within WICA as a cost effective and efficient management alternative. A Memorandum of Understanding was signed between SDGFP and WICA that identifies the commitments of both parties in bison and elk management (Appendix 12).

Black Hills National Forest

Black Hills National Forest encompasses western South Dakota and northeastern Wyoming, covering an area approximately 110 miles north to south and 70 miles east to west (USDA 2006). The BHNF fire protection district within South Dakota is approximately 1.9 million acres, of which 1.1 million acres are administered and managed by BHNF. The remaining acreages are in private ownership (~790,000 acres) and a scattering of other federal and state lands (Bureau of Land Management, National Park Service, SDGFP, South Dakota School and Public Lands).

Eighty-nine percent of the lands managed by the BHNF are forested lands (USDA 2005). Forest lands are at least 10% stocked by trees of any size and are at least 1 acre and 120 feet wide. Unimproved roads and trails, streams and small clearings in forest areas are considered forest lands if less than 120 feet wide (Walters et al. 2013). The most common forest type is ponderosa pine (*Pinus ponderosa*) at 92%. Ponderosa pine (herein referred to as pine) occurs in 13 plant associations from the higher elevation, mesic coniferous forests/woodlands with greater than 60% canopy cover to the lower elevation, dry coniferous forests/woodland types with less than 50% canopy cover. The dry coniferous forests/woodlands are the most dominant ecological group within the entire Black Hills (Marriott and Faber-Langendoen 2000, USDA 2005).

Black Hills National Forest classifies and inventories vegetative diversity by structural stages (SS) which delineate the dominant plant cover by tree size, stem diameter at breast height (DBH = 4.5' above ground level) and overstory crown cover (Table 21). Developed stages of tree stands, pine for example, are classified by the most dominant SS. Pine has a dominant influence on understory plants which shapes the type of forage available for elk and other ruminants, including domestic livestock. In the Black Hills pine forests, understory production increases as the overstory stocking level (basal area) and crown cover decrease (Pase and Hurd 1957) and plant diversity demonstrates a similar pattern (Uresk and Severson 1989, Uresk and Severson 1998).

Table 21. Structural stage or dominant plant cover by size, diameter (DBH) and percent crown cover (USDA 2005).

SS Code	Structural Stage	Tree Size Class	Diameter (DBH)	% Crown Cover
1	grass-forb	non-stocked	--	0 – 10
2	shrub-seedling	established	< 1"	11 – 100
3A	sapling-pole	small, medium	1 to <9"	11 – 40
3B				41 – 70
3C				71 – 100
4A	mature	large, very large	9" and above	11 – 40
4B				41 – 70
4C				71 – 100
5	late-successional	large, vary large	varies	varies

Managing habitats for wildlife species which prefer a diversity of vegetation, such as elk, calls for comprehension of the relationship between overstory and understory, which SS attempts to define. Managers have to know what is there on the landscape, in order to propose vegetation treatments (if any) to maintain or improve elk habitat. Elk will use a variety of SSs, from early successional with an abundance of forage to late successional with dense canopy which provides shade in summer and intercepts snow in the winter (allows big game to escape deep snow and maneuver in winter).

The remaining forest lands on BHNF are comprised of 6% aspen (*Populus tremuloides*), bur oak (*Quercus macrocarpa*) and paper birch (*Betula papyrifera*); 2% Black Hills white spruce (*Picea glauca*) and less than 1% juniper woodlands (*Juniperus spp*.) (USDA 2005). There are scattered inclusions of less than 100 acres each of Lodgepole pine (*Pinus contorta*) in the northern Black Hills and non-native Douglas fir (*Pseudotsuga menziesii*) in Norbeck Wildlife Preserve (NWP) (USDA 2013a).

The remaining vegetative cover types are non-forested. There are 4,400 acres of shrublands (dominated by greater than 40% crown canopy of shrubs and less than 10% tree crown cover) (USDA 2005, 2013a) in which mountain mahogany (*Cercocarpus montanus*) makes up over 95% of the mapped upland shrub cover type (USDA 2013a).

There are 105,805 acres of grasslands as prairie and interior types with less than 10% tree crown cover and include species such as blue grama (*Bouteloua gracillis*), buffalograss (*Buchloe dactyloides*), oatgrass (*Danthonia spp.*) green needlegrass (*Stipa viridula*), wheatgrass (*Pascophyrum smithii, Elytrigia spp.*) and non-native graminoids such as smooth brome (*Bromus inermis*), Kentucky bluegrass (*Poa pratensis*) and Timothy (*Phleum pretense*) (USDA 2005, 2013a).

In 2005, BHNF reported 77,606 acres of riparian areas and wetlands (montane and low-elevation) which includes 3,470 miles of perennial and intermittent streams on BHNF (USDA 2005). In 2007, BHNF reported 6,542 acres of "meadow" because it changed the classification of "meadow" to include cover types more representative of wet meadows with hydric sedges (*Carex spp.*) and rushes (*Juncus spp*.) (USDA 2013a). The remaining percentage of BHNF lands includes barren rocky areas, water bodies (>100 acres), and administrative structures.

<u>Elk and Forest Planning</u>

Elk were evaluated in the Forest Planning process because of public demand and interest in the species, and were labeled as a *demand species* along with five other game animals and fish (USDA 2005). Elk have a different set of considerations within the Norbeck Wildlife Preserve (NWP), as discussed in the following section. BHNF can implement site-specific considerations for elk if abundance, availability and condition of elk habitat have been proposed by the public (including SDGFP) and identified by BHNF as important and substantial land management issues, but BHNF is not required to do so. One avenue which establishes a process for SDGFP

and BHNF to communicate and exchange information is the 1985 Memorandum of Understanding (MOU) between all FS Units in South Dakota and SDGFP. Both agencies acknowledge that while significant populations of fish and wildlife are on lands under FS jurisdiction, these species are also of importance to South Dakota. It is in the mutual benefit of BHNF and SDGFP to cooperate and exchange information to ensure wildlife, fisheries and their habitats on BHNF are managed in the best interest of the public and ecology (USDA SDGFP 1985).

Norbeck Wildlife Preserve

A separate and very unique portion of BHNF has its own set of management guidelines and direct working relationship with SDGFP; that is the 35,000 acre Norbeck Wildlife Preserve (MA 5.4A). Within the NWP, elk are classified as a *focus species*, which includes selected game animals and birds that breed in or spend a significant portion of their life requirements within NWP (Griebel et al. 2007). While the NWP currently has a small population of elk, it is disproportionately important for elk and sportsmen for several reasons:

- Effects of proposed management in the NWP *must* consider impacts to elk and other focus species (USDA SDGFP 2009, USDA 2010a). Elk are afforded site-specific considerations in management over and above general BHNF planning.
- Recently, SDGFP and BHNF cooperated in a long-term habitat management project on 26,727 acres to improve or maintain certain habitat features for focus species, including elk (USDA SDGFP 2009, Brundige 2010, Deisch 2010, USDA 2010a, 2010b). The level of detail in vegetation treatments and partnership is precedent setting and could be a template for treatments for elk outside the NWP boundary.
- The NWP shares a 20 miles southern boundary with northern CSP and elk commonly cross between the two land units (Brundige 2010). Habitat projects adjacent to this boundary are done in a cooperative fashion between SDGFP and BHNF.
- NWP provides a fairly remote and quiet experience for humans, including hunters, looking for solitude and a “walk-in” area free from distractions likely found elsewhere on BHNF.
- The last active livestock allotment within NWP was recently phased out by BHNF. The FS’s decision was based on several administrative challenges and impacts to some of the focus species (USDA 2010d).

Big Game Winter Range

Land and resource management emphasis on BHNF is categorized by geographic areas, known as management areas (MA). Each MA has a concentrated emphasis on land management prescriptions for certain multiple uses. BHNF employs six general MA categories which range from little human use to extensive use. The category which focuses on intensively managed landscapes includes MA’s that elk likely use. To date, there are no designated elk calving grounds or traditional migratory routes identified within the BHNF. However, big game winter range (MA 5.4) has always been identified as a focus in BHNF planning efforts since the first BHNF Plan in the 1980s. This category weights management guidelines of BHNF towards high

quality winter and transitional habitats for big game (mule deer, white-tailed deer, elk, bighorn sheep and turkey).

Big game winter identified by BHNF range encompasses 396,516 acres or 31.8% of the BHNF with an emphasis on a vegetative mosaic (USDA 2006). The topography is typically lower elevations where snow depths do not impede big game travel and may include spring fawning/calving areas. Elk may use these and adjacent areas year-round. An objective within big game winter range is to increase understory forage production within pine stands which are 9"DBH or less (SS 3A, 3B and 3C – see Table 21) while providing for a variety of SS across the landscape. A BHNF Plan standard (mandatory course of action and deviation requires a Plan amendment) requires BHNF to design livestock management strategies to be compatible with big game winter range objectives. A guideline suggests that increases in forage favor wildlife, while also providing for livestock. Another objective beneficial to elk is an open-road density of 1 mi/mi^2 or less from December 15 through May 15 which is likely achieved by seasonal road closures and reduction of new road construction. Over-the-snow vehicles (OSV) are restricted to designated routes. One desired outcome of diverse, high-quality winter range on BHNF is to reduce the time spent by big game, including elk, on adjacent private lands (USDA 2006).

The current BHNF boundary between big game winter range (MA 5.4) and non-big game winter range (MA 5.1) was developed during the first BHNF Plan in the early 1980s. Landscape changes brought about by the Jasper fire in 2000 and an increasing elk herd resulted in an expanding elk range. In 2003, a new assessment of elk seasonal ranges was made by SDGFP and Rocky Mountain Elk Foundation (RMEF) which identified winter range reaching further north of the BHNF designated boundary (RMEF 2003). This new information did not change the winter range boundary designated by the BHNF Plan. However, the BHNF Plan continues to mitigate human disturbances to wintering big game by closing some roads and trails from December 15 through May 15 within the expanded range. The current designation of big game winter range should be reviewed for revision during the next BHNF plan revision.

Silviculture Practices

Ponderosa pine is extremely successful in regenerating. Vigorous, healthy seed is produced almost every year with abundant crops every two to five years (Boldt and Van Deusen 1974) throughout most geographic areas within the Black Hills. Shepperd and Battaglia (2002) attributed the prolific growth and establishment of pine to the growing season precipitation and climatic influences. It is a challenge for all land owners within the Black Hills to keep up with pine regeneration in order to maintain or create less dense understory and "dog-hair" stands. Because of pine's prosperous growth, BHNF is a very active, intensively managed public forest and is the most viable timber producing forest within its FS region that extends into Colorado.

Black Hills National Forest has identified and classified 865,890 acres in South Dakota and Wyoming that are "*suitable*" and available for timber production (USDA 1997). Federal planning regulations (36 CFR 219.14) require lands suited or not suited for timber production to

be identified as part of the forest planning process (Appendix G, USDA 2006). Black Hills National Forest has an objective to manage 1,037,100 acres, or 84% of the suitable timber base in certain percentages of pine SS for a diverse pine ecosystem (Table 21).

Pine regeneration is monitored and pine stands that are stocked with a minimum of 150 pines/acre are certified as regenerated. Regeneration is a requirement (2408 Standard, USDA 2006) and most silvicultural treatments employed on BHNF are used as a means to accomplish regeneration. Treatments to eliminate a pine stand are rare and are analyzed as "type conversions" which changes vegetation from a forest to early successional stage such as grass/forb. Pine is also completely removed when it has invaded areas it did not naturally occur in and would not have occurred due to recurring fire; those habitats include hardwood stands and meadows.

Accepted silviculture practices treat, or create, the following pine stands: even-aged, two-aged or uneven-aged systems. Prescriptions generally include shelterwood, clear-cut, seed tree, group selection and individual tree selection (USDA 2006). The very common shelterwood system removes a portion of the mature overstory but leaves a very low basal area (BA) of residual mature trees to reseed the area. This system creates and perpetuates an even-aged overstory and mid-or understory of pine which are essentially rotated as growing stock. Once the mature overstory pine is removed, the mid-story sapling pine flourishes to become the next generation of mature pine (Smith 1962, Alexander 1987). The quantity and quality of understory forage (non-pine) that is available for wild and domestic ungulates is dependent upon the stage of growth and density of the pine stand, and past mechanical or fire treatments.

The types of silvicultural treatments that most benefit elk depend upon what aspect of habitat is needed within an elk's home range compared to existing conditions. A mosaic of pine SSs across a landscape benefit elk and their habitat requirements. Generally, the greatest forage production per acre for ungulates is within SS1 and SS2 followed by SS3A and SS4A (see Table 21) depending upon soil type, aspect and other physical and biological factors. Many vegetation treatments which enhance elk habitat, benefit a myriad of other species including livestock. Elk prefer diverse habitats with healthy native vegetation and riparian areas.

Vegetation treatments include:

- In some situations, it is the non-commercial treatments of small-diameter pine that most affect elk habitat. Small-diameter pine can act as weather breaks, shade and screening cover but conversely, can also shade out and out-compete understory forage.
- Small openings, or patch clear-cuts (PCC) are created in the pine forest to generate forage and edge contrast. PCCs are recommended for elk because they create pockets (typically < 20 acres) of forage near escape cover.
- Non-typical pine treatments such as retention of groups of similar-aged pine and removal of other adjacent trees, rather than a plantation-like appearance of a pine stand, can create a desirable mix of forage and screening cover for elk. The intermittent overstory canopy provides shade and intercepts snow.

- Retention of very large-diameter pine with overlapping canopies intercepts snow and provides summer shade.
- Variable density thinning (VDT) provides stand diversity by varying the density of pine by slope and aspect. This pine treatment allows for heavier timber on north and east-facing slopes while lowering timber basal areas on south and west-facing slopes. South and west slopes can generally have poor pine growing potential with the trade-off of providing more understory production when pine is heavily thinned (Pase and Hurd 1957). Elk benefit from enhanced forage in the winter on sun-exposed sites and seek north-facing slopes for shade in the summer. VDT creates a more natural configuration of pine across a watershed after years of fire suppression. Varying the spatial arrangement of pine SSs, allows for pine regeneration while restoring hillsides to a less manufactured appearance.
- Heavier pine densities can be retained next to roads and trails to create screening cover for elk and other wildlife. Opening the forest canopy farther from the road provides forage and solitude.
- Prescribed fire reduces ground and overstory fuels, and enhances native grasses, forbs and shrubs.
- Selective cuts remove pine from hardwoods, meadows and riparian areas. The most important aspect of hardwood treatment is to ensure that regenerating shoots are protected from wild and domestic ungulates by hinging, slash retention and/or fencing. Hinging can be used in riparian areas to discourage livestock trampling and heavy browsing by deer.

Forage Availability and Allocation

Black Hills National Forest defines its rangelands as lands capable of producing forage for grazing and browsing animals which may consist of upland meadows, riparian sites, open-canopy forests, or closed-canopy forests which have understory vegetation. Range resource managers seek to manage the vegetation of BHNF for the benefit of all users of the forage and habitat (USDA 1996a).

Forage production was calculated for the BHNF 1983 Plan and allocation of forage among wild and domestic ungulates apparently was determined on a site by site basis, such as a particular allotment (USDA 1981). However, the 1997 Revised Forest Plan (USDA 1996a) allocated forage to livestock, deer and elk across the entire BHNF, not just by certain areas (USDA 1997). There are 135 grazing allotments (USDA 2013a) on BHNF with approximately 262 permittees (USDA 2004b) in both South Dakota and Wyoming. Allocation (Plan Objective #301) across BHNF in Wyoming and South Dakota has remained the same for the Phase II Forest Plan used today (USDA 2006) with the following caveats:

- Wildlife spend 85% of their foraging time on BHNF and 15% off BHNF.
- 50% of the forage produced is available for use by livestock and wildlife (USDA 1996b; Plan Guideline #2505, USDA 2006).
- Livestock generally graze BHNF five months from June 1 – October 31.
- Estimation of wildlife forage needs is calculated on a 100% (year-round basis)

- Livestock are considered cattle with age classes of yearlings, bulls, dry-cows and cows with calves. There are no sheep, goat, horse or buffalo allotments on BHNF.
- Forage utilization and condition depend on variables such as weather, use patterns and different species' diet overlap for forage.
- AUM (animal unit month) is the tenure of one animal-unit for one month. For 1 livestock AUM, it is considered one mature 1,000-pound cow and her calf with the average daily forage consumption of 33-lbs. of dry matter/day. An elk AUM is 0.462 and a deer is 0.1.

In 1996, BHNF employed a forage model that based forage production on various attributes such as percent crown cover and basal area for non-crystalline soils (Pase 1958) and crystalline soils (Uresk and Severson 1989). Crystalline soils are present over the granite core of the Black Hills. Basal area is defined as a cross-sectional area of a stand of trees measured at DBH and expressed as ft^2/ac. It was estimated that 466,000,000-lb of forage/year or 466 million-lbs. (expressed herein as million for millions of pounds) were produced and applying proper use guidelines of 50% for all livestock, deer and elk, the balance remaining for consumption was 233 million-lbs. forage/year.

For both South Dakota and Wyoming on BHNF, all ungulates had 233 million-lbs. of forage/year available and the allocation breakdown was livestock 127 million-lbs. (54.5%), and wildlife 106 million-lbs. (45.5%).

Non-FS Lands

Lands adjacent to BHNF and within the Fire Protection Boundary are also available to those wildlife which use both BHNF and non-FS lands within their respective home ranges. The BHNF 1997 Revised Forest Plan made the assumption that wildlife spend 15% of their time on lands outside the BHNF boundary (USDA 1996b).

BHNF Range Monitoring

To address the ecological and social needs to provide forage for all ungulates on BHNF, wild and domestic, BHNF, along with a task force of range and wildlife experts, elected to set proper herbivore use guideline, or percent forage utilization by weight (Table 22). Use at 50% generally is thought to leave the rangeland in satisfactory condition. Unsatisfactory condition implies that herbivory did not occur at expected levels. Use was not established in the first 1983 Forest Plan but was made as an amendment to the Plan in 1988 (USDA 1988) and the maximum levels remain the same today (USDA 2006).

Table 22. BHNF Forest Plan Guideline #2505 allowable forage use and residual levels. Livestock and wild herbivore allowable forage use or residual levels on rangelands by grazing system and range condition (Percent Utilization by Weight Each Year).

Season Of Use	Satisfactory Condition	Unsatisfactory Condition
Continuous Use	0-45%	0-40%
Continuous Use	55-60%	0-55%
Deferred Rotation	0-50%	0-45%
Rest Rotation	0-55%	0-50%

Note: Use levels for riparian areas are different (USDA 2006).

BHNF monitors utilization during the growing season and employs various methods (USDA 1996b). There are four Ranger Districts on BHNF. Some allotments occur on the South Dakota and Wyoming border and therefore, may include lands in both states. Each Ranger District on BHNF monitors range condition and annual pasture/allotment utilization as staffing, funding, and District priorities allow. Monitoring is reported in BHNF annual reports. The degree of monitoring and the associated reporting varies among Districts from year to year. Therefore, monitoring results cannot be directly compared from year to year or among Districts. Methodology is generally used according to the Interagency Technical Guides and the USFS Region 2 Rangeland Analysis and Management Training Guide (USDA 1996b).

There are two major types of monitoring, short-term and long-term. Short-term, or implementation, monitoring is used to determine how the BHNF Plan directives are being met. Per each term grazing permit, the permittee is responsible for proper utilization of the forage by their livestock, and the USFS monitors livestock use to ensure the permittee is in compliance with the permit. Short-term range monitoring techniques vary depending on the resources being monitored. Key areas of livestock use are the main sites monitored. Examples of short-term monitoring include, but are not limited to:

- Range readiness used in the spring determines soils and vegetation conditions. BHNF reports that "rangelands are generally ready for grazing when soils have become firm after winter and spring precipitation, and when plants have reached the defined stage of growth, at which time grazing may begin under the specific management plan without long-lasting damage" (USDA 2013a).

- Ocular utilization estimates are a qualitative visual evaluation of utilization of riparian and upland herbaceous or woody browse by all grazing and browsing species. Ocular estimates are based on a description representing a broad range (class) of utilization rather than a precise amount (USDA 1996b, USDA 2013a).
    - Stubble height measures the residual height on streamside vegetation which a certain amount is needed to be left at the end of the grazing period or at the end of the grazing season for maintenance of plant vigor and stream bank protection and

to aid in holding sediments for rebuilding degraded stream banks (USDA 2013a). Measurements of the residual sedges (*Carex* spp.) are taken along the greenline. Specifically, 3 to 4 inches of residual *Carex* spp. are required for spring pastures and 4 to 6 inches for summer and fall pastures (USDA 1996b).

- Photographs and photo-points are easily repeated to document visual changes on the landscape over time. Photos are used along monitoring plots and transects.
- Browse use of willows, shrubs, woody vines or young deciduous trees in any year by livestock or wildlife is monitored (Standard 2505 – USDA 2006). Browse is limited to 40% of the total individual leaders produced in that year and is not to be confused with 40% use on each and every leader.

The second type of FS monitoring is long-term, or effectiveness, monitoring. Effectiveness monitoring evaluates how successful management actions are moving the vegetation and other factors toward desired conditions as established in the Forest Plan and Allotment Management Plans (AMPs). Uplands and riparian areas are the focus of effectiveness monitoring which is primarily the responsibility of the FS but BHNF invites permittees to participate. Trends (up, down, or stable) for a variety of rangeland resource parameters may be monitored in riparian areas and uplands at benchmark areas on each allotment. Examples of long-term, effectiveness monitoring include, but are not limited to:

- Cover-frequency index (also known as Daubenmire) is a permanent transect for repeated, quantitative vegetation monitoring. Understory canopy cover and frequency (percent) by plant species, ground cover (litter, bare, rocks) are recorded (USDA 1996b). Changes in plant species or ground cover offer trend data to indicate how the vegetation is responding to environmental factors, including herbivory by wild and domestic ungulates.
- Photographs and photo-points.
- Greenline/cross section methods are used in riparian areas to describe and quantify riparian areas. Transects are perpendicular and parallel to the stream and plants are recorded at a particular intercept (USDA 1996b).
- Multiple indicator method (MIM) combines up to 10 metrics to capture both short-term and long-term changes in a variety of riparian conditions (vegetation, streambank stability, stubble height and many others). The data can be used to track changes or capture site conditions (Burton et al. 2011).

Monitoring results summarized from the latest BHNF monitoring report (USDA 2013a) indicate that in general, and regardless of methodology, of those allotments monitored, upland conditions and trends were steady or upward in moving toward desired vegetation conditions as outlined in the Forest Plan. The few downward trends were attributed to activity on a prairie dog town, noxious weeds, an increase in an undesirable fescue species, and presence of bare ground due to weeds or heavy utilization in a particular spot. Forage utilization throughout most of the allotments surveyed was within Forest Plan standards (2505 – Proper Allowable Use Guidelines, USDA 2006) and allotment management objectives. The 2013 monitoring report (USDA 2013a) indicated that “measured forage utilization exceeded proper allowable use guidelines on a small amount of areas within certain pastures and some allotments.

Adjustments were made and corrective actions are being taken as needed. Areas where utilization exceeded guidelines will continue to be monitored to see if management changes are needed." Browse use was not specifically reported in the 2013 report.

PRIVATE LANDS

Private Land Forage Availability

The 1997 Revised BHNF Forest Plan (USDA 2005) estimates forage availability on USFS lands and also on non-Forest System lands (primarily private). Approximately 584,300,000 pounds of forage are estimated to be produced on mostly private lands found within the exterior perimeter of the BHNF property boundary. Many of these lands are hayed and grazed by livestock, but the Forest Plan estimates 186,980,000 pounds of forage are theoretically available for wildlife use even after these activities. Although these forage estimates are substantial, and SDGFP acknowledges private land contributions to wildlife management and actively manages to abate depredation on private lands, private land forage estimates will not be used to evaluate the elk population objective in the Black Hills. Rather, SDGFP will rely primarily on forage availability on public lands managed by the USFS. This approach is being utilized in attempt to maximize elk use of public forage resources while concurrently minimize potential impacts experienced on private lands.

Depredation Management

Elk management in South Dakota is a complex and adaptive process that must include careful consideration of the biological, social, economic, and political impacts. Wildlife managers must make careful decisions that recognize these considerations because wildlife is a public-trust resource yet utilizes private lands throughout the year. Wildlife depredation has been a source of conflict between private landowners and governmental agencies for many years (Davis et al. 1987). In some hunting units in the Black Hills and the majority of hunting units on the prairie, private land is the only type of property where elk occur and hunting opportunity exists. Elk on private land is an important consideration because sportsmen and women greatly seek any opportunity to hunt elk. In 2014, there were over 27,000 applicants for all elk hunting seasons in South Dakota. Successful wildlife management programs must work cooperatively with farmers and ranchers to be effective (Bookhout 1996). SDGFP diligently works to maintain a balance between viable elk populations, social tolerances, and the needs of a variety of stakeholders. SDGFP understands that cooperative partnerships with private landowners are an essential component to elk management and that private lands serve an important role regarding elk management. Without this cooperative partnership, it would not be possible to meet the agency's responsibility of successfully managing South Dakota's elk population. The public also supports management of wildlife that is causing damage to personal property, especially when non-lethal techniques are employed (Reiter et al. 1999). It is because of these

important considerations that SDGFP operates such an active and comprehensive wildlife damage management program regarding elk depredation.

As the elk population increased in South Dakota in the 1990's, SDGFP worked with the South Dakota Legislature to establish a funding mechanism to provide wildlife damage abatement services. In 1998, a five-dollar surcharge was established on most types of hunting licenses. Fifty percent of these funds are allocated to SDGFP's wildlife damage management program and the other fifty percent go to hunter access programs. The establishment of this funding was the financial foundation for which SDGFP's elk depredation abatement program was initiated. From the year 2000 through 2014, SDGFP has spent nearly $2.5 million addressing elk depredation on private lands. Annual expenditures range from approximately $115,000 to $215,000 and assist between 50 to over 100 landowners (Table 23). Because these programs are funded one-hundred percent by sportsmen and women, SDGFP requires that all landowners participating in elk depredation programs sign an agreement that states, *"the Producer agrees to allow reasonable, free public hunting access to non-family members who obtain proper permission" and "the Producer agrees NOT to charge any person or entity* a *fee or payment for elk hunting access".* To achieve successful elk management it is imperative that sportsmen and women have access to private lands when revenues from hunting licenses are used to operate such programs and wildlife populations are largely managed through regulated hunting.

The demand for elk damage abatement services fluctuates annually due to weather events (i.e. drought or harsh winters) and seasonal variations, elk populations, and changes to elk habitat (i.e. impacts of fires, agricultural development, logging practices, and human encroachment). However, the most significant factors that affect social tolerance and demand for elk damage abatement services are elk population herd size, landowners' financial status, and weather patterns. Lacey et al. (1993) found that tolerance for wildlife depredation quickly diminished as landowners' economic dependency on their land increased. When the estimated elk population peaked in the Black Hills in 2004 through 2006, South Dakota was also experiencing severe drought conditions in many areas and as a result of these two factors, SDGFP experienced record numbers of requests for assistance from landowners as well as record amounts of expenditures to reduce elk damage on private property. In a survey conducted by Longmire (2014a) 26% of area landowners indicated that elk had caused damage to their property within the last year. In another survey, Longmire (2014b) reported that 45% of responding landowners who were surveyed indicated that elk damage was a problem. Requests for damage abatement services typically involve damage to growing crops (i.e. alfalfa, barley, wheat, and corn), damage to stored-feed supplies (i.e. hay or stored-grain), damage to fences, and grazing competition between livestock and elk on meadows. Frisina and Morin (1991) also stated that competition for forage between elk and cattle has generated intense conflicts in many western states. Nevertheless, 64% of landowners that received SDGFP elk depredation abatement services were satisfied with the assistance provided in 2013 (Longmire 2014a).

Table 23. Breakdown of annual expenditures (fiscal year 2000-2014) of SDGFP's elk depredation abatement program components.

Fiscal Year	Food Plots	Stackyards/Panels	Fencing	Hazing Efforts, Etc.	Total Expenditures
2000	$101,703	$7,450	$3,400	$3,547	$116,100
2001	$103,875	$24,250	$0	$8,587	$136,712
2002	$94,362	$7,400	$1,470	$60,406	$163,638
2003	$83,329	$12,000	$500	$70,418	$166,247
2004	$91,067	$12,500	$275	$97,467	$201,309
2005	$96,742	$15,300	$1,250	$93,737	$207,029
2006	$83,266	$11,115	$0	$101,333	$195,715
2007	$97,896	$14,400	$0	$90,577	$202,873
2008	$106,156	$4,600	$525	$64,525	$175,806
2009	$99,788	$12,300	$0	$82,302	$194,390
2010	$93,767	$5,000	$0	$60,098	$158,865
2011	$81,058	$4,900	$0	$55,376	$141,333
2012	$76,129	$10,000	$0	$82,107	$168,236
2013	$78,193	$20,000	$4,982	$17,403	$120,579
2014	$70,952	$15,000	$750	$46,179	$132,881

SDGFP has designed its elk damage abatement programs to address most of these types of requests for assistance. The most widely used program component to address crop damage is cost-share assistance for growing-season food-plots. In fiscal year 2014, SDGFP spent over $70,000 in cost-share assistance to cooperating landowners. Landowners that have elk-use in alfalfa fields or other crop fields are eligible for up to $3,000 of cost-share assistance to establish and manage these fields, annually. For example, elk may continually utilize an alfalfa field throughout the summer months immediately after haying activity occurs to utilize the new growth. Elk can find these fields highly attractive and dependent upon other factors (i.e. availability of other forage) may attract large concentrations of elk. In this case, the landowner would be eligible for some level of cost-share assistance based upon the number of elk that use the field and the extent of elk-use, provided that the landowner signs the agreement with SDGFP (which states no fee-hunting and they must allow reasonable hunting access). Another program component that provides long-term solutions is the permanent stackyard (i.e. protective fencing) and protective panel program. In these programs, landowners are reimbursed for materials to construct a permanent stackyard or purchase protective panels, up to a maximum of $2,500. Dependent upon individual needs and available funding, some landowners may be eligible for multiple contracts over several years. This program has provided permanent solutions to elk depredation to hay and other stored-feed supplies for many years, and in some areas chronic problems have been completely resolved.

Another management technique utilized in the elk damage abatement program is different forms of hazing. SDGFP routinely works with landowners to employ different hazing practices

to scare animals away from problem areas. These techniques include: pyrotechnics, propane cannons, hazing with ATV's, rubber bullets, and helicopters. SDGFP also implements depredation pool hunts where unsuccessful licensed hunters are enlisted to harvest elk in strategic locations to reduce impacts to private property. These types of hunts occur after the elk hunting season has ended and usually conclude by early-March. This management tool typically only removes a small number of animals at a specific location, but more importantly helps haze the animals away from the immediate area because of the human disturbance. During the winter of 2013-2014, SDGFP implemented one depredation pool hunt and removed five antlerless elk. The hazing effect of the hunting pressure was enough to move the elk several miles away from the problem area.

The final program available to landowners is cost-share assistance for the replacement of fence materials because of damage caused by elk crossing fences. When elk cross barbed-wire fences, they can cause substantial damage to the fence (Bauman et al. 1999). SDGFP has utilized aircraft-grade aluminum cable strung along the top of fences to reduce the damage caused by elk when crossing the fence. This technique has proven successful if the area where the cable is applied has a fence in good condition with an adequate number of wooden posts. SDGFP also provides replacement posts and wire to cooperating landowners. Since 2000, SDGFP has provided cooperating landowners with over 35 miles of cable to protect fences within the Black Hills area. Cooperating landowners are limited to $5,000 but dependent upon individual needs and available funding some landowners may be eligible for multiple contracts over several years.

Finally, while grazing competition between livestock and elk exists in South Dakota, most sportsmen/women and landowners agree that it is possible to manage effectively for both. Longmire (2014a) found that 82% of hunters and 80% of landowners agreed that it is possible to manage for both elk and livestock grazing in the Black Hills. In Montana, wildlife officials have found success by implementing certain grazing management practices that benefit both elk and cattle (Frisina and Morin 1991). Current elk depredation abatement programs do not address requests for assistance regarding grazing impacts to pastures or meadows, under most circumstances. However, SDGFP has provided hazing devices (i.e. propane cannons and pyrotechnics) and technical assistance to landowners that have concerns of elk grazing on grasslands. In a few circumstances SDGFP has also temporarily hazed elk away from these areas with ATV's and vehicles. If these conflicts occur near or during on-going hunting seasons, SDGFP will direct hunters to these areas for increased harvest and hazing pressure.

During the legislative session of 2014, SDGFP was successful at introducing legislation which increased the non-refundable application fee that sportsmen and women pay when applying for elk licenses or purchasing preference points for elk. Sixty-seven percent of hunters and 58% of landowners indicated that they were willing to pay an additional five-dollars (a total of ten-dollars) for this non-refundable application fee (Longmire 2014a). This legislation became effective on July 1, 2014 and will generate an estimated $150,000 annually. This funding has been earmarked for enhanced elk depredation abatement services for landowners in an effort

to raise the social tolerance for higher numbers of elk in the Black Hills. In 2013, 38% of landowners indicated that their tolerance would increase to some degree if SDGFP enhanced current elk depredation services while 51% of landowners indicated that their tolerance would stay about the same (Longmire 2014a). Due to this information and because elk hunting is held in very high regard with South Dakota hunters, SDGFP believes that increased funding for enhanced levels of elk depredation programs is a valuable use of these funds. While a significant portion of these new monies will be utilized to increase cost-share assistance provided to landowners that participate in the agency's food plots, stackyards, and protective fencing programs in 2015 and beyond, SDGFP is researching other innovative solutions.

Landowner Licenses and Preference System

Since elk populations and elk habitats in South Dakota's agricultural dominated landscapes are limited, and elk hunting opportunities in South Dakota are highly desired (Figure 4), only residents of South Dakota are eligible to apply for elk licenses. The majority of elk hunting opportunity exists in the Black Hills elk management units, which comprises < 4% of the state. Approximately 41.6% of the Black Hills Fire Protection District in South Dakota is owned by private landowners, therefore landowner tolerance for higher populations of elk limits elk population objectives. Limited elk populations in prairie management units reside predominantly on private lands and conflicts with agricultural production are common. South Dakota Game, Fish, and Parks and the Commission acknowledge the important role landowners serve in providing habitat requirements for wildlife, including elk. As a result of this recognition, preference is offered for those qualified landowners interested in the opportunity to hunt elk.

The following are requirements as established in South Dakota Administrative Rule (ARSD) for resident only elk landowner/operator preference licenses for Black Hills, Black Hills Archery, and Prairie Elk hunting seasons (landowner/operator preference is not available for CSP elk hunting licenses):

- Qualifying landowner-operation applicants may apply for this preference every year.
- Fifty percent of the licenses are available to persons who qualify for landowner-operator preference.
- A minimum of 240 acres of land within an elk unit which has had at least 500 days of elk use since the last day of the previous application period is required to qualify. An elk use day is any day an elk feeds or waters on private land.
- For purposes of elk preference eligibility, members of the qualifying landowner-operator's family including grandparents, parents, spouse, children, children's spouse, or grandchildren who live on the ranch or in the closest community and have an active role in the ranch operation also qualify.
- Only one qualifying applicant per ranch unit per year may apply for a landowner-operator preference elk license in each elk hunting season. A ranch unit is described as all private property owned and leased for agricultural purposes by written agreement by

an individual qualifying landowner or a qualifying corporation, limited liability company, partnership or trust in the state. Only one shareholder, member, partner or trust beneficiary of a qualifying corporation, limited liability company, partnership or trust may apply under landowner-operator preference for each elk hunting season. A ranch unit may not be subdivided for the purpose of qualifying for more than one landowner-operator preference in a specific elk season.

- A landowner or tenant, but not both, may claim landowner preference for the same qualifying property. Employment on a farm or ranch alone does not qualify an individual for landowner preference.
- Restrictions on landowner preference for legal entities. Shareholders of a corporation, members of a limited liability company holding a membership interest in the company, partners in a partnership, and beneficiaries of a trust entitled to the current income and assets held in trust; all organized and in good standing under the laws of the State of South Dakota are eligible for landowner preference if:

  (1) The entity holds title to no less than the minimum number of acres of private land located within the hunting unit applied for as established in rule;
  (2) The shareholder, member, partner, or trust beneficiary applying for landowner preference is a resident; and
  (3) The shareholder, member, partner, or trust beneficiary is responsible for making the day-to-day management decisions for agricultural purposes on the farm or ranch.
- The landowner preference elk license is not restricted to the land owned or operated, but can be used anywhere within the respective elk management unit.

Unlike the application restriction for the Black Hills firearm, archery, and the prairie elk hunting seasons, where a person who received an elk hunting license in one of these seasons as a first choice in the first lottery drawing in any of the nine preceding years may not apply for a license, one qualifying applicant per ranch unit per year may apply for a landowner-operator preference elk license every year, even if they held a landowner preference elk license the previous year.

Qualified applicants using landowner preference for available elk licenses varies greatly from season type and unit. From 2009-2014 in the Black Hills firearm season, an average of 11.3% of all “any elk” licenses were issued to applicants with landowner preference, with a range of 9.1% in 2009 to 13.2% in 2013 for all units combined. In 2014, “any elk” licenses issued to applicants with landowner preference by unit ranged from 7.1% in Unit 1 to 50% in Unit 3.

From 2009-2014 in the Black Hills archery season, an average of 5.4% of all “any elk” licenses were issued to applicants with landowner preference, with a range of 1.4% in 2010 to 8.4% in 2014 for all units combined. In 2014, “any elk” licenses issued to applicants with landowner preference by unit ranged from 0% in Unit 5 to 20% in Unit 3.

From 2009-2014 for the prairie elk season, an average of 22.2% of all “any elk” licenses were issued to applicants with landowner preference, with a range of 14% in 2010 to 32.3% in 2014

for all units combined. In 2014, “any elk” licenses issued to applicants with landowner preference by unit ranged from 0% in Unit 30A to 50% in Units 15A and 27A.

Since all of the land within the prairie elk units and much of the southern portion of Unit 3 within the Black Hills is private land, there is an obvious demand by landowners and operators within these respective units for landowner preference elk licenses. In all elk seasons and their respective units, there is minimal interest for using landowner/operator preference for antlerless elk licenses. See Figures 12-14 for number of applicants by season type using landowner/operator preference.

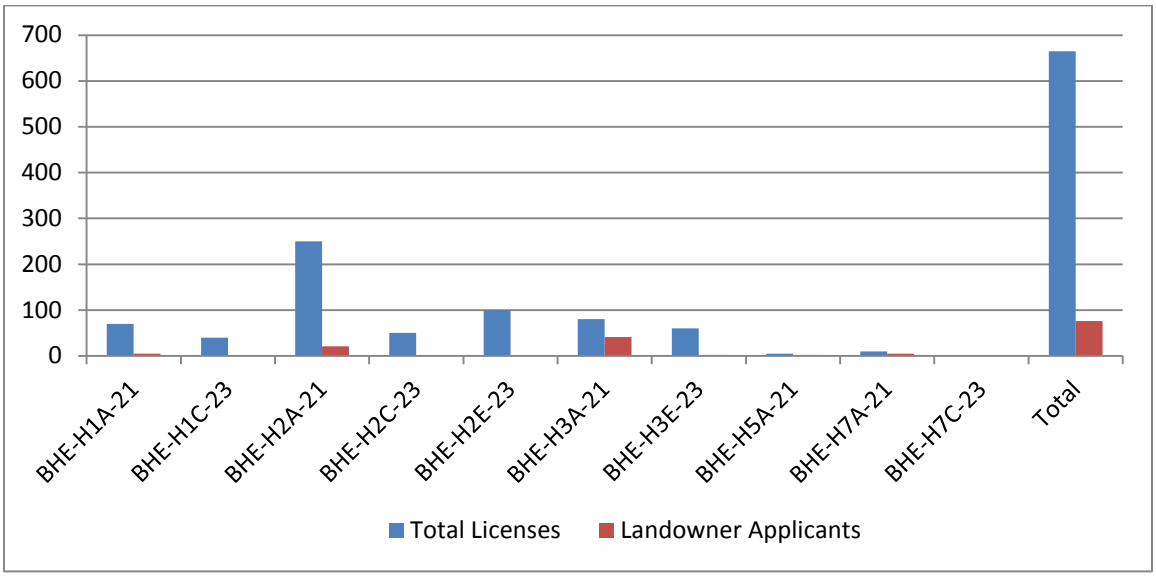

Figure 12. 2014 Black Hills Rifle elk licenses and landowner applicants by management unit.

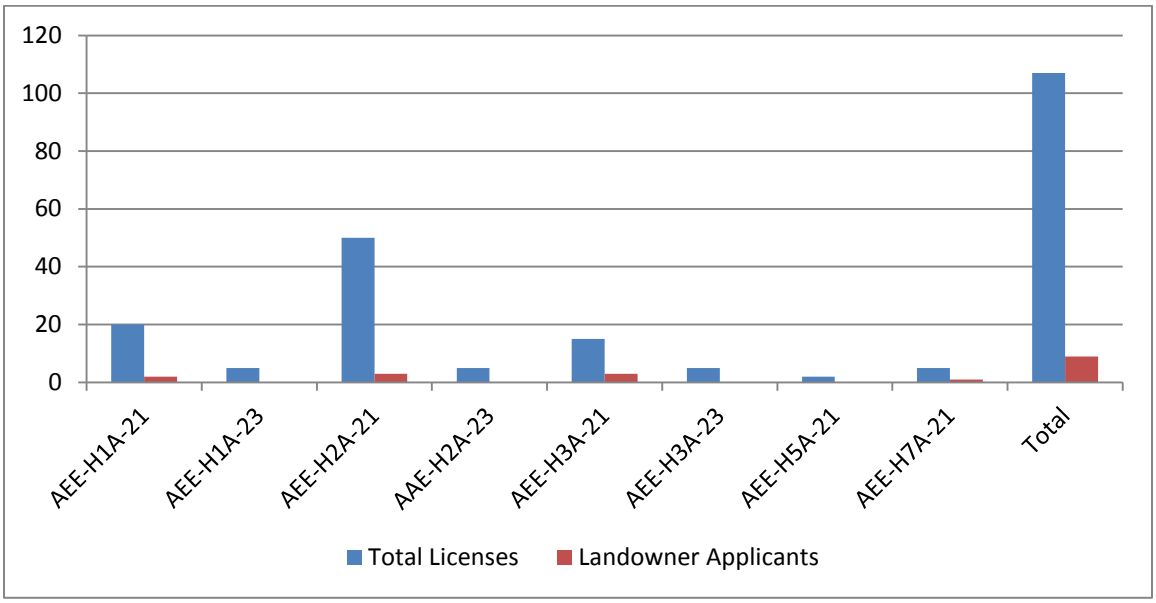

Figure 13. 2014 Black Hills Archery elk licenses and landowner applicants by management unit.

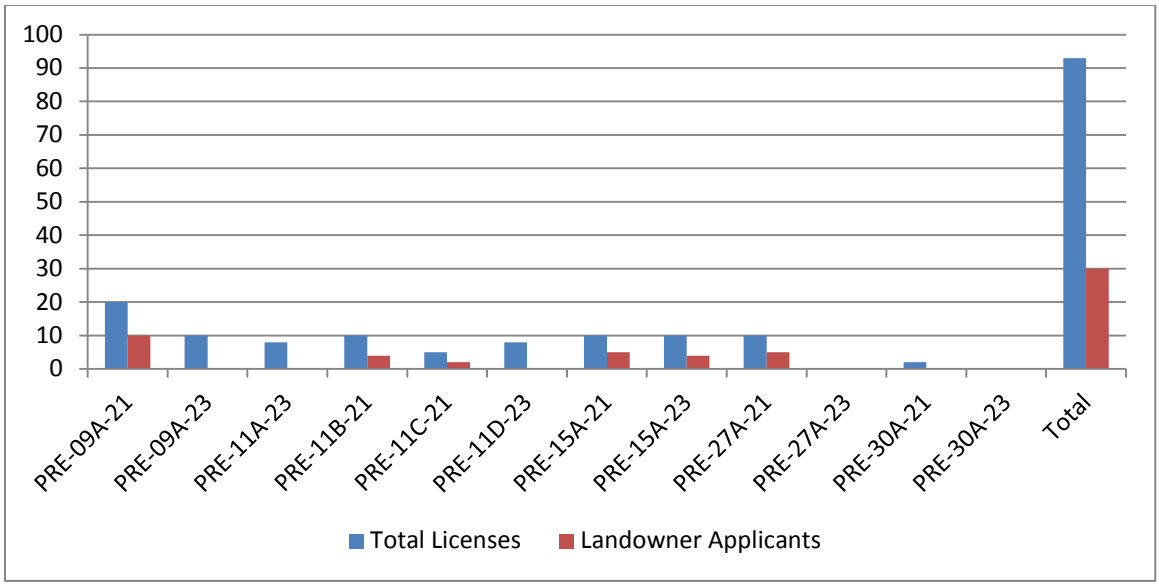

Figure 14. 2014 Black Hills Prairie elk licenses and landowner applicants by management unit.

Wildlife Partners Program

South Dakota Game, Fish, and Parks recognizes landowners as a most essential partner in ensuring agency responsibilities for managing South Dakota's fish and wildlife trust resources are met. Wildlife management not only involves biological and science-based habitat management practices, but also includes careful consideration of the wide array of social values held by both the general public and South Dakota landowners.

Since the 1970's, SDGFP has offered an evolving toolbox of voluntary wildlife habitat incentive programs to landowners though the Wildlife Partners Program (WPP). One objective of SDGFP's WPP is to provide cost-share incentives to cooperating landowners who establish wildlife habitat on their lands, thereby helping to sustain and enhance local wildlife populations. These habitat incentives are designed to (1) meet the biological needs of a variety of resident and migratory wildlife species, (2) complement conservation program opportunities offered through the federal Farm Bill, and (3) meet the needs and desires of private landowners seeking to restore, protect, and enhance wildlife habitat on their lands.

Social tolerances of wildlife populations also play an integral role in successful wildlife management. Wildlife populations can at times exceed management objectives or impact agricultural operations. Offering habitat-based management programs that address both wildlife needs and social tolerances on private lands are important in meeting our wildlife trust management responsibilities.

The following habitat practices are currently available to landowners in the Black Hills with an interest in providing habitat for elk and other resident wildlife species:

Wildlife Habitat Fencing

This practice involves using fences to protect and enhance existing wildlife habitat, and better manage livestock grazing to benefit grassland dependent wildlife, with a special emphasis placed on riparian areas. Riparian areas provide important habitat for many wildlife species, and are arguably the most important yet most under-managed habitat in the state. Healthy riparian areas provide water and shelter for both livestock and wildlife, while also improving water quality and aquatic habitats by filtering runoff and capturing sediment.

Grassland Habitat Enhancements

This practice involves reestablishing and managing grassland vegetation on previously farmed areas as year-round habitat for wildlife. Plantings involve either a dense nesting cover mixture of alfalfa, sweet clover and western, intermediate, or tall wheatgrass; or a mixture of native warm and cool season grasses and native forbs. Grassland habitat restoration activities on previously cropped land has also become a widely utilized practice by cooperators who are reseeding marginal cropland areas back to grass as part of managed grazing systems.

Woody Habitat Establishments

This practice involves planting woody cover plots to benefit resident small and big game species. Since their inception over 30 years ago, woody cover plots have been one of the most popular and long-lived habitat program offered by SDGFP. For a number of years participation in SDGFP's woody cover planting program had waned as landowners utilized more lucrative and flexible opportunities for woody cover planting available through the Conservation Reserve Program (CRP). Recently, however, diminished opportunities available through CRP and a

renewed desire by landowners in providing higher quality winter cover for wildlife on their property has given rise to increased participation in this program

Food Habitat Plots

This practice involves planting and maintaining annual food habitat plots to benefit resident big game and small game species. Since their inception in 1988, food habitat plots have been the most popular habitat program offered by SDGFP. With Conservation Reserve Program fields providing abundant nesting and fawning cover, the need for strategically located food plots to boost small game and big game winter survival and provide much desired hunting opportunities propelled this activity's success.

Wildlife habitat management practices utilized through WPP aid migratory and resident wildlife populations by (1) helping meet their annual life cycle needs, (2) providing additional natural resource benefits by complementing other conservation program opportunities offered through the federal Farm Bill, (3) helping maintain social tolerance towards wildlife populations, and (4) providing financial and technical assistance to cooperating landowners seeking to improve wildlife habitat on their lands.

Improved wildlife habitat and healthy wildlife populations resulting from this project also provide opportunities for countless hours of consumptive and non-consumptive wildlife related recreational activities to many South Dakotans and visitors to the state. Landowners cooperating with SDGFP through these programs also agree to open their lands to reasonable use by the public. Unfortunately, a highly reliable information source is not currently available to accurately quantify the public use opportunities and benefits provided by this project.

Conservation Easements

A conservation easement is a deed restriction placed on a piece of property to protect its natural resource values, such as traditional agricultural land-use, wildlife habitat, or open space. Easements are either sold or donated by the landowner to a qualifying conservation organization or government agency, and constitutes a legally binding agreement that prohibits certain development (e.g. commercial or residential) from occurring on the property. An easement does not grant ownership nor does it absolve the property owner from traditional owner responsibilities, such as property tax.

A conservation easement permits the holder certain rights regarding use of the land, while the ownership of the land remains with the private property owner. However, the easement holder is also held responsible for monitoring and enforcing upon the current and future property owners the restrictions and condition imposed by the easement.

While conservation easements may restrict or permit certain public uses of the land, they generally do not require public access. The decision to allow public access is left to the individual property owner.

Using conservation easement, several organizations have protected wildlife habitat, natural areas, and open spaces on several thousand acres of private land in the Black Hills; a complete inventory of these areas and total acres protected is unavailable. Owing principally to costs associated with such a program, SDGFP currently does not have a program to acquire or hold conservation easements, nor are there any plans to implement an easement program for elk management.

CITIZEN INVOLVEMENT AND OUTREACH

Effective decision-making by wildlife agencies necessitates the need to consider public perceptions and opinions, along with potential responses to management policies. Along with hunter harvest and biological data collected, public involvement is an important component in developing and implementing an elk management plan in South Dakota. Public participation helps ensure decisions are made in consideration of public needs and preferences. It can help resolve conflicts, build trust, and inform the public about elk management in South Dakota. Successful public participation is a continuous process, consisting of a series of activities and actions to inform the public and stakeholders, as well as obtain input regarding decisions which affect them. Public involvement strategies provide more value when they are open, relevant, timely, and appropriate to the intended goal of the process. It is important to provide a balanced approach with representation of all stakeholders. A combination of informal and formal techniques reaches a broader segment of the public; therefore, when possible, combining different techniques is preferred to using a single public involvement approach. No single citizen or group of citizens is able to represent the views of all citizens. Multiple avenues for public involvement and outreach, therefore, are used in the development of the Elk Management Plan including open houses, commission meetings, social media, written public comment, and other avenues. These approaches are designed to involve the public at various stages of plan development and to ensure opportunities for participation are accessible to all citizens.

Public Opinion Surveys

In addition to hunter harvest surveys, SDGFP conducts opinion surveys to identify and understand the interest and needs of the public. Scientific standards are used to ensure reliability, validity, representativeness, and generalizability of results when designing and administering public opinion surveys. Successful surveys are conducted in a way which reduces error to the extent practical. The four primary types of error in survey research are sample error, coverage error, measurement error, and non-response error. SDGFP surveys are administered to random samples of the target population using a modified Dillman Tailored Design Method and, when possible, a mixed mode approach using both internet and mail surveys. A target overall response rate of 50 percent is used. When response rates below 50 percent are obtained consideration should be given to administering a non-response survey to

determine the presence of and effect of non-response error. Appropriate sample sizes should be determined using a ±5 percent sampling error at a 95% confidence interval.

SDGFP conducted elk hunter opinion surveys in 2000, 2001, and 2005. The 2000 survey pertained only to Gregory County elk hunters from 1996 to 1999 and was designed to evaluate hunter access to elk hunting on private land (Gigliotti 2000). Results from this study showed that most hunters were satisfied with their ability to gain access to private land, and this access is critical for hunters' overall satisfaction with elk hunting in Gregory County. Nearly three-quarters of hunters were satisfied with their ability to gain access to private land for their elk hunting. On average, hunters contacted nine landowners and were refused permission by an average of three landowners. The overall average refusal rate from 1996 to 1999 (average number of landowners that refused permission/average number of landowners hunters asked permission for access) was 33 percent (Gigliotti 2000).

The 2001 survey was administered to all licensed rifle elk hunters in South Dakota, and was designed to collect information regarding hunters' opinions regarding specific elk management options (Gigliotti 2002). These options included attitudes toward changes in the use of preference points in the license draw, attitudes toward a separate antlerless elk season, and attitudes toward a "once-in-a-lifetime" rifle any-elk license. Nearly three-quarters of rifle elk hunters favored the preference point system increasing the odds for individuals with 10 or more preference points and decreasing the odds of those with less than 10 preference points. In addition, nearly three-quarters of rifle elk hunters favored being able to use their elk preference point for any unit in the season. The majority of rifle elk hunters (80%) favored a separate antlerless elk season, however, three-quarters of hunters were opposed to the idea of an "once-in-a-lifetime" Black Hills rifle any-elk license (Gigliotti 2002).

Research into the social tolerance of wildlife indicates both objective and subjective factors influence perceptions of wildlife populations. Therefore, understanding how stakeholder groups perceive elk in South Dakota is an important step in developing and implementing an elk management plan responsive to public values. In 2005 a survey was administered to a sample of elk hunters designed, in part, to evaluate the Black Hills elk season from the hunters' perspectives (Gigliotti 2006). The amount of satisfied elk hunters in 2005 was 13 percent lower than those in 2001. On average, elk hunters in 2005 reported seeing approximately 5 fewer elk compared to elk hunters in 2001. Elk hunters' average rating [rating of the number of elk seen was measured on a scale ranging from 1 (very few) to 9 (lots of elk)] of the number of elk seen (3.9) in 2005 was significantly lower than the 2001 rating of 5.1 (Gigliotti 2006).

As part of developing this elk management plan and as a first step in identifying the interests and needs of area landowners and South Dakota elk hunters, SDGFP conducted a comprehensive opinion survey in the fall of 2013 (Longmire 2014a). Topics covered include: elk on private lands, elk hunting experiences, general wildlife attitudes, attitudes specific to elk, elk population preferences, and season structure. The frame for this study consisted of elk license applicants from 2010 through 2013 and landowners within the nine counties in South Dakota

with elk management units. Surveys were sent to a sample of 2,000 elk hunters and 2,134 landowners who owned property within the counties encompassed within an elk management unit; 64 percent of hunters and 61 percent of landowners responded to the survey. The majority of elk hunters (81%) and 50 percent of landowners believe there are too few elk in South Dakota. Over the next five years, 93% of elk hunters and 62% of landowners would prefer to see the elk population in South Dakota increase. On average, both hunters and landowners agreed with statements regarding perceived benefits of elk in South Dakota; hunters slightly disagree with statements regarding perceived costs and risks, and landowners tended to be more favorable toward livestock grazing. Significant differences were found among landowners in both their rating of current elk population and preferences for future elk population numbers based on acreage owned, experience with elk depredation, perception of the number of elk on their property, and owning their property primarily for farming and ranching purposes (Longmire 2014a).

Further evaluation of landowner opinions in the 2013 survey (Longmire 2014a) were completed by separating landowners into 2 categories – 1) landowners who legally fit the definition of a landowner by South Dakota Administrative Rule 41:06:01:15 (must own or operate $\geq$ 240 acres) for the purposes of qualifying for elk license landowner preference, and 2) landowners with < 240 acres. Approximately 44% of landowners with $\geq$ 240 acres felt that there were too few elk and 17% felt there were too many elk, whereas about 62% of landowners with < 240 acres felt there were too few elk and only 7% felt there were too many (Figure 15). When asked about preference for future elk populations, approximately 55% of landowners with $\geq$ 240 acres wanted to see the elk population increase to some extent, whereas 75% of landowners with < 240 acres wanted the elk population to increase (Figure 15).

Elk Stakeholder Group

A stakeholder for this purpose is defined as a person, group, or organization with an interest in the management of elk and elk habitat. Because elk and elk hunting are greatly prized by many South Dakota residents, SDGFP felt it was important to have a diverse representation of stakeholders to provide input for future management of elk in South Dakota. The formation and input from this stakeholder group, however, did not inhibit SDGFP from obtaining and incorporating additional input or opinions on elk management in South Dakota.

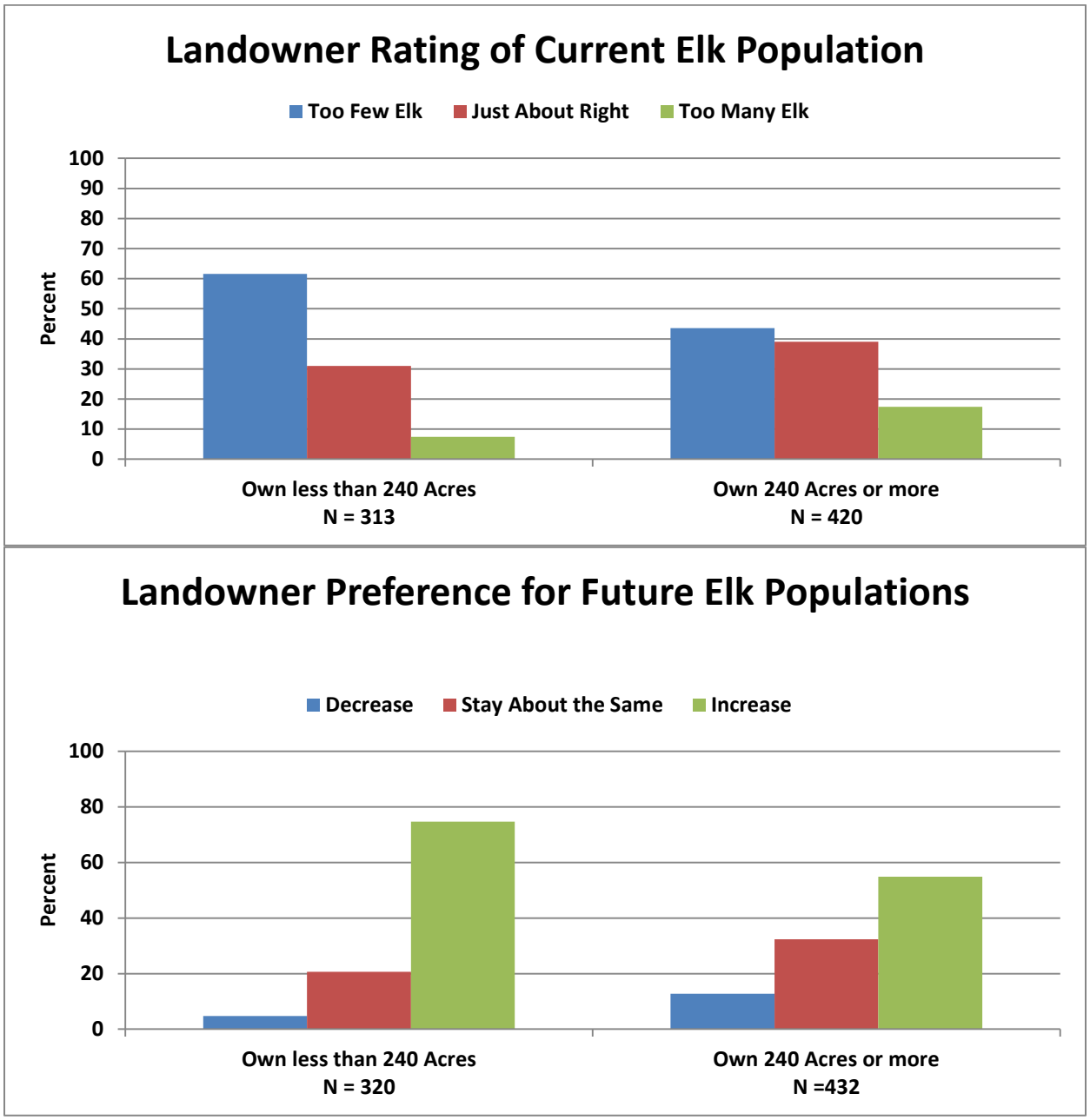

Figure 15. Landowner opinion regarding elk population size within the Black Hills of South Dakota.

The South Dakota Elk Stakeholder Group included representation from the following: general public, elk hunters, private landowners, public grazing lessees, conservation organizations, and public land managers. Those who served on the South Dakota Elk Stakeholder Group during this planning process can be found on page 2. An Elk Stakeholder Group Charter (Appendix 13)

was shared with all stakeholders and described the purpose, objectives, authority, roles and responsibilities of this group.

The South Dakota Elk Stakeholder Group held four meetings in 2014 (February 10, July 14, September 3, and December 2) at the Outdoor Campus West in Rapid City. Information and supportive data were provided by SDGFP, WICA, and USFS BHNF staff to ensure all members were knowledgeable about the topics and issues discussed and deliberated by the group. Key topics and issues discussed by the stakeholder group included the following: results of the elk public opinion survey, elk population monitoring and status, BHNF Land and Resource Management Plan, history of elk license allocation, SDGFP elk depredation program, depredation pool hunts, landowner elk preference licenses, cooperative habitat projects, archery and firearm license allocations, and review of draft elk management plan.

Individual views and opinions varied amongst the broad representation of this stakeholder group. While many topics were discussed at great length, a great deal of time was devoted to the Black Hills elk population goal. It should be noted that there were contrasting opinions at differing levels between those who wanted to maximize hunter opportunities and those who had concerns over elk and cattle forage competition and elk damage to private property. As a result, careful considerations of these opinions were included in identifying the management objectives and strategies necessary to successfully manage this elk population within biological and social carrying capacities.

Public Meetings

The term *public meeting* is used as an umbrella term for all types of meetings including but not limited to public hearings, open houses, or workshops. SDGFP uses a variety of public meeting formats designed to be accessible by all members of the public and to provide meaningful opportunities for public involvement. Two formal involvement opportunities are the Regional Advisory Panels and through the SDGFP Commission. As part of the rule setting process the SDGFP Commission formally holds a public hearing at each meeting where it takes public testimony regarding pending matters under the board's purview, including but not limited to elk management. In addition to the public hearing process, the Commission also reviews department management plan drafts, related public comments, and formally approves final plans. The SDGFP Division of Wildlife also has four Regional Advisory Panels, which meet to share information and receive feedback from wildlife stakeholders. Panels typically consist of around 8 members. Members to the panels are appointed, with selection designed to be representative of the stakeholders in their respective regions.

In addition to these formal involvement opportunities, SDGFP provides informal opportunities for public participation. In an effort to ensure accessibility to all interested individuals, multiple regional open houses are held each year in different locations and at various times to provide for maximum participation. These open houses are advertised to the public through a variety of outlets, and are designed to both inform the public about specific topics (i.e., elk

populations, season dates, tag numbers, etc.) and to gather input and feedback from the public. Elk planning meetings and working groups are also used to inform and collect input from targeted stakeholders and groups regarding elk populations and season recommendations. Each given situation is different and each approach to a specific challenge will be unique, therefore public involvement strategies will use a variety of techniques to encourage all citizens to actively participate.

Social Media

The 2014 Elk Management Plan is located on the South Dakota Game, Fish and Parks website where other wildlife management plans are stored: http://gfp.sd.gov/wildlife/management/plans/default.aspx. Information on elk hunting in South Dakota along with season dates and other surveys and reports, can be found here: http://gfp.sd.gov/hunting/big-game/elk/default.aspx.

Feedback on the plan was solicited through several different platforms by way of public opinion surveys, stakeholder workgroups as well as through public meetings, open house events and the standard commission meeting process. Plan updates and other information were provided through digital platforms by using Facebook, Twitter and targeted email messaging. A week prior to the comment period deadline, a targeted email was sent to a distribution group of approximately 47,000 email recipients who opted to receive information on SDGFP Commission agenda topics and public comment periods. Scheduled Facebook and Twitter posts were also made after the release date of the plan as reminders to let followers know that this information is available online. However, when users made comments via social networking, they were directed to provide those comments in writing to wildinfo@state.sd.us or mail them to 523 E. Capitol Ave., Pierre, S.D. 57501 and include a full name and city of residence in order for them to be a part of the official public record.

Media was also informed of the plan through the standard press release distribution process. Press releases were sent via email to a group of over 5,000 recipients (media and customers alike) who have opted in to receive all SDGFP News (or press releases). Press release information was also shared internally with over 550 SDGFP employees and was posted to all SDGFP digital platforms mentioned above as well as online at: http://gfp.sd.gov/news/default.aspx and http://news.sd.gov/.

Non-Governmental Organizations

Several non-governmental organizations have missions that cooperatively work to benefit elk and elk habitat in South Dakota. The Rocky Mountain Elk Foundation (RMEF) has conducted over 215 projects in South Dakota since 1990 that included land acquisitions, easements, habitat enhancement, public education and research. Nearly 62,000 acres have been affected, either protected or enhanced, by the South Dakota Chapter of the RMEF. Over 300 volunteers in the state have conducted fund raising banquets, coordinated the Black Hill Special Elk Tag

raffle (formerly known as the CSP Elk Tag) and other events. Nearly $1,080,000 of RMEF funding has gone to enhancing elk habitat, management, research, and outreach activities.

The Nature Conservancy (TNC) also has completed and continues to complete projects that benefit elk. The 4,383 acre TNC Whitney Preserve is located southwest of Hot Springs, South Dakota, and is managed for various plant and wildlife species. Management on the property includes cattle grazing allotments. Elk hunting is allowed on the preserve during the month of October. A maximum of 4 hunters share the time by splitting it into an early half and late half season structure, and hunters are allowed to harvest cow elk only. Small groups of elk utilize this property typically in the fall.

CHALLENGES AND OPPORTUNITIES

Habitat

Habitat is defined as the place where an organism makes a living with the essentials of food, water, shelter (cover) and space. The arrangement, abundance and connectivity of these elements across the landscape, and proximity to each other, primarily dictates where organisms, elk for example, distribute themselves. In order to manage elk, it is necessary to apply what we do know, and continue to study and observe elk to comprehend the interplay between elk and their habitat. An understanding of elk habitat requirements and other outside influences, such as climate and weather, humans and human activities, interactions with other wildlife and domestic livestock, is needed to interpret or predict various scenarios in elk range.

Components of elk habitat include, but are not limited to: meadows for nutritious forage, tall residual grasses and forbs for calf cover, dense timber for horizontal screening cover, high canopy cover on ridges and north-facing slopes for summer thermal cover, windy ridge tops to escape swarming insects, vertical cover in dead trees, riparian areas for water and forage, closure of certain roads due to habitat degradation or to reduce open road densities where elk may be more vulnerable to human disturbances, and remote areas for solitude. These habitat components vary by season, climactic conditions, human land uses, fragmented ecosystems, road density, predators, elk gender and herd structure.

Quantity and quality of elk habitat in the Black Hills affects elk herd distribution, abundance, and productivity. A healthy, productive, and sustainable elk herd requires quality habitat throughout the year. Any loss or degradation of existing elk habitat in the Black Hills will certainly result in a reduction in elk numbers.

Unfortunately elk habitat in the Black Hills is continuing to be impacted and fragmented by a variety of causes, including human development and expansion. The BHNF recognizes the importance of acquiring property within its boundary to prevent further habitat fragmentation or “loss of open space”, one of the four threats to the National Forest System

(http://www.fs.fed.us/projects/four-threats. Accessed 12 Feb 2015). Additionally, human disturbance impacts to elk habitat are particularly true on the densely-roaded BHNF. Off-highway vehicle (OHV) use has recently been restricted to designated areas instead of forest-wide; however, enforcement is insufficient and violations are largely unnoticed. While curbing or mitigating this habitat loss is a significant challenge, it is essential for maintaining a sustainable elk population. Assessment of roads and trails in sensitive wildlife areas remains a challenge and with each site-specific project, there is an opportunity to work with BHNF to determine if travel management is compatible with elk for that particular area.

Habitat quantity and quality is often gauged by the seasonal availability of forage in areas elk occupy. To meet nutritional requirements elk select from a variety of plant species - grasses, forbs, and browse from trees and shrubs are all utilized. Forage condition and availability in the Black Hills are principally the result of forest and range management activities - including livestock grazing - under the control of the BHNF and private landowners. Except for its small Game Production Area holdings, SDGFP has no direct management authority over elk habitat in the Black Hills.

Forest management practices such as logging, timber thinning, and prescribed burning can either help maintain, enhance, or degrade elk habitat, depending whether elk habitat was a considered project objective. If elk habitat was an objective during project design, forest management practices can greatly improve forage quality and quantity. Silviculture and vegetation treatments that move a large percentage of even-aged forest to a more diverse pine ecosystem are opportunities to enhance and create habitats for a variety of wildlife, including elk. Recently a significant emphasis has been placed on cutting and thinning pine trees on both public and private lands to reduce the wildfire threats and address mountain pine beetle (MPB, *Dendroctonus ponderosae)* infestations, resulting in what will likely be a general long-term improvement to elk habitat.

Grazing management on public and private land in the Black Hills, like forest management, can either benefit or degrade elk habitat. Most rangeland in the Black Hills is subjected to annual livestock grazing, with the timing, intensity, and duration greatly affecting forage quality and quantity available to elk. And like forest management objectives, grazing practices that give consideration to the habitat needs of elk can be beneficial by rejuvenating decedent forage. However, grazing practices that give little or no consideration to elk habitat conditions can result in removal of much needed forage, and a general degradation of habitat quality and quantity. Other rangeland management activities used to benefit grazing practices, such as water developments and fencing, can also indirectly impact elk habitat quality and quantity by affecting the intensity, distribution and duration of grazing.

Finally, prescribed burning can also affect elk habitat, depending on its timing, intensity, size, weather, and the habitat being treated. If elk habitat was an objective during a prescribed fire project design, it can greatly improve forage quality and quantity. Prescribed burns, both in forest or rangeland habitats, will remove overgrown, decadent vegetation, and create openings

that in general improve elk forage. However, on a short-term basis, fire can also negatively impact important winter browse habitat or have negative impacts on calving and spring foraging habitat.

Mountain Pine Beetles

Mountain pine beetles are small (1/4") native beetles which burrow below bark of host pine species, including ponderosa pine, for part of their lifecycle. An adult MPB lays eggs beneath the bark and hatched larvae feed on the tree until they emerge as flying adults the following July – September. The burrowing and feeding activity on a single tree, if compounded by hundreds or thousands of colonizing beetles, can cause injury to or kill the pine. Not all attacked trees die. However, MPB are the most prominent insect capable of killing pines (USDA 2013a).

The Black Hills is a disturbance-based ecosystem (Parrish et al. 1996). Dynamic forces historically played an important role in shaping Black Hills plant communities through fire, insects, drought, disease and wind-throw. MPB were important in setting back pine structural stages by creating holes or pockets of dead trees from a few trees to several acres. These holes in the forest canopy allowed sunlight to reach the forest floor where early successional plants captured the site (Figure 16) until pine once again recovered the area. This constant but fluctuating rhythm of MPB outbreaks across the forest, along with other natural disturbances, allowed for diverse habitats.

Figure 16. Increased understory due to Mountain Pine Beetle-killed pine stand. Photo credit: Bob Berwyn

Since 1996, the vast habitat occupancy and shear populations of MPB have completely changed entire watersheds across 416,000 acres on BHNF (USDA 2013a), in addition to smaller pockets of dead trees. As pine stands die and remain as standing dead trees, understory will recapture the site resulting in increased forage production for many wildlife species. Within 5-10 years post-mortality, the majority of MPB killed pine will be snapped below 25' and will fall to the ground (Schmid et al. 2009), similar to the pattern after a wildfire.

Each pine stand has a unique set of variables pre-MPB mortality that sets the stage for post-MPB-mortality responses by plant communities. Variability ranges from the pine structural stages (Table 21), individual tree vigor (Larsson et al. 1983), percent stand mortality, other plant assemblages, the physical and biological environment and if there has been mechanical thinning or burning to reduce post-mortality fuel loads within that stand. In some areas, the response of shade-intolerant quaking aspen has been tremendous. But, there is no set pattern on how landscapes will respond, from understory to overstory, as the MPB infestation continues.

Recently the MPB infestation has slowed, BHNF and CSP are attempting to keep ahead of the massive pine die-off by cutting and removing, or cutting and chunking, green-hit pine (pine recently attacked and dead, but needles are green and the timber is merchantable). As funding and markets allow, abatement is fast-tracked before each new MPB flight from June – September and emerging adult MPB find new habitat. In some limited treatments, MPB hit pine has the bark removed or logs are rolled to kill larvae. Treatments also include thinning pine that has not been beetle-hit to reduce pine densities.

If MPB populations are high, most adjacent pine stands with more than 60 ft^2/ac BA are susceptible to infestation (USDA 2013a). Data on MPB infestations from 2009 through 2011 resulted in tree mortality on approximately 55,612 acres, or approximately 12 percent of BHNF pine acreage. Tree mortality rate per stand is generally 25-75%.

Elk occupy these MPB infested areas and in a recent study in the southeastern Black Hills elk selected for stands which had MPB disturbance at 24 of 45 sites (53%) over a 3-year period (SDGFP, unpublished data). However, on a large scale, it is unknown how elk will specifically respond in movements and behavior to changes in forest and forage structure as pine die, needles are cast, snags break and fall. Since the heavy pine MPB-mortality, more acres are dominated by early successional vegetation of grasses, forbs and shrubs/seedlings (SS1 and SS2), which directly benefits elk. Sapling and pole-sized pine with low to moderate canopy cover (SS3A and 3B) has increased, likely due to MPB-mortality of older, bigger trees (SS4) and a conversion of identifying stands from mature to immature. Low to moderate canopy cover, depending upon the spatial arrangement on the landscape and proximity to roads, will still provide elk screening cover, shade and wind breaks but will also allow understory production. Heavy overstory canopy within immature pine (3C) will likely inhibit abundant understory production of forage.

As expected, MBP has significantly lowered the abundance and distribution of mature pine in all overstory categories from low to high (SS4A-C). With the loss of larger, mature pine due to MPB, competition for moisture, sunlight and nutrients will be reduced for all vegetation. It is reasonable to assume that there will be increases in grasses and forbs (SS1) and shrubs and pine seedlings (SS2) in some areas. There will likely be continued decreases in the larger trees (>6" DBH) within sapling-pole (SS3) and mature ponderosa (SS4) as the MPB infestation continues. Presumably in some areas noxious weeds or other invasive species will increase and compete with understory native vegetation. Anecdotal observations indicate that where hardwoods and deciduous shrubs occur, the increased sunlight and moisture has allowed these early successional woody plants to flourish in some areas.

Fire

Elk have been described as a fire-dependent species because of their association with fire-dependent and fire-adapted plant communities, and because elk populations often decrease when fire frequency in these plant communities decreases (Patton and Gordon 1995). Bendell (1974) described elk as a "fire follower" due to the species' positive response to fire-caused changes in food. Fire suppression in the Black Hills has contributed to a degradation of elk and deer habitats in the Black Hills (Thilenius 1972) and is highly responsible for altered plant communities, especially an increase in distribution and density of ponderosa pine, significant decrease in lush understories and loss of shrubs and hardwoods; all components that provide for a healthy diverse ecosystem for many wildlife species, including elk. However, records indicate approximately 131,000 acres of BHNF lands within South Dakota have burned since 1996 (USDA 2014d). Understory diversity and biomass are inversely related to pine canopy cover (Uresk and Severson 1989). This pre-fire vegetation relationship can, in part, influence the severity and intensity of fires. Fire impacts to soils can influence vegetation recovery. The south-central Black Hills was historically subjected to an average fire interval of 16 years, up through early 1900's when Europeans began to settle the area (Brown and Sieg 1996). The southern Black Hills had more frequent fires with a 10-12 year return interval (Brown and Sieg 1999). Similar practices in other western states also experienced radical changes in pushing fire-prone ecosystems towards dense conifer cover (Slovkin et al. 2002). In the past 15 years, several wildfires within the Black Hills have demonstrated quite severe and intense fire behavior due to high fuel loads, dense pine crown closure and loss of natural fire breaks such as forest openings and expansive hardwood stands.

In late August, early September, 2000, the Jasper fire in the southern and central Black Hills burned a total of 83,510 acres (USDA 2001). The Jasper fire impacted 39,959 acres of big game winter range (MA 5.4) in the southern portion of the fire boundary and 38,546 acres of an adjacent MA 5.1 in the north half of Jasper. MA 5.1 is designated for other resource purposes such as timber and forage. Jasper was approximately 25% larger than any other recorded fire and the effective burn area within big game winter range was expanded south in 2001 when an additional 11,896 acres burned in the Rogers Shack fire (USDA 2002). Within 2 years, 12.3% of big game winter range was converted to early successional vegetation due to near 100% pine

mortality in large expanses across the landscape. Small pockets of mature pine survived (Figure 17).

Figure 17. Five years post-Jasper Fire. Small pockets of pine survived.

Fourteen years post-fire, the bulk of winter range that burned remains in SS's 1 and 2: grass, forbs and hardwood shrubs with some small diameter sapling pine. This change to a preponderance of early successional vegetation favored big game forage and created new cover-type in the form of tall shrubs unevenly distributed across the burned area. The big trade-offs, in terms of elk habitat effectiveness, were that the heavily roaded Jasper Fire area lost most screening cover along roads and dead trees along roadsides were removed as hazards and instead of a 100-ft or less sight distance, views were open for miles (USDA 2004a). Elk displacement easily occurs in this predominantly open country. A study in CSP found that in relationship to the 1988 Galena Fire, elk displacement by human activities was greatest in areas where cover availability was lowest, including overstory-killed habitat (Millspaugh et al. 2000a). The application of this hunter and elk space-use sharing may apply to the Jasper Fire area except that the road density is much higher on BHNF than in CSP. Elk have little opportunity to seek areas of low human disturbance (Rumble et al. 2005). Until all burned trees completely topple, standing dead trees do provide some visual barriers between elk and humans. Elk have been frequently observed leaving open meadows for burned pine (Figure 18).

Figure 18. Elk use dead, standing pine as visual obstruction.

With the high road densities and loss of road-side screening cover, elk may be more vulnerable to human disturbances and hunter harvest. As the burned pine began to break off, the downed logs provide natural barriers to the temptation to drive off-road. The post-fire abundant and quality forage is readily available for elk and likely contributes to an increasing elk population. There has been a decision by BHNF to re-burn a portion of big game winter range to reduce the amount of dead trees on the ground which could function as heavy fuels in another wildfire (USDA 2012). Returning fire to the landscape can keep some areas in high forage productivity if fire frequency does not impact established shrubs and hardwoods, and invasive weeds and undesirable non-native vegetation are suppressed.

Elk Thermal Cover

Thermal cover is defined as "cover used by animals to ameliorate the effect of weather and optimally, it is provided by a stand of coniferous trees, 30-60 acres in size, at least 40 feet tall, with a canopy cover of at least 70%." (Lyon and Christensen 1992, USDA 2005). This could equate to SS 3C, 4C and 5 (Table 21). Thermal cover is a BHNF Plan objective specific only to the Norbeck Wildlife Preserve (USDA 2006) and was originally adopted in the 1980's as an elk habitat requirement for cold weather. Research has been conducted in portions of the Black Hills where elk used thermal cover during extreme winter weather (Millspaugh 1995) and for diurnal bedding sites during warm summer temperatures (Millspaugh et al. 1998).

Cook et al. (2005) compared big game studies which tested the hypothesis that the sheltering effect of thermal cover is of sufficient magnitude to enhance the well-being and productivity of big game. The study found that the hypothesis lacked veracity and there was no significant, positive effect of thermal cover on herd productivity. "Weather-moderating effects of thermal cover are probably insufficient to be of much biological value" (Cook et al. 2005). Thermal cover can also be in the form of other animals, topography and a combination of weather events (Lyon and Christensen 1992).

Cook et al. (2005) contends that it is intuitive to observe that dense forests can moderate harsh weather, but there is no definitive magnitude of thermal cover effects. In fact, it was found that in dense forests, thermal cover was detrimental to elk energetics and could not substitute for lack of nutritious forage. Instead, managers should spend more time and effort considering forage value in relation to thermal cover. The approach of managing for an abundance and quality of available forage should be implemented.

Vulnerability and Visual Obstructions

Vulnerability is a measure of elk susceptibility to being harvested during the hunting season (Lyon and Christensen 1992). Vulnerability is a term that was developed specific to an area of Montana that experienced "elk populations and hunter numbers at 30-year highs" resulting in a decline in bull/cow ratios due to substantial harvest on bull elk, liberal license allocations and high road densities (Hillis et al. 1991). To date, "vulnerability" has not been found to be an issue in the Black Hills regarding viable elk populations and bull/cow ratios. SDGFP limits elk hunting licenses to residents only by lottery and sets harvest quotas to ensure bulls are not over-harvested.

Visual obstructions aid basic animal instincts to perceive risk and allow the animal to minimize or eliminate imminent harm. A rugged landscape also contributes visual obstructions in many forms of terrain and objects which break up or camouflage the outline of the animal (Brundige 2010, Deisch 2010). Visual obstructions benefit a multitude of species, not just elk.

A popular term in elk literature to describe one form of visual obstruction is "security blocks", areas where large acreages of dense trees are retained (Hillis et al. 1991). Rather than a set prescription of forest management, Hillis et al. (1991) state "interpretation of the guidelines is needed to ensure that the result makes biological sense for local conditions and not to meet some generalized guidelines, but to provide functional habitat". Another term is "security cover", which may be an important component of elk habitat in high disturbance areas and during seasonal disturbances (e.g., hunting) (Millspaugh et al. 2000a). Security cover can be provided by the boles of trees, smaller tree foliage and crowns, understory vegetation, and non-vegetative features such as There are no BHNF Forest Plan requirements for "security cover" "security blocks" or "hiding cover" as described by Hillis et al. (1991) and Christensen et al. (1993). BHNF Plan has suggestions for "screening cover" specifically along roads where the vegetation affords it. In summary, prescriptive vegetation treatments can create or retain visual obstructions between wildlife and humans, especially along roads and trails where elk perceive risk.

Additional Forage Since the 1997 Forest Plan

Mountain Pine Beetles

The MPB epidemic has affected > 416,000 acres since 1996 in the Black Hills of South Dakota and northeastern Wyoming (Figure 19, USDA 2013b). The overall impacts the MPB infestation will have on elk remains unknown. However, as trees die, canopy cover will be reduced

resulting in the reallocation of resources (e.g., water, nutrients, sunlight), promoting growth of other vegetation (Ritchie 2008). Grasses, forbs and shrubs may flourish (some of which may be invasive) in this early stage of forest succession, providing a benefit to elk in many areas through increased forage availability.

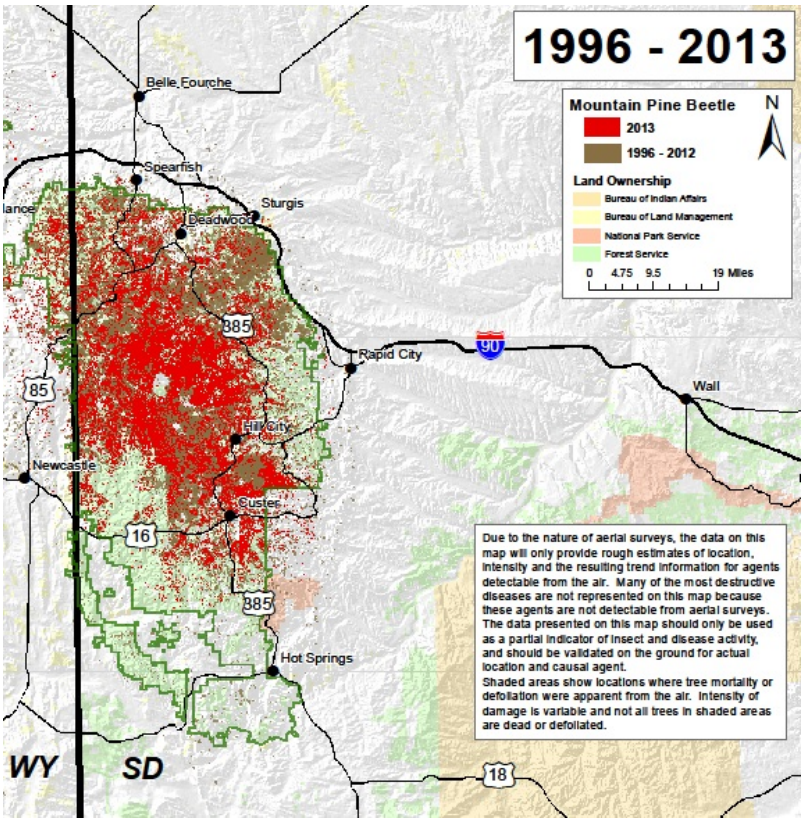

Figure 19. Mountain pine beetle activity on the Black Hills National Forest 1996-2013 (http://www.fs.usda.gov/detail/r2/forest-grasslandhealth/?cid=stelprdb5447305).

The amount of additional forage (i.e., grasses, forbs and shrubs) the MPB infestation will generate is dependent upon the overall reduction in basal area and remains unknown; however, a reduction of basal area in some proportion will inevitably occur. In an effort to remain conservative while calculating additional forage, a 12.5% reduction in overall basal area was applied to the approximate 358,000 MPB infected acres within South Dakota (86% of the 416,000 acres). According to the BHNF 1997 Revised Plan, 466 million pounds of forage are produced across 1,253,120 acres of BHNF lands. This equates to an overall average of approximately 372 lbs./acre ($\frac{466,000,000}{1,253,120} = \sim 372$ lbs./acre). Inserting the 372 lbs./acre into the non-crystalline ($y = 10^{(3.226 - 0.00936x)}$) and crystalline ($y = 0.8922 \times e^{(7.84338 - 0.02353x)}$) forage calculations for y and solving for x, the average basal area for the non-crystalline soils equation is 70 ft^2/acre and 77 ft^2/acre for the crystalline soil equation (USDA 1997). Assuming a 12.5% reduction in basal area to the 358,000 acres affected by MPB within South Dakota, results in a

new basal area estimate of 61.25 ft^2/acre for non-crystalline soils and 67.375 ft^2/acre for crystalline soils. Inserting those basal area estimates in for x and solving for y, results into a new forage estimate of approximately 458 lbs./acre. Thus, the amount of additional forage available from a 12.5% reduction of basal area on 358,000 acres affected by MPB is approximately 31 million lbs., of which 50% (15.5 million lbs.) are available for utilization (e.g., (358,000 x 458 lbs./acre = ~164 million lbs.) - (358,000 x 372 = ~133 million lbs.) = 31 million lbs.)).

Jasper Fire

Fire creates vegetative diversity and enhances elk habitat. In late August, 2000, the Jasper fire in the southern and central Black Hills burned a total of 83,510 acres (USDA 2001; Figure 20), resulting in additional forage, ultimately increasing the carrying capacity of habitats for elk within the Black Hills. The Jasper fire was approximately 25% larger than any other recorded fire during the last century within the Black Hills; providing optimal winter range habitat for elk at a large scale. Since the BHNF 1997 Revised Forest Plan was drafted, approximately 131,000 acres of NFS lands have burned within South Dakota (USDA 2014d). However, BHNF forage calculations assume fires continually are occurring through time at a much smaller scale compared to the Jasper fire. Because the Jasper fire was a large scale event and occurred after the BHNF 1997 Revised Forest Plan, additional forage was not taken into account. Revised forage availability and allocation was not a revision topic for the BHNF 2006 Phase II Forest Plan Amendment. Additional forage calculations were recently derived by SDGFP and in an effort to remain conservative while calculating additional forage, a 50% reduction in overall basal area was applied to the approximate 83,510 burned acres.

Figure 20. Area of the Black Hills affected by the Jasper Fire.

To reiterate, according the BHNF 1997 Revised Forest Plan, 466 million pounds of forage are produced across 1,253,120 acres of BHNF lands. This equates to an overall average of approximately 372 lbs./acre ($\frac{466,000,000}{1,253,120} = \sim 372$ lbs./acre). Inserting the 372 lbs./acre into the non-crystalline ($y = 10^{(3.226 - 0.00936x)}$) and crystalline ($y = 0.8922 \times e^{(7.84338 - 0.02353x)}$) forage calculations for y and solving for x, the average basal area for the non-crystalline soils equation was 70 ft^2/acre and 77 ft^2/acre for the crystalline soil equation (USDA 1997). Assuming a 50% reduction in basal area to the 83,510 acres burned, results in a new basal area estimate of 35 ft^2/acre for non-crystalline soils and 38.5 ft^2/acre for crystalline soils. Inserting those basal area estimates in for x and solving for y, results into a new forage estimate of approximately 855 lbs./acre. Thus, the amount of additional forage available from a 50% reduction of basal area on 83,510 acres burned is approximately 40 million lbs., of which 50% (20 million lbs.) are available for utilization (e.g., (83,510 x 855 lbs./acre = ~71 million lbs.) - (83,510 x 372 = ~31 million lbs.) = 40 million lbs.)).

<u>Non BHNF Public Lands</u>

Other non BHNF public lands not included in the 1997 Revised Forest Plan forage calculations include lands owned and managed by the Bureau of Land Management (BLM) and SDGFP. Within the Black Hills Fire Protection District approximately 12,498 acres are owned and managed by BLM. To remain conservative while estimating additional forage, 372 lbs./acre

(average lbs./acre in 1997 Revised Forest Plan) was multiplied to the 12,498 acres, resulting in approximately 4.6 million lbs. of additional forage; of which, 2.3 million pounds are available for utilization. The same calculations were applied to the 20,940 acres owned and managed by SDGFP; resulting an additional 7.8 million lbs. of forage; of which, 3.9 million lbs. are available for utilization.

Summary

According to the BHNF 1997 Revised Forest Plan, approximately 233 million lbs. of forage are available for livestock and wildlife utilization; of which, 54.5% (127 million lbs.) are allocated towards livestock and 45.5% (106 million lbs.) are allocated towards wildlife. Because 86% of BHNF lands are within South Dakota, approximately 200.4 million lbs. of forage (86% of 233 million lbs.) are available within South Dakota; thus, leaving 91.2 million lbs. (45.5% of 200.4 million lbs.) of forage available on BHNF lands for wildlife utilization within South Dakota. Approximately 121.6 million lbs. of forage are needed to support 70,000 deer and 7,000 elk within the Black Hills Fire Protection District. However, because approximately 41.6% of the lands owned within the Black Hills Fire Protection are privately owned, it must be acknowledged that wildlife do occupy and forage on private lands. As a result, the 1997 Revised Forest Plan acknowledges wildlife occupy and consume forage on BHNF lands 85% of the time, while the remaining 15% of the time wildlife occupy and consume forage on privately owned lands. This consideration reduces the amount of BHNF land forage needed to support 70,000 deer and 7,000 elk (121.6 million lbs.) by 15%, which equates to 103.4 million lbs. of forage (Table 24).

Table 24. A breakdown of forage availability and requirements on BHNF Lands.

	MM[3]-lbs. Forage (SD Only)
Forage available on BHNF lands within South Dakota	200.4
Forage allocated towards wildlife (45.5%) on BHNF lands within South Dakota	91.2
Forage needed to support 7,000 elk and 70,000 deer	121.6
Forage needed on BHNF lands to support 7,000 elk and 70,000 deer considering 85% occupancy	103.4
Additional forage needed on BHNF lands to support 7,000 elk and 70,000 deer	(103.4 – 91.2) = 12.2
Estimated additional forage on BHNF lands and other public lands	41.7

[3] MM = million

Conservative additional forage calculations suggest approximately 41.7 million lbs. of forage are available on BHNF lands and other public lands (Table 25), resulting in 242.1 (200.4 + 41.7) million lbs. of forage available for utilization. To reiterate, 103.4 million lbs. of forage are needed to support 7,000 elk and 70,000 deer, which means 12.2 million lbs. of additional forage (29.3% of the calculated additional forage) will be utilized. To account for potential variability within the additional forage calculations, SDGFP wanted to make certain not all 242.1 million lbs. of estimated forage were allocated; thus, leaving a surplus of 29.5 million lbs. of additional forage. This surplus forage will be valuable during times of sustained drought conditions.

Table 25. Calculated additional forage.

Additional Forage Scenario	Additional Forage MM[1]-lbs. Forage (SD Only)
Mountain Pine Beetles	15.5
Jasper Burn	20
Non BHNF Public lands	6.2
Total	**41.7**

[1] MM = million

The BHNF 1997 Revised Forest Plan calculated forage needs for wildlife and livestock. The Forest Plan estimated that 70,000 deer and 4,500 elk would utilize approximately 87% of the USFS forage allocation for wildlife. The estimates for deer and elk used in the Forest plan were compiled after consultation with SDGFP and WYGF, and represented state agency goals at that time. These population estimates were not based on data from research or aerial surveys, rather they were based on limited survey data and qualitative assessments of elk densities by agency staff. During the winter of 2013 SDGFP conducted an aerial survey of all elk management units in the Black Hills and calculated elk densities based on a logistic regression sightability model. The aerial survey methodology and sightability model are based on current research findings from studies conducted by South Dakota State University. The aerial survey yielded an estimate of 5,077 (95% CI 4,807-6,116; excludes WICA and CSP) elk which is the first scientific and quantitative estimate of elk in the Black Hills of South Dakota. This estimate cannot be compared with previous population estimates or goals because 2013 was the first time the entire Black Hills in South Dakota had been surveyed. It is the goal of SDGFP to base future population estimates and objectives for elk on aerial survey data and the best scientific data available. Due to substantial changes to forest habitats caused by fires and the mountain pine beetle epidemic, forage estimates from the 1997 Forest Plan underestimate current forage availability. South Dakota Game, Fish, and Parks staff has estimated current available forage based on the 1997 Forest Plan and a conservative estimate of additional forage available due to fire and the mountain pine beetle epidemic. Staff has also incorporated additional available forage from SDGFP and BLM lands that were not included in the forest plan estimate. SDGFP will continue to estimate current available forage in this manner until a revised forage estimate is calculated by the USFS.

Depredation

South Dakota Game, Fish and Parks understands that cooperative partnerships with private landowners are an essential component to elk management and that private lands serve an important role regarding elk management in South Dakota. Longmire (2014b) reported that 45% of responding landowners who were surveyed indicated that elk damage was a problem. Effectively addressing elk depredation is a tremendous challenge for SDGFP and fluctuates annually because of weather events (e.g., drought and severe winters), increasing elk populations, and changes that occur to elk habitat (e.g., impacts of fire, agricultural development, and logging). Elk can impact private lands in many ways, and because of these impacts, SDGFP cooperatively works with many private landowners each year to resolve wildlife damage concerns. Private landowners with high intensities of wildlife damage experience a lack of tolerance for the species responsible for the damage (Conover 1998). Wildlife depredation management operates at the cross-roads of science and politics as well as economics and social tolerances. SDGFP understands that cooperative partnerships with private landowners are essential to elk management and private lands serve an important role regarding elk management in South Dakota.

As outlined in this management plan, SDGFP plans to increase the elk population within the Black Hills. Longmire (2014a) stated that 64% of landowners that received SDGFP elk depredation abatement program services were satisfied with the assistance. However, to successfully manage a larger population of elk, SDGFP will need to enhance current elk depredation abatement programs to address private landowners' concerns regarding elk depredation. While a larger elk population in the Black Hills will certainly offer more recreational opportunity, there will be increased costs to address conflicts due to elk depredation to private lands. In 2013, 38% of landowners indicated that their tolerance would increase to some degree if SDGFP would enhance their current elk depredation services while 51% of landowners indicated that their tolerance level would stay about the same (Longmire 2014a). Because social tolerance is an important element in elk management and because elk hunting is held in such high regard with South Dakota sportsmen and women, SDGFP believes that enhancing its elk depredation programs is a valuable use of additional funding. During the legislative session of 2014, SDGFP successfully introduced legislation which increased the non-refundable application fee that sportsmen and women pay when applying for elk licenses or purchasing preference points for elk. Sixty-seven percent of hunters and 58% of landowners indicated that they were willing to pay an additional five-dollars (a total of ten-dollars) for this non-refundable application fee (Longmire 2014a). This legislation became effective on July 1, 2014 and will generate an estimated $150,000 annually. This funding has been earmarked for enhanced elk depredation abatement services for private landowners in the Black Hills as well as in the prairie elk hunting units. These monies will help SDGFP provide food plots, stack yards, and protective fencing programs into the future. SDGFP will need to continually research new and innovative solutions to the challenges of efficient and effective management of elk depredation issues.

In areas where abundant elk populations already exist, SDGFP will continue to work cooperatively with landowners. In some circumstances additional efforts to reduce elk damage to private lands will not be satisfactory, regardless of SDGFP's efforts. In these instances, a smaller elk population at the local level is the only viable solution. South Dakota Game, Fish, and Parks will be continually challenged to find the balancing-point between recreational opportunity and impacts to private lands from elk. Areas where conflict exists between livestock and elk competition for grazing will also continue to occur. Due to the complexity of these matters, this issue will continue to challenge SDGFP and impacted private landowners. However, by utilizing elk hunting and the associated hunting pressure, hunters can play a vital role in reducing elk-livestock competition during certain times of the year (Heydlauff et al. 2006). South Dakota Game, Fish, and Parks will continue to cooperatively work with willing landowners to utilize hunting as the principle form of management, when possible, to address these concerns.

While many of these management strategies have proven successful over the last 20 years, elk depredation and the associated conflicts will continue to challenge SDGFP. Oftentimes these matters are complex and not only involve the management of elk but include socio-economic and political dynamics as well. South Dakota Game, Fish, and Parks acknowledges that its' programs will not be able to completely resolve all issues regarding elk depredation; however, SDGFP has a proven history of working with private landowners and is committed to cooperatively working with private landowners to implement reasonable solutions which address most concerns.

Inter-State and Tribal Coordination

Nebraska

A small elk herd resides in southeastern Gregory County, which originated from a captive herd that escaped from an enclosure in the Ft. Randall area, after having been acquired by the Yankton Sioux Tribe in the late 1980s, who initially obtained these elk from WICA. This elk herd now resides in both Gregory County and Boyd County, Nebraska.

Upon establishment of this elk herd, an elk hunting season was initiated in 1996, primarily to address elk depredation to crop fields, which was first documented in 1992. As these elk readily move between South Dakota and Nebraska, they may or may not be available for harvest during the respective state's hunting season. Therefore, a Memorandum of Agreement was created between Nebraska Game and Parks Commission (NGPC) and SDGFP beginning with the first season in 1996, which allowed licensed hunters to hunt in both states. Both SDGFP and NGPC share similar management objectives, which are to maintain a population that provides some recreational hunting opportunity, while keeping elk depredation on crop fields at a minimum. SDGFP has depredation assistance programs, but utilizing licensed hunters to manage this elk herd is the most effective method available. Low harvest rates in recent years and the majority of hunters only hunting in the state where their license was issued from, resulted in SDGFP and NGPC coming to an agreement prior to the 2013 hunting season that a

shared elk unit was now not necessary. Beginning with the 2013 hunting season, licensed hunters could only hunt in their respective state. Coordination of license allocations, harvest, and depredation complaints, continues with NGPC.

Wyoming

South Dakota shares many elk with Wyoming along the western border. Elk move to and from Wyoming across the state boundary in Butte, Lawrence, Pennington, Fall River, and Custer counties. These movements can present difficulties with managing herds because of state lines and jurisdiction issues. Currently there is no agreement with Wyoming to allow hunters from Wyoming and South Dakota to hunt across state lines. It is vitally important that both States cooperatively manage these elk herds. Considering this, SDGFP and the Wyoming Fish and Game Department (WGFD) hold a coordination meeting annually to discuss elk management as well as management of other wildlife species shared by each State. Topics discussed are elk management goals, population objectives, survey data results, research findings, season design, and depredation issues. SDGFP and WGFD also coordinate on a regular basis at the regional wildlife manager level to ensure cooperation between the States. Discussions are currently being held to coordinate helicopter aerial surveys in Wyoming and South Dakota in the winter of 2016.

Rosebud and Oglala Sioux Tribes

Elk that occur in Bennett, Mellette and Todd counties in South Dakota originated from enclosures on the Rosebud Sioux Tribe (RST) and Pine Ridge Indian Reservations. Elk were transplanted to these enclosures as early as 1970 (Appendix 1). Over time elk were released or escaped from these enclosures. Additional transplants to enhance the free-roaming elk on RST and Pine Ridge occurred through the mid-1990s. The elk herd increased rapidly in the mid-1990s with an estimated 600 to 800 elk roaming Todd, Shannon and Bennett Counties. Recently, the Oglala Sioux Parks and Recreation Authority (OSPRA) has brought elk in from private game ranches and those elk have been documented moving through Bennett County. It is thought that elk may be moving in from other areas (e.g. Nebraska) as occasionally a harvested elk has an ear tag or radio collar that was not identified as belonging to RST, OSPRA or SDGFP.

With increasing elk numbers, in the mid 1990's, depredation complaints on private land also increased. In response to damage occurring on stored feed and standing crops such as corn, soybeans and alfalfa grown in the area, a limited season was opened in Bennett County in 1995 to attempt to discourage elk from damaging private property. SDGFP coordinated with RST and OSPRA prior to initiating the season; however, RST was not in favor of the hunting season in Bennett County. Efforts are ongoing to coordinate with both tribes to keep the elk on tribal lands and off of adjacent private lands. Minimal management practices have occurred by the tribes to deal with depredation on adjacent private lands. In Todd County, growing season food plots have been planted periodically by RST in an attempt to hold elk on tribal land. RST has established seasons for elk on tribal owned lands in Todd and Mellette Counties. In 1997, an attempt was made to enter into a memorandum of understanding (MOU) with OSPRA to allow

tribal hunters to hunt on private lands with permission and SDGFP licensed hunters to hunt on tribal lands. According to SDGFP records, the MOU was never signed by the OSPRA. OSPRA currently opens their hunt on the 1st of September and runs it until the end of the year. Numbers of licenses vary, but generally it has been 24 to 50 bull licenses each year. In recent years OSPRA has requested that SDGFP close the season on elk in Bennett County. Considering the amount of depredation to private property SDGFP has decided not to close the season. Because of the considerable amount of tribal land within this elk herd's range, which encompasses portions of Todd, Bennett, Shannon and Mellette counties, prior to developing season recommendations for this unit, previous license allocations and harvest data is shared and discussed with RST and OSPRA.

Prairie Elk Management

The prairie elk season was created in 1995 primarily to address elk depredation outside of the Black Hills. The prairie elk season allows SDGFP to work with private landowners by using hunters to reduce elk numbers on private property and to pressure elk into areas where they may not cause as much damage to private property. Because the prairie season occurs almost exclusively on private land and the fact that success rates are highly variable due to private property access and elk movements, this season is separate from the other elk seasons in the Black Hills. Elk harvest success in the prairie units is highly dependent on landowner cooperation and free access to private land. One benefit to having a separate season on the prairie from the Black Hills is that it allows SDGFP to use unique season dates for each prairie unit. SDGFP puts a great amount of effort into working with the landowners on elk depredation and the hunting seasons in these prairie units. Landowners are consulted on elk numbers, season dates and license numbers for the prairie elk seasons. Currently, there are no surveys conducted on elk in the prairie units and thus no estimate of population beyond the landowner and local SDGFP staff's perspective, based on observations throughout the year. Because there is no population estimate for elk in the prairie units, it is difficult to identify a numerical population objective. Objectives are set to maintain landowner tolerance of elk and minimize private property damage while maintaining a hunter harvest opportunity. Prairie elk unit directions are reported as increase, slightly increase, maintain, slightly decrease, and decrease.

<u>Butte, Lawrence and Meade Counties - Unit 9</u>

Anecdotal observations suggest that elk crossed Interstate-90 and established a herd sometime around 2008. License sales ranged from 30-40 during the first 3 years and have recently been cut in half as the population reaches a manageable size (Table 7). Hunter success averages 33% with 44% of the harvest being antlerless elk (Table 7). Unit size has remained consistent in the area around St. Onge, SD; however, in 2013 an additional area that was formerly part of Unit 7 in the Black Hills Season was added to this Prairie Unit to continue to address a herd of elk that established across Interstate 90 near Tilford, SD (Appendix 4). Elk continue to move back and forth across I-90 causing a traffic hazard at times. Elk in this herd are causing damage to fences and stored feed. Currently SDGFP is managing this herd to decrease the total population through liberal antlerless harvest strategies.

Bennett and Mellette Counties - Unit 11

Prairie unit 11 was created in 1995 and was the first prairie unit established. Elk that occur in this unit originated from enclosures on the Rosebud Sioux Tribe (RST) and Pine Ridge Indian Reservations. Elk were transplanted to these enclosures as early as 1970 (Appendix 1). Over time elk were released or escaped from these enclosures. Additional transplants to enhance the free-roaming elk on RST and Pine Ridge occurred through the mid-1990s. The elk herd increased rapidly in the mid-1990s with an estimated 600 to 800 elk roaming Todd, Shannon and Bennett Counties. Recently, the Oglala Sioux Parks and Recreation Authority (OSPRA) has brought elk in from private game ranches and those elk have been documented moving throughout Bennett County. It is thought that elk may be moving in from other areas, (e.g. Nebraska) as occasionally a harvested elk has an ear tag or radio collar that was not identified as belonging to RST, OSPRA or SDGFP.

With the increasing elk herds came depredation impacts on private land and as a result, SDGFP managed elk seasons and harvest in Bennett County have occurred every year since 1995. Initially, seasons were in place to allow limited opportunity, particularly to the landowners in the area suffering damage. Season lengths were extended to allow harvest when the elk were present on private lands. By the late 1990s, considerably more licenses were offered with an emphasis on antlerless harvest to address the growing elk population. Season dates have varied since 1995 and currently the season is divided into several hunt periods to encourage hunters to harvest elk. Currently, elk depredation is experienced as early as mid-July and to address this issue an antlerless only season was established from July 15 – August 31. Elk herds are currently lower than they have been historically and depredation events are minimal. The time elk spend in Bennett County has also decreased. SDGFP has responded with less elk licenses and longer hunt periods.

Beginning in 2011, the southwest corner of Mellette County was included into the SDGFP Bennett County unit boundary in response to elk depredation to crop fields in that area. Elk may or may not be available to hunters in this area during the season; however, by including the southwest corner of Mellette County, SDGFP can now utilize hunters as a method of reducing crop depredation in this area. Hunter success in Mellette County has been relatively low with only about four elk being harvested since 2011.

This unit was started with 2 bull licenses and hunters had 100% success. By 2003 the tag sales increased to 72, with a total of 41 elk harvested, to address increasing elk depredation to private lands (Table 3). License sales peaked again in 2011. Hunter success rates fluctuated from >80% for the first couple years to an average of 51% over the remainder of the years. Antlerless harvest consisted of 38% of the total harvest from initiation to 2002 and increased to 47% from 2003-2013. SDGFP is currently managing elk in prairie unit 11 to maintain the population.

Butte County - Unit 15

Prairie Unit 15 was created in Butte County in 2004 to address depredation issues caused by elk moving to and from Wyoming and a growing resident herd in the area. Elk in this unit cause damage to fences, standing crops and stored feeds. The number of licenses allocated annually range from 20-30 depending on the amount of damage and size of the elk herd. Hunter success averaged 39% with an average of 52% of the harvest being antlerless elk (Table 6). Unit boundaries have remained consistent with small additions to the Northern extent (Appendix 4). SDGFP is currently managing elk in prairie unit 15 to maintain the population.

Fall River County - Unit 27

Prairie Unit 27 was the most recent addition to the prairie elk season. This unit was established in 2012 to address property damage caused by an elk herd that likely originated from elk moving south out of Black Hills Unit 3. The elk in this unit are causing damage to fences and stored feed. SDGFP is currently managing this elk herd to maintain the population. Ten type 21 licenses and 5 type 23 licenses were sold in 2012 and 2013 and 10 type 21 licenses were sold in 2014. Harvest success for "any elk" tags averaged 70% in 2012 and 29% in 2013.

Gregory County - Unit 30

As noted, the elk herd that currently resides in southeastern Gregory County is believed to have originated from a captive herd that escaped from a Yankton Sioux Tribe enclosure in the Ft. Randall area, nearly 30 years ago. Crop depredation by elk was first reported and documented in 1992, with a hunting season being established in 1996. McCrea and Lengkeek (2000) estimated this elk population at ~ 70 animals.

Gregory County is located in the south-central portion of South Dakota, encompassed by the southern river breaks and Ponca plains within the northwestern glaciated plains ecoregion. Because of the dense draws of eastern red cedar, the sightability of elk within this area is extremely difficult. No current elk population estimate is available for this population due to limited sightability, and the fact that these elk also inhabit portions of Boyd County, Nebraska.

Depredation complaints, landowner tolerance, and hunter success are the primary factors used to set population objectives for this unit. Minimal crop depredation is desired, along with high hunter success rates. There have been relatively few elk depredation complaints over the past several years within this unit, along with lower hunter success rates, which has resulted in fewer licenses being issued (Table 4). Successful hunters are required to check-in harvested elk. The current population direction for this unit is to maintain the current population.

Elk-Vehicle Collisions

Elk in South Dakota primarily occur in the Black Hills area and in particular occur on BHNF lands. The BHNF has the highest density of roads within all national forests in the United States (USDA 1997). With the high density of roads and a healthy elk population, one could assume that elk-vehicle collisions would be a concern for the public. However, Longmire (2014a) reported that

the majority of people surveyed were not concerned about striking an elk with their vehicle. Unfortunately, there is little data available regarding the number or frequency of elk-vehicle collisions. The South Dakota Department of Public Safety (DPS) tracks wildlife-vehicle collisions but does not differentiate between species of wildlife (i.e. deer, antelope, or elk). Therefore, extensive data on known locations and the number of elk-vehicle collisions that occur is not available. SDGFP field-staff does respond to several elk-vehicle collisions each year and has knowledge of several areas where elk-vehicle collisions have occurred; however, this information is not comprehensive. SDGFP and the South Dakota Department of Transportation (DOT) have identified several areas where elk-crossing signs will be placed to alert the traveling public of this potential hazard based upon knowledge of previous vehicle-strikes.

There is a strong desire for multiple agencies (e.g. DOT, SDGFP, and DPS) to have reliable information regarding elk-vehicle collisions for management and planning purposes in South Dakota. This information is the foundation for mitigation projects that could benefit both drivers and wildlife (Ford et al. 2009). The DOT, DPS, and SDGFP are currently working on a research project that will assist all agencies involved with the development of better methods to track all types of wildlife-vehicle collisions comprehensively and provide possible mitigation strategies.

Hunting Regulations

Harvest Strategies

When determining unit-specific management directions (Figure 21), SDGFP staff review and analyze recruitment rates, population estimates, harvest levels, hunter success, hunter comments, depredation complaints, and landowner and public input. Methods used to collect public input include hunter opinion surveys, landowner opinion surveys, harvest report cards, regional advisory panels, regional open houses, commission meetings, and staff contacts (personal, phone, email). When unit-specific management directions are determined, SDGFP staff develop season recommendations that strive to provide the most hunting opportunity, while shifting the population towards management direction. It is important to note that the biological and social considerations used to develop these population objectives are not static and may change over time.

Depending on management direction identified for each elk management unit, SDGFP staff utilizes various harvest tools to guide management decisions, including but not limited to cow harvest rates, license numbers, license types, and season structure.

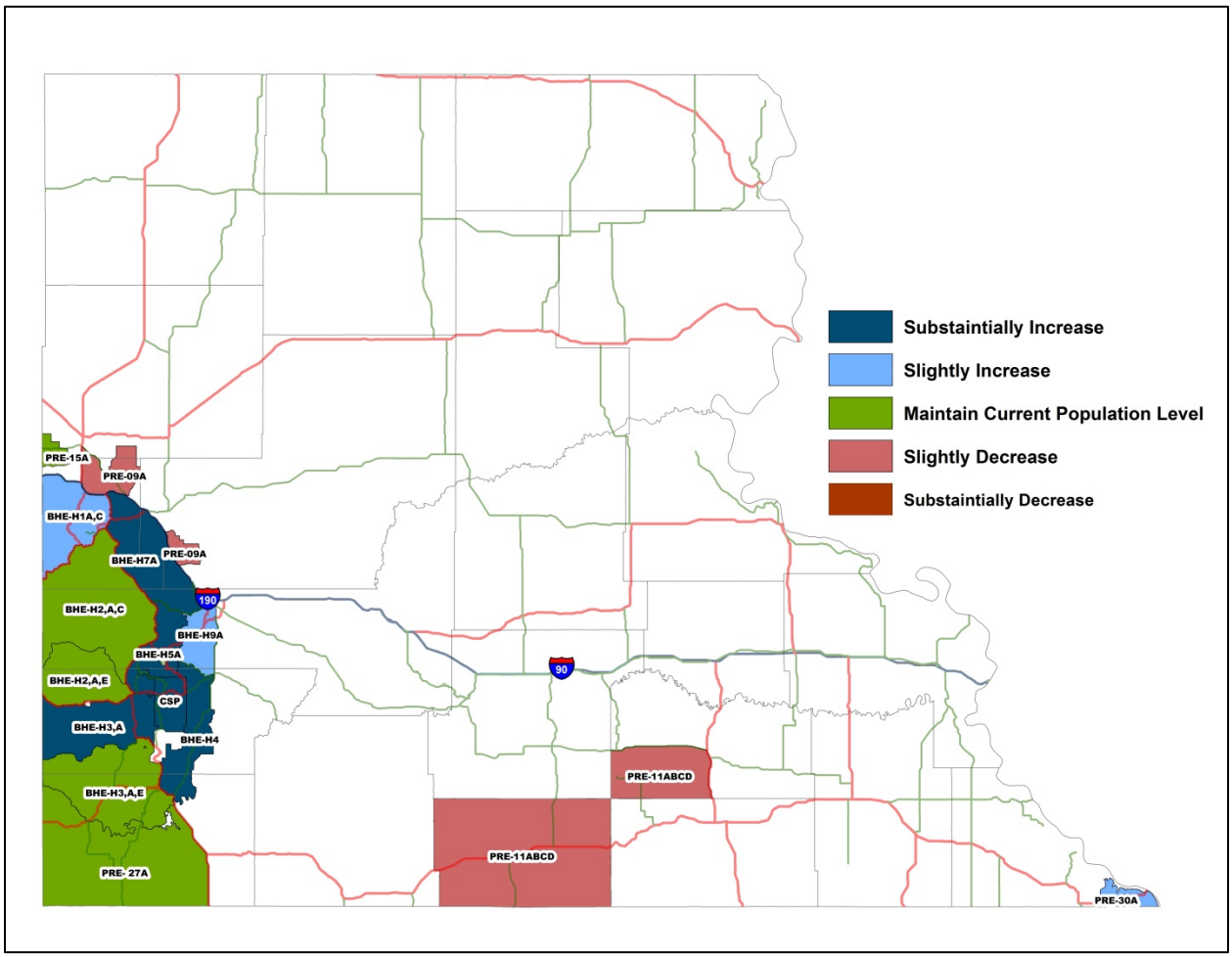

Figure 21. 2015 elk management unit directions.

Management Units

Management units are used to meet elk harvest management objectives and to facilitate the distribution of elk hunters within a specific geographic area. To ensure that unit boundaries can be easily identified, highways, roads and rivers are used as distinguishable features.

Elk distribution and movements within the Black Hills and prairie management units vary amongst seasons and the availability and juxtaposition of habitats. SDGFP has documented seasonal movements of elk across unit boundaries from radio telemetry studies (Schmitz 2011, and Lehman, personal communication). Since elk licenses are issued at the unit level, numerous factors can influence the availability of elk to hunters during the different hunting seasons; these factors include weather, current habitat conditions, and hunting pressure. Elk may be unevenly distributed in adjacent units within the state, or in adjacent units managed by Wyoming, Nebraska, or Tribal wildlife agencies.

Annual evaluation of elk movements, hunter harvest statistics, hunter comments, potential elk disturbances, and major habitat changes (e.g., fires, timber harvest, pine beetle impacts) which could significantly alter elk herd distributions, is necessary to ensure that management units are being implemented to maximize hunter opportunities and meet harvest objectives.

Elk Drawing System

The draw process for elk licenses in the Black Hills and prairie units involves several stages (Appendix 14). Initial draw begins with 50% of licenses within each unit available to qualified landowner applicants with successful landowners receiving licenses. All remaining licenses are returned to the available license pool and the second draw selects licenses to be allotted to successful non-landowner applicants with 10+ years of preference and any unsuccessful landowners from the original landowner draw with 10+ years of preference. This portion of the draw constitutes 30% of the licenses. The next 15% of licenses are then allotted to non-landowner applicants with 2-9 years of preference, any unsuccessful applicants with 10+ years of preference, and any unsuccessful landowners with 2+ years of preference. The last 5% of licenses are allotted to non-landowner applicants with 0-1 years of preference, any unsuccessful applicants with 2-9 years of preference, any unsuccessful applicants with 10+ years of preference, and any unsuccessful landowners. The draw process for CSP is similar to the above process, but without the landowner preference stage (Appendix 15). The first 33% of licenses are allotted to applicants with 15+ years of preference. The next 33% of licenses are allotted to applicants with 10-14 years of preference. The final 34% of licenses are allotted to applicants with 0-9 years of preference.

Due to the strong desire by resident hunters to hunt elk and the social tolerances that currently limit the availability of occupied elk habitat, there will always be more demand for elk hunting opportunities than can be provided to South Dakota residents. In fact, for those hunters that are not eligible for landowner/operator, the opportunity to obtain an “any elk” license could be a once-in-a-lifetime opportunity. The statistical breakdown of drawing a South Dakota elk license is visually displayed in Table 26.

As a result of hunter demand to draw a South Dakota "any elk" license primarily in CSP and for the Black Hills, a thorough review and analysis of the current drawing system should be conducted. During this process, drawing systems from other state wildlife agencies should be examined. Perhaps there are other factors that could be considered to improve the current elk drawing system for those elk applicants with significant years of preference.

Sharing information and educating the public and those interested in hunting elk is an important aspect of elk management. Developing the proper outreach mechanism that fully explains the supply and demand for elk hunting in South Dakota could help improve understanding of the realistic chances of drawing an "any elk" license.

Table 26. Number of applicants by year of preference category going into the 2014 license drawing.

Years of Preference Category	Black Hills Firearm Elk	Black Hills Archery Elk	Custer State Park Firearm Elk	Custer State Park Archery Elk
0	8,951	1,084	228	52
1-5	17,459	6,132	10,548	4,087
6-10	6,966	2,625	5,555	2,115
11-15	2,269	551	3,168	900
16-20	239	4	1,918	312
21+	3	0	929	40
Totals	**35,887**	**10,396**	**22,346**	**7,506**

[1]Not all of these elk applicants applied for the 2014 elk hunting seasons.

Landowner/Operator Preference

For all elk hunting seasons excluding those for CSP, up to 50% of all elk licenses made available for each management unit are available to those who qualify for landowner/operator preference. Except for Black Hills Unit 3, this 50% allocation of licenses meets the demand of those applicants with landowner/operator preference. From 2009-2014, an average of 11.3% of all "any elk" licenses allocated for the Black Hills rifle elk season have went to those applicants qualifying for landowner/operator preference.

There are numerous opinions related to landowner/operator elk licenses. For those landowners and operators that support/tolerate elk on their lands throughout the year, a license is a way to compensate them for the possible elk depredation that does occur on their property. This may increase landowner tolerance, allowing a higher social carrying capacity, which in return, maximizes hunting opportunities for all hunters interested in hunting elk. Perhaps there is an alternative method that could be explored and negotiated that would still

meet the expectations of providing and issuing landowner/operator preference and improve elk license opportunities for the general drawing process.

Elk Raffle License

Since 1991, the SDGFP Commission has entered into an agreement with a nonprofit organization to conduct a raffle for one "any elk" license, limited to a South Dakota resident, that is valid in any elk management unit where "any elk" licenses are issued. Prior to the 2013 elk hunting season, this elk rifle license was valid only in CSP. As established in South Dakota Administrative Rule, the nonprofit organization must have a mission devoted to providing big game management, preservation, propagation, habitat, and research. The Rocky Mountain Elk Foundation (RMEF) has been the successful nonprofit organization to obtain and conduct the raffle for this highly sought after South Dakota elk license.

The nonprofit organization is allowed to use proceeds from the elk raffle license to cover related advertising costs, printing and other expenses, but may not exceed 20 percent of gross receipts. The remaining proceeds are then deposited and approved by the SDGFP Department Secretary. All of the proceeds of the elk raffle must be spent in South Dakota within three years after the date of the raffle drawing for the benefit of elk, including elk habitat and funding of elk research.

The Rocky Mountain Elk Foundation (www.rmef.org) has been an important and valuable conservation partner, not only for the management of elk, but for other wildlife species and their habitats associated with elk. Proceeds from the raffle license are spent only as authorized by a majority vote of the RMEF elk raffle advisory committee. This unique funding mechanism administered by RMEF in cooperation with SDGFP has been instrumental in numerous elk habitat projects, elk research, and cooperative projects between WICA and SDGFP. It is recommended to continue with the annual allocation of this elk raffle license to help promote and fund elk conservation and management in South Dakota.

Most western state wildlife agencies provide elk licenses for raffle drawings, as well as auction to the highest bidder. These drawings and auctions are usually open to both resident and nonresident applicants, and funds generated from these license sales directly benefit the management of elk in that respective state. It is recommended that SDGFP further evaluate these potential sources of additional revenue for future elk management.

Archery and Rifle License Allocation

The first Black Hills archery elk season occurred in South Dakota in 1986. The number of applicants for the archery elk hunting season has increased from 1,232 in 2000 to 3,952 in 2013. This is an increase from 10 to 37 applicants per available license. It is apparent that archery hunting has increased in popularity (Figure 4). The previous 5-year (2009-2013) success rate for archery elk hunters is 32%, compared to 60% for rifle elk hunters.

The challenge for SDGFP wildlife managers and the Commission when developing harvest strategies to meet current population objectives, is determining the appropriate allocation of archery and rifle licenses. During the past 5 years, 13% of the all elk licenses issued in the Black Hills have been issued to archery elk applicants. An evaluation of archery licensing in other western States showed that the allocation of elk licenses to archery seasons in South Dakota (13%) is lower than other states (range 19-32%).

The previous 5-year average for "any elk" archery licenses in the Black Hills comprised 16% of the total "any elk" licenses allocated, compared to 84% for "any elk" rifle licenses. For this same time period, "antlerless" elk archery licenses in the Black Hills comprised 8% of the total licenses allocated, compared to 92% for "antlerless" elk rifle licenses. In assessing the supply vs. demand, 11% of Black Hills firearm elk applicants were successful in drawing a license, compared to 5% of Black Hills archery elk applicants.

Because archery elk hunters have lower harvest success and a lower odds of drawing a license, the allocation of archery licenses could be increased with a minimal impact to rifle license applicants. The same level of elk harvest to meet population objectives could be retained, while increasing the overall hunting opportunity for elk hunters in South Dakota. Future allocation of "any elk" licenses will be 25% archery and 75% firearm, and antlerless licenses will be 10% archery and 90% firearm.

Archery and Rifle License Allocation in Custer State Park

In Custer State Park (CSP) rifle elk hunting began in 1962 and archery began in 1966. However, these hunts were guided and tag allocation was liberal until the late 1980's. In 1989, seasons were redistributed with the advent of an early archery hunting season, a rifle elk hunting season and a late archery elk season. With this redistribution, tag numbers were dramatically lowered and a more limited harvest started to occur. Applications for the early archery and rifle elk seasons increased steadily with the proportion in the archery season increasing from approximately 9% in 1995 to 18% in 2005. The number of applicants for the early archery elk hunting season has steadily increased the last 5 years from 4,432 in 2010 to 5,100 in 2014. For rifle applicants, there were 13,065 in 2010 and decreased slightly to 11,767 in 2014. Harvest success in recent years has been excellent for both archery and rifle hunters. The goal for the elk population in CSP is to have a greater percentage of mature bulls (6+ years of age) in the population for viewing and hunting opportunities. Based upon recent demand for licenses, future allocation of "any elk" licenses will be 25% archery and 75% firearm.

Disease

Wild and captive elk have the potential to acquire and transmit diseases that may impact other wildlife, domestic animals, or elk population growth. In South Dakota, while there are several diseases documented within the elk herd, there are few that have been documented to cause major concerns regarding the sustainability of elk populations within the State. Disease monitoring conducted by SDGFP, WICA, and other agencies has occurred through research

projects, harvest check stations, and opportunistic events. This section will address pertinent elk diseases, testing results, and the current knowledge of particular diseases potentially found in South Dakota.

Bovine Tuberculosis

Bovine Tuberculosis (TB) is caused by the bacterium *Mycobacterium bovis* and affects many ungulates including, but not limited to, cattle, bison, elk and deer. During the early stages, wild ungulates with TB often appear healthy as infection is usually localized. However, this disease can become chronic and manifest itself, resulting in emaciation, depression, and intolerance to movement (Davidson 2006). The history of TB sampling in wild elk in South Dakota is limited, with some reports of sampling with trans-locations from WICA to other areas of the Black Hills. In 1985, a total of 52 elk were tested for TB and all results came back negative for the disease (NPS 1985b). A total of 150 elk were tested for TB in January 1994, all with negative results (NPS 1994c.). Jacques (2001) tested 401 elk from 1997-1999 in the Black Hills of South Dakota and did not find any elk with TB. No wild elk have ever tested positive for TB in South Dakota.

Bovine Viral Diarrhea

Bovine virus diarrhea (BVD) is caused by a *Pestivirus* (Williams 1999). BVD is a common disease in beef cattle and vaccination for this disease is common and generally controls the disease. This disease usually infects the fetus of cattle, and depending on when the fetus is infected may cause the fetus to die and be aborted, suffer illness, be born with congenital effects, or be a carrier of the virus for life (Williams 1999). There are many strains of the virus, with the most common tested strains being Type I and Type II. Williams (1999) noted that until recently, there has been little interest in the possible occurrence of BVD virus in wild ruminants, and recent research findings suggest BVD does not appear to cause significant illness in wild ruminants including elk. Surveillance of the disease is ongoing and testing has occurred with elk populations residing in South Dakota. One elk out of 19 (5.3%) tested positive for BVD in CSP during 1980-1983 (Walker et al. 1995). In 2009, Lehman (unpublished data) tested 27 elk in CSP and documented all negative results for Type I and Type II BVD. In 2011, Lehman (unpublished data) tested 40 elk and all 40 tested positive for BVD Type I, and 38 of 40 tested positive for Type II BVD. Testing again occurred on these same populations of elk in 2012 and 2013 and of 84 elk, none tested positive for either Type of BVD. In 2012 and 2013, Simpson (unpublished data) tested 80 elk in the central Black Hills and found that 8 of 80 elk tested positive for Type I BVD, and 6 of 80 elk tested positive for Type II BVD. These seropositive results indicate that wild elk have been exposed to related *pestiviruses* and may only serve as a host to BVD virus. However, it is not known in most cases if wild species serve as a reservoir for BVDV or whether infections occur due to contact with cattle (Van Campen et al. 2001). There is no evidence that persistently infected wild elk occur in South Dakota. The most significant vector of BVD virus for range cattle is a persistently infected bovine carrier within a herd, and not wild ruminants (Williams 1999).

Brucellosis

Brucellosis (Bang's disease) is caused by the bacterium *Brucella abortus*. Brucellosis in wildlife is generally associated with wild elk and bison in and around Yellowstone National Park and currently is not found in wild or domestic cervids elsewhere in North America. Brucellosis is known to cause abortion in elk, cattle, and bison, and transmission from one animal to another usually occurs at the time of abortion as large amounts of bacteria are expelled with the infected fetus (Williams 1999). Since early transplants of elk into South Dakota originated from the Yellowstone area, brucellosis testing was conducted on transplants from WICA to other areas of South Dakota and other States.

While translocating elk from WICA in 1970-1972, Lovaas (1973) reported that 9 of 657 (1.4%) elk reacted positively to brucellosis testing and the affected elk were euthanized. Varland et al. (1978) reported that one out of 186 elk tested positive for brucellosis during a transplant operation to five Native American tribes in 1977. In 1979, a total of 38 elk were tested for brucellosis, of which, four came back positive and were euthanized (NPS 1979). In 1980, Rice (1988) documented one positive reaction to brucellosis out of 88 elk tested from WICA. Custer State Park conducted disease testing on elk over a three year period from 1980-1982 and all results were negative for brucellosis (Walker et al. 1995). From 1985 and 2013, a total of 1,089 elk were tested for brucellosis and all tested negative (NPS n.d., NPS 1985c, NPS 1985d, NPS 1986b, NPS 1994d, NPS 1994e, Lehman unpublished data, Simpson unpublished data). The last recorded brucellosis positive elk in South Dakota was recorded in WICA in 1980 as part of a transplant into the Black Hills (NPS n.d.). Therefore, it is believed that brucellosis no longer exists in wild elk populations in South Dakota.

Chronic Wasting Disease

Chronic Wasting Disease (CWD) has received the most attention within the last 15 years in South Dakota. CWD is a fatal brain disease of deer, elk, and moose that is caused by an abnormal protein called a prion. Animals infected with CWD show progressive loss of weight, poor body condition, behavioral changes, excessive salivation, increased drinking and urination, loss of muscle control and eventual death. CWD is always fatal for the infected animal. Elk with CWD have an incubation period of 1.5 to 3 years before they become clinically affected; with most succumbing < 12 months after the initial clinical signs appear, and some may survive with clinical signs > 12 months (Miller et al. 1998). Therefore, CWD is a disease that cannot be diagnosed by observation of physical symptoms because many big game diseases affect animals in similar ways. In wild cervids, the only practical method of testing for this disease is through lethal removal and sampling of infected tissue.

In South Dakota, CWD was discovered in seven captive elk facilities during the winter of 1997-98 and in another captive elk herd in 2002. These positive captive herds were located in Pennington, Custer, and McPherson counties. After the disease was discovered, research was initiated in cooperation with South Dakota State University to determine the extent and prevalence of CWD in wild cervid populations. Jacques (2001) tested a total of 368 elk for CWD from 1997-1999 and found no positive CWD elk in the Black Hills region. CWD was first

discovered in the wild in 2001 when a positive white-tailed deer in Fall River County was detected during the 2001 big game hunting season. The first discovered free-roaming CWD infected elk was found in 2002 in WICA. Chronic wasting disease was then discovered in a wild elk from the Southern Black Hills in 2003. Since 2002, CWD has been found in 92 elk within the counties of Lawrence, Pennington, Custer, and Fall River. These include 60 elk from WICA, 9 elk from CSP, and 23 elk from hunting units within the Black Hills Fire Protection District (Figure 22).

As of July 2014, a total of 5,931 elk have been tested since testing began in 1997. Although prevalence rates from hunter harvested individuals have risen slightly in the last decade, they have remained low (Figure 23, Table 27). As a result, managers in South Dakota have not seen any indication that CWD has negatively affected elk population rates of change. Unknowns still exist with this disease and biologist and managers will continue to monitor for CWD in South Dakota and across the country. Recent research conducted in Colorado suggests that in areas of high CWD prevalence, CWD can reduce survival rates of cow elk and decrease elk population growth (Monello et al. 2014). The long-term impacts of CWD on elk populations in South Dakota remain highly unknown.

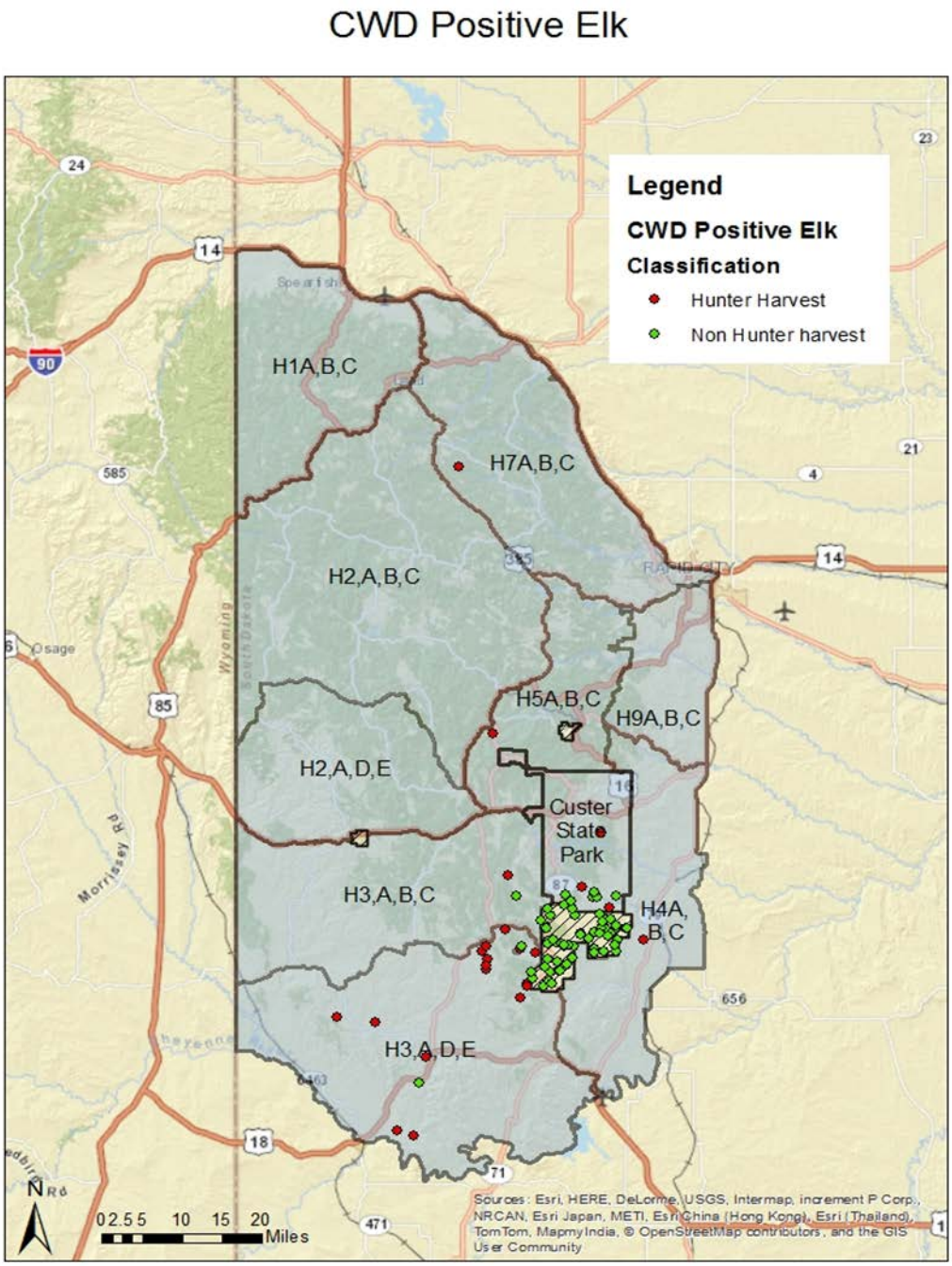

Figure 22. Chronic Wasting Disease positive wild elk in South Dakota 2001-2013.

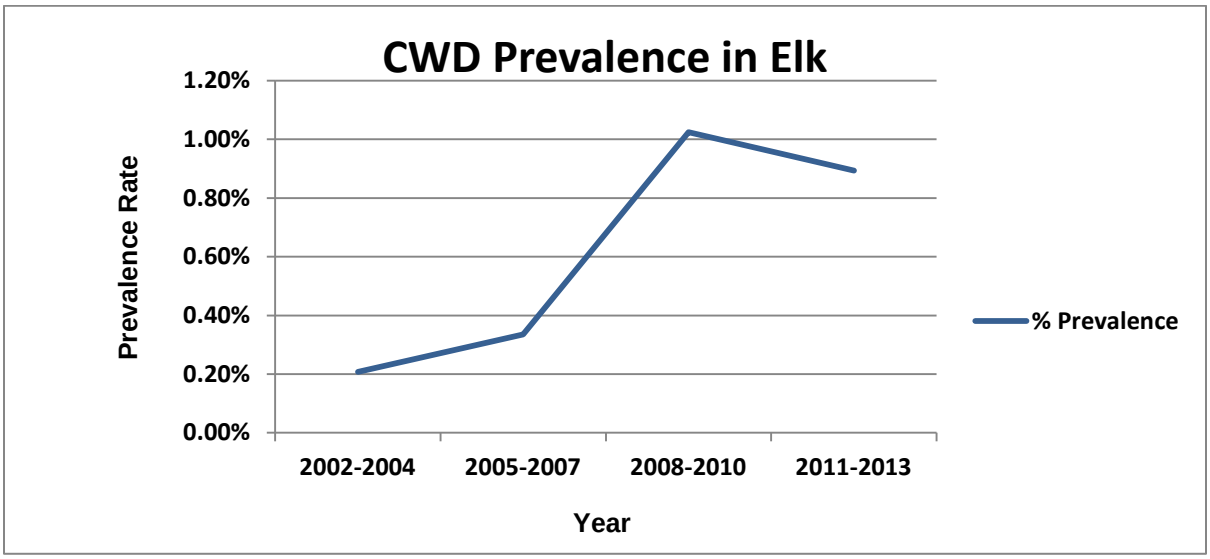

Figure 23. Three year average prevalence rates for CWD from hunter harvested elk in South Dakota 2002-2013.

Table 27. Number of hunter harvested elk, number of positive CWD elk samples collected, and percent prevalence of CWD in elk from 2001-2013 in the Black Hills.

Year	Number of Hunter Harvested samples	Number of Positives	Percent Prevalence
2001	164	0	0.00%
2002	586	0	0.00%
2003	662	2	0.30%
2004	678	2	0.29%
2005	748	2	0.27%
2006	581	3	0.52%
2007	463	1	0.22%
2008	369	5	1.36%
2009	376	4	1.06%
2010	231	1	0.43%
2011	153	1	0.65%
2012	100	1	1.00%
2013	83	1	1.20%
Total	**5,194**	**23**	**0.44%**

Hemorrhagic Disease

Epizootic Hemorrhagic Disease (EHD) and Bluetongue (BT) viruses are a group of related viruses endemic to white-tailed deer populations in much of the United States including South Dakota. Collectively, EHD and BT viruses cause hemorrhagic disease, which is transmitted from animal

to animal through biting flies of the genus *Culicoides*. Symptoms, typically occurring in late summer, in white-tailed deer include fever, sores in the mouth, hemorrhaging, and excessive fluid in the head and chest cavity which may lead to death. EHD has been identified in elk, but the impacts it has on elk populations in South Dakota remains unknown. Seventy-three elk were tested for BT from 1980-1983 (Walker et al. 1995) and all results were negative for the virus. In 1990, a total of 50 elk were tested for BT in WICA during translocation efforts, and all tested negative for the virus (NPS 1990b). Lehman (unpublished data) sampled elk from 2009 to 2013 and found 13 EHD seropositive elk out of 151 samples (8.6%). Simpson (unpublished data) found 2 EHD seropositive elk from 80 samples (2.5%) in 2012 and 2013 combined. In 2012 and 2013, SDGFP documented four elk that had symptoms severe enough to cause death or warrant euthanasia. These elk were all positive for EHD serotype ehdv-2, and one was also positive for the bluetongue virus. Through testing by SDGFP, exposure to these viruses has been documented. As an effort to monitor the potential impacts EHD may have on elk herds occupying South Dakota, surveillance for EHD and BT will continue.

Leptospirosis

Leptospirosis is a bacterial infection that has the potential to infect numerous species of domestic and wild animals. It is caused by various serovars of *Leptospira interrogans* (Williams 1999). Antibodies to the various serovars have been detected in elk in South Dakota, but it is not known to cause symptoms. Elk were tested in CSP for Leptospirosis from 1980-1983, and tests revealed a total of seven positive results for two different serovars for the bacteria out of 73 elk (Walker et al. 1995). Lehman (unpublished data) tested for 6 serovars in 124 elk occupying the south eastern Black Hills from 2011-2013 and only found 3 seropositive elk. Simpson (unpublished data) tested 80 elk over two years in the west-central Black Hills and found all elk negative for leptospirosis. While both cattle and wild ruminants may become infected with *Leptospira interrogans*, the serovars they carry are different and interspecies transmission is not significant (Williams 1999). This bacterium is not considered a high risk to elk in the Black Hills.

Meningeal Worm

Meningeal worm *Parelaphostrongylus tenuis* is a parasitic worm found in white-tailed deer throughout most of eastern North America. It typically causes insignificant mortality in white-tailed deer in South Dakota, but can cause illness and death in other ruminants including elk, mule deer, and pronghorn. Once ingested, the meningeal worms can produce severe neurologic disease with lesions usually found in the central nervous system that can result in death (Davidson 2006). The potential for meningeal worms to become established in the western United States is dependent on the presence of suitable terrestrial gastropods (e.g., snails [*Zonitoides sp*., *Discus sp*.] and slugs [*Deroceras sp*.]) (Jacques 2001). The life cycle of the meningeal worm needs these gastropods to complete their life cycle. Jacques (2001) tested 344 elk in South Dakota from 1997-1999 and found no infections of meningeal worms. The meningeal worm has not been found in elk in South Dakota due to the lower prevalence of the host gastropods. For elk in western South Dakota, the meningeal worm is not considered a disease of concern at this time.

Paratuberculosis (Johne's Disease)

Paratuberculosis, also known as Johne's disease is caused by the bacterium *Mycobacterium avium* subspecies *paratuberculosis* (Williams 1999). This disease can cause chronic infection of the intestine, resulting in severe diarrhea and loss of body condition (Williams 1999). Lehman (unpublished data) tested 151 elk from 2009-2013 for Johne's disease and all elk were negative. Simpson (unpublished data) did not detect this disease in 80 tested elk from 2012-2013. Williams (1999) stated that paratuberculosis is not common in beef cattle or wild ruminants and interspecies transmission is not likely.

Captive Cervid Game Farming

The history of captive elk in South Dakota before 1983 is not known, as no records were discovered associated to the first elk being placed in captivity within South Dakota. In 1983, legislation was passed giving Animal Industry Board (AIB) authority over five species of non-domestic animals held in captivity including elk, deer, moose, caribou and antelope (Miller 2014). In 1993, HB 1002 was passed implementing regulations pertaining to the required application process and permitting of animals, premise location descriptions, inventory of animals, marking of animals, confinement from free-roaming animals, allowing inspection by AIB board, allowing denial and seizure of unlawfully held animals, and establishing a fee permit [South Dakota Codified Law (SDCL) § 40-3-24, SDCL § 40-3-25, SDCL § 40-3-26]. Data provided by AIB demonstrates the number of captive elk and the number of captive elk facilities increased from 1993 to 2004 and have steadily decreased since 2005 (Figure 24) (Oedekoven 2014a). The number of facilities with captive elk peaked in 2003 at 58, and the number of captive elk peaked in 2004 at 3,356. In 1993, 10 of the 66 (15%) South Dakota counties had captive elk facilities. This number rose to a high of 37 (56%) counties in 2002, and currently 27 (41%) counties are occupied with captive elk (Oedekoven 2014a).

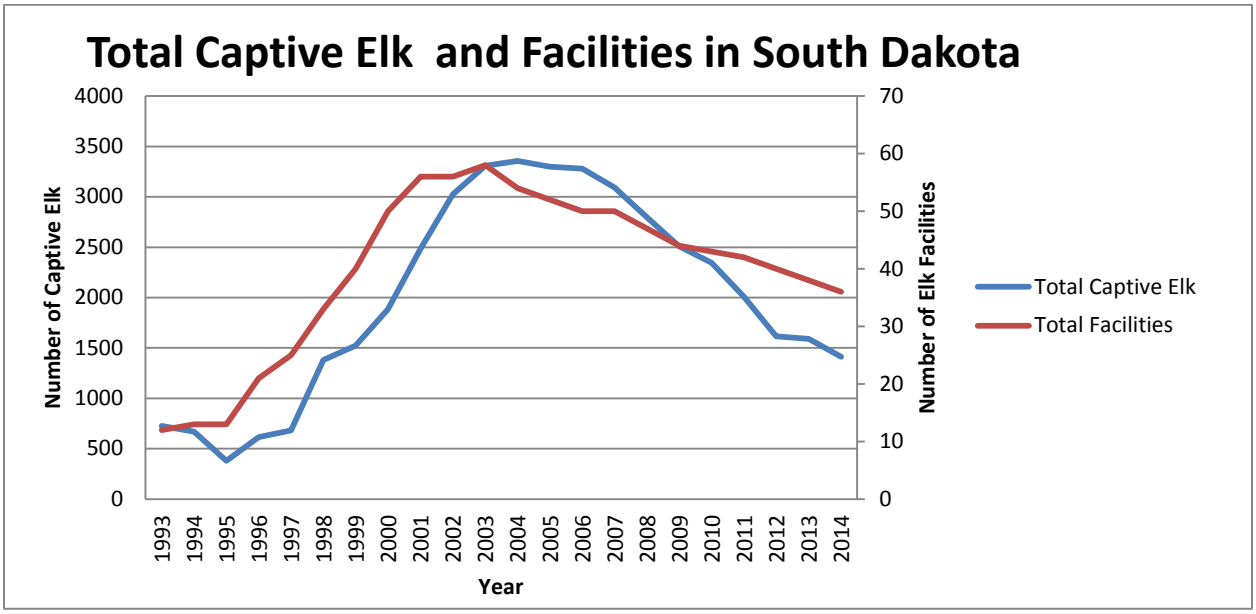

Figure 24. Total number of captive elk and captive elk facilities in South Dakota, 1993-2014.

In 1997, CWD was discovered in seven captive cervid facilities, and as a result, new legislation was passed in 1998, giving AIB statutory authority over CWD surveillance of captive cervids (SDCL § 40-5-8.6). CWD testing was mandatory on all captive cervids that died in South Dakota from 1997-2012 (ARSD § 12:68:25:03). Soon after testing became mandatory on captive elk in South Dakota, the AIB tested a total of 1,307 captive elk with 130 positive results up through October of 2002. Since October 2002 another 4,032 captive elk have been tested with no positive results (Oedekoven 2014b). Since 2012, CWD sampling on captive cervids in South Dakota has been voluntary.

The South Dakota Elk Breeders Association was founded in 1997. Primary objectives of the association include, inform and educate members on new ideas and technological advances, meet with peers to discuss current views and topics, and to vote on issues concerning the well-being of the association and the captive elk industry (South Dakota Elk Breeders Association 2014).

Winter Feeding

SDGFP believes that elk populations should be managed under natural conditions and subsist on naturally occurring forage. While SDGFP conducts winter feeding under certain conditions, the department strongly discourages individual citizens from feeding elk and deer species. The best way to help elk survive a severe winter is to provide a year-round high quality diet. If elk go into the winter in good condition, most are able to survive persistent deep snow, ice and cold temperatures (Washington Department of Fish and Game 2014). SDGFP staff will not conduct winter feeding unless first consulting with the Regional Supervisor, Senior Big Game Biologist, Regional Wildlife Manager and Regional Habitat Manager. Considerations such as

weather forecasts, severity of snow and temperatures, condition of the elk, feed site logistics, economics, effectiveness, degree of private land depredation, and the level of public concern over such feeding actions are considered before SDGFP initiates feeding operations.
In some instances elk are fed in the winter to keep them off adjacent private property where they may cause damage. This type of feeding is often referred to as short-stop feeding. When persistent severe conditions concentrate elk or draw them into private property SDGFP might utilize short stop feeding as a strategy to keep elk off private lands and away from livestock and crops.

There are several drawbacks to feeding elk. Feeding elk with the proper feed in sufficient amounts can be expensive. The state of Wyoming, for example, spends more than $2 million annually to feed elk and to study and manage feeding ground diseases (Smith 2013). Concentrating elk at feeding sites can make elk susceptible to transmission of disease such as Chronic Wasting Disease, Brucellosis, Tuberculosis and eye and respiratory infections (Dean et al. 2004). Elk may be more vulnerable to predation when concentrated at feeding sites. Elk drawn to artificial feed tend to increase in numbers over time and can cause damage to rangeland and adjacent private property. An elk's digestive system often is not able to process many common types of feed (e.g., corn, wheat), potentially causing acidosis and possibly death.

Predation Management

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

<u>Predators of Elk</u>
Within the Black Hills of South Dakota, mountain lions (*Puma concolor*), coyotes *(Canis latrans*) and bobcats (*Lynx rufus*) prey on elk (Lehman unpublished data). Mountain lion predation occurs on all age classes and throughout the year, while coyote and bobcat predation occurs on newborn calves in early spring (Griffin et al. 2011). Numerous research projects investigating the impacts predators, especially mountain lions, have on elk occupying the Black Hills have been conducted. From 1 January 2007 – 1 May 2010, 105 adult elk (76 females, 29 males) were

monitored throughout the Black Hills of South Dakota. Sixty-seven mortalities were documented throughout the duration of the study, of which eight were determined to be caused by mountain lions (11.9%; Schmitz 2011). From 2005 – 2009, 202 elk (83 subadult males and 119 subadult/adult females) were fitted with global positioning system (GPS) collars within WICA. Twenty-eight mortality events were documented involving collared individuals throughout the course of the study and six (21.4%) were attributed to mountain lion predation (Sargeant et al. 2011).

From 2011 – 2013, Lehman (unpublished data) captured and radio-marked 58 female elk ≥ 2 years of age and 125 calves during the parturition season in the southeastern Black Hills. Throughout the study, 18 adult mortality events were documented, of which five (27.8%) were attributed to mountain lion predation. It was estimated that 4% (95% CI; 0.01 – 0.08) of all radio-collared adult female elk occupying the study area were predated by mountain lions. Mountain lion predation accounted for 81% (*n* = 59) of all documented calf mortalities and coyote and bobcat predation accounted for 10% (n =7) and 1.4 % (n = 1), respectively. Overall predation accounted for 93% of all documented calf mortalities throughout the three years. In summary, 63% (95% CI; 0.51 – 0.76) of all radio-collared calves occupying the southeastern Black Hills were predated by mountain lions (Lehman unpublished data).

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

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

Monitoring Impacts of Predation

Two critical metrics in determining population performance includes annual cow survival and calf survival to reproductive age. Fluctuations in cow and calf survival can result in different elk population trajectories; heavily influencing population growth and decline (Table 28). Considering the Black Hills is essentially a one predator system, analyzing trends in seasonal herd composition data (fall recruitment ratios) can be a useful tool in determining if mountain lion predation on elk calves within the Black Hills is a limiting factor. Fall recruitment rates have been mostly stable over the last ten years (44-52 calves/100 cows) despite changes in mountain lion population size (Figure 25), suggesting that lions are not a limiting factor on a broad scale across the Black Hills. However, as demonstrated by Lehman (unpublished data), mountain lion predation on elk calves can negatively impact calf recruitment on a localized scale. In addition, a suite of covariates such as body condition, birth date, birth weight, disease and severity of environmental conditions may affect whether or not calves are recruited into an elk population (Singer et al. 1997). Determining what variable(s) has the greatest impact on calf recruitment is very difficult because calf recruitment is likely dependent on a combination of multiple factors.

Table 28. Predicted elk population trends generated through MCMC model simulations: (decrease [↓], stable [●], increase [↑]) based on adult female (>2 years) survival and over-winter (October - May) calf survival in relation to August - September calf:cow ratios (modified from IDFG 2014).

	30 Calves: 100 Cows		**40 Calves: 100 Cows**		**50 Calves: 100 Cows**	
Over-winter Calf Survival	60%	80%	60%	80%	60%	80%
Annual Adult Female Survival						
80%	↓↓	↓	↓	●	●	↑
85%	↓	●	●	↑	↑	↑↑
90%	●	↑	↑	↑↑	↑↑	↑↑↑

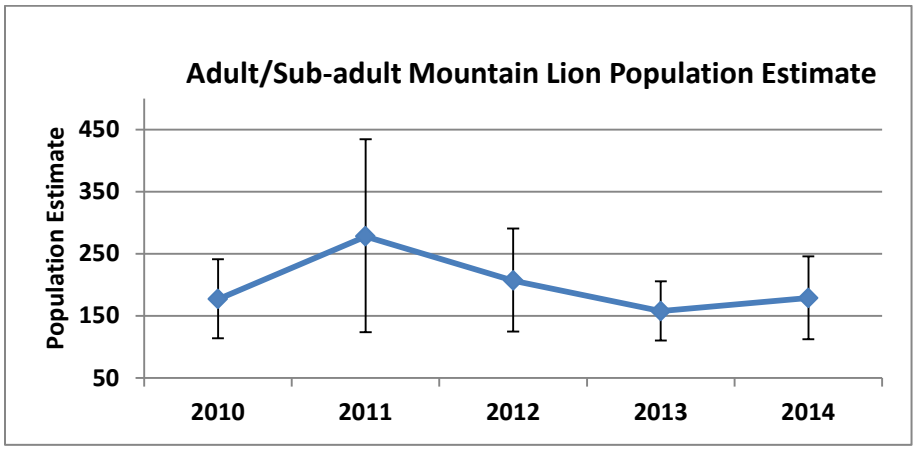

Figure 25. South Dakota Black Hills 2010-2014, adult/sub-adult mountain lion population estimate 2010-2014 (SDGFP unpublished data).

Predator Management and Research

Mountain lion caused mortality on adult cow elk is limited (4%, southeastern Black Hills; 2.3%, west-central Black Hills); however, mountain lion predation on elk calves does have the potential to affect elk population performance in some areas of the Black Hills (Lehman unpublished data, Simpson unpublished data). The mountain lion harvest season continues to be the number one management tool in maintaining a sustainable and socially acceptable mountain lion population (SDGFP 2010; Figure 26). The 2014 season length was 96 days, occurring from 26 December 2013 - 31 March 2014, with a harvest limit of 75 total lions or 50 female lions. Use of dogs is prohibited except during specified hunting intervals in CSP during established seasons. A year-round season exists throughout the prairie landscapes outside the Black Hills Fire Protection District.

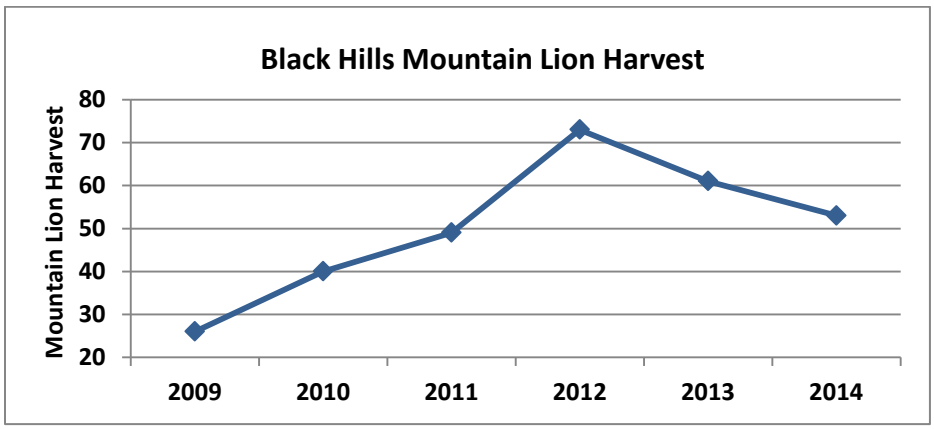

Figure 26. South Dakota Black Hills mountain lion harvest, 2009-2014.

In an effort to better understand the feeding habits of mountain lions occupying the Black Hills, along with quantifying prey selection and kill rates, 41 mountain lions (29 female; 12 males) were captured and collared throughout the Black Hills with GPS telemetry from 2009 – 2012. Over 5,500 cluster locations (i.e., potential feeding sites) were investigated, of which 1,506 were feeding sites (kills = 1,246; scavenge = 260). Results indicated that deer (*Odocoileus spp.*) comprised the majority of mountain lions diets (83%; Smith 2014). The most common prey species was white-tailed deer (62.9%). Elk made up 5.5% of feeding sites. Kill rates averaged 0.79 ungulates/week (95% CI = 0.81 – 0.88) and varied significantly among individual (range = 0.13 – 1.75 ungulates/week) and season (e.g., summer, $\dot{x}$=0.92 ungulates/week; winter, $\dot{x}$=0.62 ungulates/week). Annual kill rates averaged 52 ungulates killed per year for females with cubs > 6 months, 42 for females with cubs < 6 months, 39 for adult females, 38 for subadult males, 35 for adult males and 33 for subadult females (Smith 2014). In addition, Smith (2014) noted that CWD infected elk potentially have an increased risk to predation. From December 2011 to April 2012, elk kills (*n*=14) from two GPS collared mountain lions (1 male; 1 female) occupying WICA were tested for CWD. Nine of the 14 (64%; 95% CI = 50.3 – 78.3%) elk were positive for CWD.

Coyote and bobcat predation on elk calves within the Black Hills appears to be limited, typically occurring in the first 30-days of life (Lehman unpublished data, Simpson unpublished data). In the southeastern Black Hills collared calf (*n*=125) mortality rates caused by coyotes and bobcats were 6% (*n* = 7; 95% CI: 0.0 – 0.13) and 1.5% (*n*=1; 95% CI: 0.0 – 0.06), respectively. No mortality events caused by coyotes or bobcats involving adult elk have been documented within the Black Hills. Thus, research findings suggest coyote and bobcat populations have minimal impacts on elk populations. Liberal harvest strategies exist for coyotes including a statewide year-round hunting and trapping season with unlimited harvest, excluding CSP. A more conservative harvest season exists for bobcats, including a 52 day hunting and trapping season (26 December–15 February), excluding CSP.

Determining if predation is a limiting factor can be extremely difficult because predator-prey dynamics are complex situations. If predation is found to be a limiting factor, developing solutions that make a difference requires adaptive management strategies where effective monitoring allows managers to learn, and adjust management strategies through time. Ballard et al. (2003) emphasizes numerous guidelines for determining if a more aggressive approach in predator management would likely increase elk populations.

- Elk populations are below carrying capacity
- Predation identified as a major cause of mortality
- Predator management efforts can result in a significant decline in predator numbers
- Predator management efforts are focused within a geographic area (e.g., <400 mi^2)
- Predator management efforts are timed just prior to predator and/or prey reproductive periods

The Black Hills of South Dakota is not occupied by breeding populations of wolves and/or bears, resulting in the potential to manage the impacts of predation on elk populations more

effectively. Even though mountain lion populations have increased since 2005, elk populations continue to grow. Research findings indicate that predation rates on elk calves in localized areas have slowed growth rates. Continued monitoring is necessary to ensure predation does not become a limiting factor and predator management strategies need to be adjusted accordingly.

Multiple Use

Travel Management: Roads and Motorized Vehicles (non-snow)

Recreational use of public lands can produce unintentional harassment of wildlife. Numerous studies conducted in the western states (Rowland et al. 2005), published findings over the past 35 years on the effects of roads to elk, including road maintenance levels (Gardner 1971), reduction in elk habitat effectiveness (Lyon 1979a), excessive creation of edge habitat (Ebert 1972), habitat fragmentation and increased vulnerability to disturbance, poaching and disproportionate spatial harvesting (Sundstrom and Norberg 1972). Big game, particularly elk, need screening cover adjacent to secondary and primitive roads (Lyon 1979b, USDA 1975) as previously mentioned.

Elk movements and habitat use in the Black Hills is largely dictated by human activities (Rice 1988) versus weather or habitat modifications. This includes motorized use of roads and trails (Millspaugh et al. 2000a). Pulses of human intrusion are evident in the daily movements of elk (Rumble et al. 2005). Elk response to roads differs by season, time of day and road type (Lyon 1979b, Millspaugh 1999). One behavior is evident; elk compensate their normal movements by waiting to become more active during periods when human use is lowest (Millspaugh et al. 2000a).

Road type and motorized activity level are the primary components determining the influence of roads on habitat suitability. In CSP, areas near tertiary roads (dirt roads closed to the public but occasionally used for administrative purposes) were actually used more often than random, suggesting elk preferred to use areas near these roads. Conversely, in areas with higher open road density and during hunting seasons when activity was concentrated along these roads, elk avoided them (Millspaugh 1999).

Compared to BHNF, tertiary roads are considerably fewer in CSP and do not receive the volume of year-round motorized use. Road densities in general are much lower in CSP than BHNF and there has never been authorized off-road motorized recreation (OHV) by the public. Elk hunters in CSP used tertiary roads to a greater degree than primary (paved) or secondary (gravel) roads. Elk negatively responded most acutely to roads and trails traveled (foot and motorized vehicles traffic) most heavily by hunters in the fall. Some elk were displaced onto private lands on the east side of the Park during archery seasons due to disturbance. In CSP, elk response to human activities in the fall was short-lived and after hunting seasons, elk moved back into CSP and selected areas near secondary and tertiary roads in the winter. However, the negative influence of primary or paved roads open year-round to the public, which includes

highways, was still evident and elk dispersion was extended to 300m (327 yards) during winter (Rumble et al. 2001a). Conversely, the effects of edge that roads create with delayed phenology and green vegetation during late summer and early fall attracted elk to take advantage of this forage adjacent to primary (paved) roads at night when there was less motorized traffic.

However, on BHNF, the effects of roads and motorized traffic is compounded by the fact that up until 2010, there were few restrictions on OHV recreation and road densities were the highest of any national forest at 2.2 mi/mi^2 (Rumble et al. 2005). A study conducted in early 2000, found that elk could not move more than 150m from a primitive road (Rumble et al. 2005). Elk on BHNF were always further from primitive roads during hunting rifle seasons (deer and elk) and usually further from secondary and primary roads in areas of high road densities. During the archery season elk appeared more tolerant of limited human activity and were closer to primary and secondary roads compared to the rifle season. Elk distributed themselves away from roads more frequently on hunting season opening weekends and the day after Thanksgiving (which is a traditional day for hunting deer in the Black Hills). Since the 2005 published study, a mountain lion season brings additional traffic to both CSP and BHNF roads as many lion hunters drive roads to cut lion tracks in the snow.

In some parts of the Black Hills, where high road densities combined with high volume non-snow traffic and snowmobile trails in the winter, elk have little opportunity to seek low disturbance on a year-round basis (Rumble et al. 2005). Aggravated displacement and increased movements of elk create more than just a group of animals moving across the landscape. Motorized and human disturbances on roads can result in larger home ranges, meaning elk need more area to fulfill habitat requirements of forage, water, shelter and space. Flight response will cause increased demands for energy input and elk may require 0.5 hour of additional foraging time to accommodate greater movements resulting from human activity (Rumble et al. 2005). Displacement from favored foraging areas, especially in the fall and winter, creates physiological stress effects (Millspaugh 1999) that are difficult to quantify. Nutritional deficit (forage becomes less than 50% digestible) and spending more time in habitats with less forage availability are additive, meaning that some elk may winter in poor condition due to constant movement to avoid roads and/or to find quality habitat (Rumble et al. 2001b, 2005). On summer range, cow elk may enter spring with a nutritional deficit from the previous 7-9 months and there can be added stress from human disturbances during elk lactation, despite better forage quality during summer.

Another trade-off is that in areas on public land with dwindling quality elk habitat, which includes a high use of roads by hunters and recreationalists, elk leave public land for private, even if temporary (Wertz et al. 2004). The BHNF Forest Plan strives to manage big game habitat to keep big game on BHNF winter range to reduce the time spent on private lands (USDA 2006).

Stress in elk can be measured using fecal glucocorticoids (GC). The adrenal cortex secretes GC that alters metabolic pathways and diverts energy not required for immediate survival. Chronic GC elevation can cause physiological responses that inhibit digestion and growth, result in decreased resistance to disease, suppressed reproduction and influence muscle wasting (Munck et al. 1984, Sapolsky 1992). Physiological responses of elk to various stressors in CSP resulted in limited interpretations (Millspaugh et al. 2001) but it was noted that human activity, high temperatures and normal seasonal metabolic rhythms may elevate summer GC concentrations. Many factors, including direct stress by humans or predators, influence GC excretion adrenal responses but do not necessarily equate to a lethal response (Romero 2004). These factors include age, gender, daily and seasonal behaviors, diet and body condition, herd social ranking, and reproductive status (Millspaugh and Washburn 2004). Biologists must carefully consider confounding factors and the relationship between GC concentrations and population performance or biological costs when interpreting effects of environmental or human-induced disturbances on wildlife (Millspaugh and Washburn 2004).

South Dakota Game, Fish, and Parks and BHNF partner on several types of habitat improvement projects in BHNF elk country. For example, an unauthorized road created by the public was reclassified to foot and horse use only in an area adjacent to the Pleasant Valley SDGFP Game Production Area. Both BHNF and adjacent SDGFP land are important winter range for elk. This area will now provide elk and other wildlife less disturbance.

Snowmobiles and Over-Snow-Vehicles

The snowmobile trail system within the BHNF has been in place for decades and currently provides 310 miles of groomed trails in South Dakota and 40 miles immediately across the Wyoming border. On a north-south axis, the current South Dakota system starts 4 miles south of Spearfish, south to Lead and Deadwood in Lawrence County and then over 30 miles further south to the Pennington County line (which is approximately 11 miles south of Deerfield Lake and 8 miles north of Highway 16A). From west to east, the trails within South Dakota extend 14 miles from the WY border in the southern most portion of the trail system and approximately 19 miles east in the northern trail system near Lead. Trails may be closed for numerous reasons including but not limited to active logging operations, safety and maintenance and may be periodically rerouted seasonally or throughout the years. An area determined to be wildlife winter range on BHNF immediately west of Spearfish, SD, and 5 miles into Wyoming is closed to snowmobiling.

The South Dakota trails are maintained by SDGFP, Division of Parks and Recreation. State recreation managers have cooperative agreements with BHNF, USDI Bureau of Land Management, Barrick Mining Co., Wharf Resources and private landowners. Local economies rely upon and benefit from this winter sport which generates approximately $131.6 million in annual economic impact to South Dakota (Allgrunn 2012). The season runs December 15 through March 31. Snowpack within the trail system is variable with generally more reliable snow in the northern portions of the trail system. Allgrunn (2012) queried residents and non-residents as to which months they typically recreated on the snowmobile trail system (Table

29). The bulk of the trail traffic occurs in January and February by both South Dakota residents and non-residents.

Table 29. Snowmobile trail use by South Dakota residents and non-residents from December 12-March 31. (Allgrunn 2012).

Month	Residents	Non-Residents
December	35%	17%
January	75%	70%
February	86%	81%
March	45%	20%

Snowmobilers are required to stay on groomed trails except where trails are located on BHNF (other exceptions see www.gfp.sd.gov/to-do/snowmobile/default.aspx). Trails on several areas within BHNF pass through forested and open habitats. Plus, there are unlimited opportunities for off-trail riding on BHNF well outside the trail area on over 1.2 million acres (USDA 2014a).

In June 2014, the FS sought national public comment on a proposal to standardize sustainable access for over-snow vehicles designed for use over snow and run on track and/or ski or skis (OSV) on national forests and grasslands (USDA 2014b). USFS is required to evaluate OSV use on relevant USFS lands through its Travel Management Rule (36 CFR Part 212, Subpart C). After publication of the final Rule on January 28, 2015 (Federal Register Vol. 80, No 18), FS Units, such as BHNF, that provide motorized OSV recreational opportunities, will decide how or if the new rule applies and engage the public in their thoughts at a later date.

Exhaustive research has been conducted on the effects of winter recreation on wildlife and natural resources in western landscapes outside of the Black Hills (Olliff et al. 1999). There has been no comprehensive study or impact analysis conducted on the effects of *winter* recreation (outside of non-OSVs and hunting season use of roads) on wildlife and natural resources in the Black Hills. The effects of OSV to elk have been documented primarily in Yellowstone National Park (YNP) where elk and other wildlife species are not exposed to the same type or degree of human disturbances found in many areas throughout their range in the western United States, including the Black Hills. For example, within YNP, there is no hunting, domestic livestock grazing, active timber logging or mechanical vegetation treatments, private in-holdings with associated daily human movements and open road densities are considerably lower than BHNF. Elk responses to OSV in YNP included increased vigilance (look/respond), travel (walking away) and, occasionally, flight or defense if elk were on or near roads, groups of elk were smaller, elk were approached by humans or their movements were impeded or hastened by OSV (Borkowski et al. 2006). Elk continued to use the same core winter range for 30 years, despite high levels of OSV that remained confined to roads or trails and for the most part, humans did not deliberately harass wildlife. There were no observable adverse effects to elk population dynamics or demography.

Physiological responses such as elevated heart rate, blood pressure, breathing rate, and release of adrenal cortex secretes glucocorticoids (GC) or adrenaline as measures of fitness effects were monitored in companion studies (Hardy 2001, Creel et al. 2002). For elk, day-to-day variation in fecal glucocorticoid levels paralleled the number of snowmobiles when effects of weather and age were controlled. Although GC concentrations were higher in elk responses to OSV compared to wheeled vehicles, researchers found no correlation to current levels of OSV and negative effects to elk populations (Creel et al. 2002).

Based on these three studies, Borkowski et al. (2006) recommended Park managers not increase winter recreational activities but continue in the same predictable manner. Absent other forms of disturbances to elk which could cause severe or prolonged impacts, it was hypothesized that elk in YNP may have become conditioned to the same form of human winter activity of OSV use. Research on the effects of OSVs in the Black Hills may be warranted.

Motorized Elk Retrieval

In March 2010, BHNF issued a new travel management plan for motorized vehicles for other than OSVs (USDA 2010d). Today, the Forest has over 3,600 miles of open routes for motorized travel and recreation and land adjacent to roads is considered closed unless designated otherwise. There are abundant opportunities for motorized recreation and permits may be required (USDA 2014c). Motorized Vehicle Use Maps (MVUM), downloads, and other federal regulations can be found on BHNF website or by visiting a BHNF Office. For non-BHNF lands, hunters should consult with that respective federal or state land management agency to determine if motorized game retrieval is allowed. Custer State Park highly regulates uses of OHVs.

The major change in travel management on BHNF came with ending decades of off-road use on most of BHNF with the exception of a few areas open to cross-country recreation, dispersed camping and elk retrieval (USDA 2010c). Retrieval of a downed elk by packing out on horse, mule, backpack or travois has always been available but another option is by motorized vehicle. It was SDGFP's opinion that getting a legally harvested elk properly field dressed, body cooled and quickly transported for processing were critical to our resident hunters and additional access adjacent to some roads would aid in proper handling of wild game. The amount of added disturbance from motorized retrieval to other hunters was considered minor and negligible to elk due to high amount of all human activity already taking place throughout the hunting seasons.

For the final BHNF travel management decision, SDGFP encouraged adoption of limited-distance for off-road motorized use to retrieve legally harvested elk. BHNF agreed to such an allowance as long as hunters honor the conditions established each year. Today, there are approximately 294,800 acres for off-road elk retrieval under the following conditions (USDA 2014c):

- Elk retrieval only. No other hunted species may be retrieved off-road with a motorize vehicle.
- Motorized elk retrieval is allowed only in the zone as displayed on the MVUM. SDGFP does not set these zones. Contact BHNF for clarification.
- The MVUM will indicate the distance allowed to retrieve up to 300 feet, or up to 1 mile within the designated Elk Retrieval Zones, from certain designated roads.
- There is no restriction on time of day.
- Only one vehicle will be allowed off-road to retrieve each harvested elk, but more than one pass of this single vehicle will be allowed as needed.
- Persons retrieving an elk will be required to use the most direct route to and from the nearest designated road, possess a valid hunting license, and keep weapons cased during elk retrieval.
- Crossing live streams and wetlands is not permitted. Cutting fences is not allowed. Resource and infrastructure damage could result in federal fines.
- Scouting off-road in a motorized vehicle is not allowed. There must be a legally harvested, downed elk, at the end of a hunter's motorized jaunt.

Dispersed camping is allowed where indicated on the MVUM. Open fires are never allowed within the Black Hills Fire Protection Boundary. Hunters should come prepared to camp without depending upon an open campfire for warmth and/or cooking.

South Dakota Game, Fish, and Parks worked diligently with BHNF to partner on this off-road exception for elk hunters and a joint MOU was developed (USDA-SDGFP 2010). We encourage hunters be cognizant of the conditions set forth to retrieve downed elk and honor the provisions of "tread lightly" on all outdoor excursions within the BHNF.

Hiking and Camping

South Dakota Game, Fish, and Parks studied elk behavioral and physiological responses to human disturbances in CSP from 1993 – 1997 (Millspaugh 1999). The study looked at several types of human disturbances including use of roads, trails and hunters. CSP trails receive a high volume of foot and horseback traffic during peak tourist season. Use of hiking and horse trails in CSP by all user groups any time during the year affect elk movements but significantly more so in the summer when human use is greatest. Results of the study indicated elk avoided areas within 600 m (656 yards) of trails.

In conclusion, local research of the direct movements of elk and physiological responses due to human activities, particularly use of roads and trails, parallels studies from other western states. In conclusion, the effect of roads on elk decreases as distance from roads increase, irrespective of available vegetative cover. Lyon (1979a) stated that road management is a powerful means of manipulating elk habitat. With recreation of various sorts becoming more and more a demand on public lands and to natural resources, managing recreational and human disturbances will be challenging. Borkowski et al. (2006) suggested (based on findings by Meadow et al. 2005) that the public holds onto their strongly held beliefs and despite

persuasions backed with scientific findings, most people do not change their strongly held attitudes. Never-the-less, science and professional judgment by SDGFP will continue to provide insight into elk-human interactions and impacts to elk habitat (beneficial and negative) which should be considered in public land management in the Black Hills.

Wildlife Guzzlers

Wildlife guzzlers can serve a purpose by supplying surface water where water is a limiting factor. Guzzlers can also entice wildlife to stay on public land. At one time, BHNF, often with the assistance of SDGFP and conservation groups, installed many guzzlers as a tangible wildlife improvement project. However, guzzler maintenance is imperative and if not conducted, guzzlers may become malfunctioning watering mechanisms. Through the years, many guzzlers have fallen into disrepair and to vandalism, but some have been recently repaired primarily through the efforts of public volunteers (e.g., RMEF). Maintenance of these guzzlers is recorded by BHNF personnel. Water sources, including guzzlers, streams, wetlands, ponds, dams, reservoirs, springs and other water enhancements, are dispersed throughout BHNF (Figure 27).

On BHNF, many guzzlers have been installed at the end of a road or have had short spur roads created to get to a guzzler. Placement of some guzzlers has unintentionally created nuisance disturbances by humans that defeat the well intentioned purpose to supply water for wildlife in a safe atmosphere. The discussion of installing additional guzzlers or maintaining current guzzlers on BHNF is within the jurisdiction of BHNF.

Shed Hunting

Shed hunting for private use is legal on lands managed by the BHNF; however, a local BHNF office should be consulted regarding commercial uses and seasonal road closures. No permits are required for recreational or commercial collecting. Sheds cannot be taken from any South Dakota state lands (including parks and Game Production Areas) and National Park Service lands as they are considered a natural feature of the land.

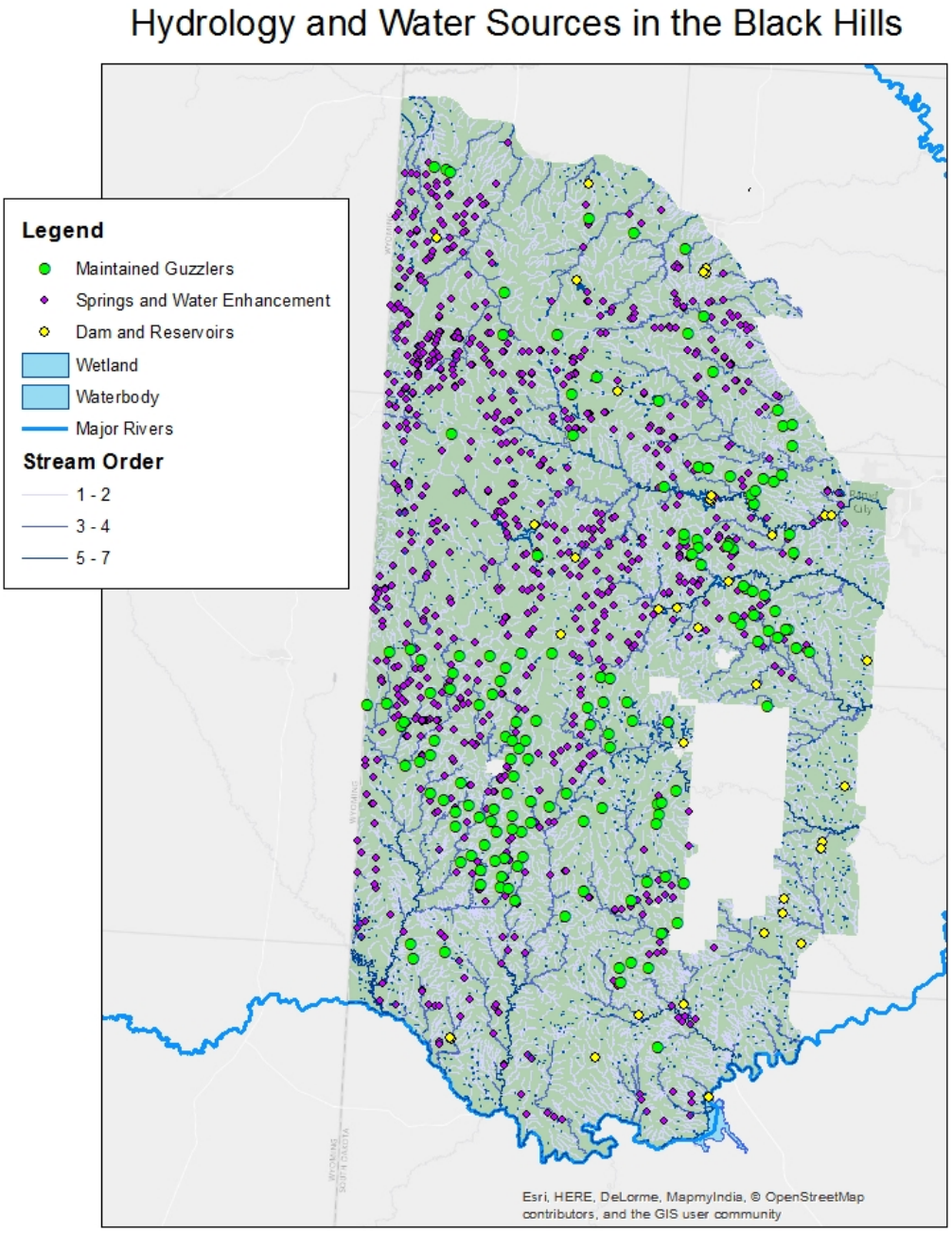

Figure 27. Known hydrology and water sources in the Black Hills of South Dakota.

Note: Water enhancement includes dugouts, ponds, pumps, wells, tanks/towers and windmills

Mining, Energy Development and Transmission

Gold, slate, limestone, pegmatite minerals, mica, iron, clay and aggregate mining along with oil production all occur within South Dakota's elk range. Statewide, 47 mine permits total 6,727 acres; 3,544 acres of those are "affected" or "disturbed" lands (SD/DENR 2012). Abandoned relic mine sites, and gravel operations and quarries are not included in the affected or disturbed mine acreage total; although these sites are locally numerous, the individual areas are small. The majority of disturbance at active or inactive mines in the Black Hills and Prairie Elk Units are less than 50 acres; only 3 mine sites are over 500 acres. These permitted mines exist in various operational stages ranging from active mining to full vegetative reclamation. All types of mining that occur in the Black Hills or Prairie Elk units are considered for long-term planning consideration in this document.

Many mining regulations are in place mitigating impacts to important wildlife habitats and species. SDCL § 45-6B-1, also known as the "South Dakota Mined Land Reclamation Act", is the state's guiding document for mine regulation. Laws in this section explicitly require mine permit applicants to comprehensively describe project area critical resources (SDCL § 45-6B-92) and to determine suitability of land for mining (SDCL § 45-6B-33.3). Implementation of these laws requires applicants to identify project's species use with specific intent to protect critical habitats of these species. State, as well as federal laws require projects to have a site-specific reclamation plan with the priority in re-establishing productivity of the land after mining.

In the Black Hills, the USFS regulates natural resource impacts from mineral development (habitat fragmentation or conversion) and associated infrastructure (roads, pipelines, power lines, etc.) on lands under its control. The BHNF Forest Plan is the USFS guiding document for forest use. Mining objectives found in the plan ensure that exploration, development and production of mineral and energy resources are conducted in an environmentally sound manner so that they may contribute to economic growth and the national defense (USDA 2006). The BHNF Forest Plan specifically requires mine operating plans to restrict periods of operation to reduce disturbance to deer and elk during periods of high use (USDA 2006). In the BHNF Management Areas with emphasis toward big game winter range (MA 5.4) "operating and reclamation plans shall minimize or mitigate impacts to deer and elk habitat" (USDA 2006). NEPA also requires USFS to publicize mining proposals for external review and input of their projects.

Mine vegetative reclamation is often beneficial to big game. In the Black Hills, operations at large-scale mine projects range from operational to fully reclaimed. Reclaimed sites in the predominantly forested Northern Black Hills have created islands of grasslands in an increasingly exurban landscape. Some reclaimed sites in this area currently remain in a prolonged phase of closure even though fully vegetated. As expected the sites provide wildlife with a forage opportunity; and apparently a measure of security as these sites remains off limits to the public for an extended period. Wildlife benefits have not been thoroughly studied at large or small reclaimed sites in the Black Hills. Currently, mining in all elk units appear to add

little significant human, forage or spatial distraction to elk success in the Black Hills or prairie units.

Various types of mining in the Black Hills will continue in some variable extents. Forecasting the location and extent of mining in elk country is however wrought with uncertainties. Long-term impacts to topography and native habitat must be expected as well as short-term impacts from increased human interactions and decreased forage and use. State and federal laws already promulgate protection of areas important to elk. Identification of areas important to elk is therefore necessary to utilize statutory authority and mitigation opportunities for this species.

Similar to mining, predicting the state's energy development is full of uncertainties. To date, no wind or solar energy developments have been proposed on elk units.

Oil exploration in South Dakota currently has one oil rig drilling about one new well per month. The most optimistic oil development scenario statewide predicts northwestern South Dakota having six drilling rigs each drilling an average of one new well per month for the next fifteen years (The Office of Governor Dennis Daugaard 2012). Energy development in the form of electrical transmission and distribution lines are already common throughout the Black Hills region. Mitigation to reduce or eliminate direct loss of wildlife due is addressed in project design criteria developed by participating agencies and energy companies.

Energy transmission right-of-ways (ROW) include both pipelines and electrical transmission lines. ROW development and maintenance create long- term changes in existing elk habitats. Development of ROW includes direct impacts by conversion of native vegetation and habitat fragmentation in contiguous forests. Retaining accessibility, vegetation and weed control result in early successional vegetation to persist as in long narrow ROW habitat.

Impacts to elk herds occur during construction and infrastructure concomitant to this activity. Road construction, blasting, equipment staging areas, frequent human disturbances, noisy motorized equipment is direct short term impacts. Long term impacts are decreased security and productivity resulting from loss of valuable habitat. Early successional vegetation commonly found in ROW is dietary preferences of elk which may alter their movements. Authorized or unauthorized motorized vehicle use on the ROW may also have a delirious effect on movements.

GOALS, OBJECTIVES & STRATEGIES

Guiding Principles

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

- that wildlife, including elk, contributes significantly to the quality of life in South Dakota and therefore must be sustained for future generations.
- that elk play an important role in the forest and rangeland ecosystems.
- in providing for and sustaining the diversity of our wildlife heritage for present and future generations.
- in management of elk in accordance with biologically sound principles and considering social tolerances.
- in providing accurate and timely information to the public concerning elk and associated recreational opportunities in South Dakota.
- that the future of elk in South Dakota depends on a public that appreciates, understands and supports elk and their habitats.
- that elk are an important aspect of tourism and visitor opportunities.

Population Goals

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

The current Black Hills population objective (excluding CSP and WICA) is 7,000 wintering elk, but may range from 6,000 to 8,000 depending on habitat conditions. South Dakota Game, Fish, and Parks will adjust elk hunting licenses to gradually increase elk populations to this objective by 2019. The current population objective for CSP is 800 wintering elk and will generally range from 700-900 depending on habitat conditions; forage models may slightly increase or decrease this range depending on precipitation patterns. These population objectives were developed after thorough analyses of elk population data, available habitat resources on public land, private land depredation issues, and substantial input from a wide variety of publics with an interest in elk management in South Dakota. SDGFP will adopt harvest strategies that will progressively allow the elk population to reach these population objectives.

Aerial elk surveys provide substantial information about wintering elk densities and distribution in the Black Hills of South Dakota, but elk are known migrators and often gather in large concentrations during winter months on established wintering grounds. In 2013 SDGFP witnessed this migration, as approximately 75% of all elk counted during Black Hills aerial surveys were observed in the Jasper fire burn area. Estimates of elk distribution in other seasons (i.e., spring, summer, fall) are unknown; therefore estimates of elk in specific

management units outside of winter concentrations are unknown. Without unit population estimates, numerical unit management objectives are impractical. As a result, individual elk management units will be managed to increase, maintain, or decrease elk populations; hereafter referred to as unit management direction (Figure 21). Management unit direction will be based on annual collection and evaluation of elk population, habitat conditions, and social data.

Population objectives for prairie elk units will also be specific to management unit direction and not specific densities. Survey data are lacking for most prairie units and elk densities are primarily managed to abate substantial agricultural damages on private property while at the same time to provide recreational hunting opportunity. Management directives (increase, maintain, decrease) for each prairie elk unit will be evaluated annually (Figure 21).

Objectives and Strategies

Objective 1: Maintain, manage, and protect existing elk habitat throughout the Black Hills.

Strategy A: Annually work with public land management agencies, conservation organizations, and private landowners to identify and inventory the most important elk habitat areas in the Black Hills.

Strategy B: Annually work with public land management agencies, conservation organizations, and private landowners to identify threats to the most important elk habitat areas in the Black Hills.

Strategy C: Annually work with public land management agencies, conservation organizations, and private landowners to identify the most appropriate and feasible protection mechanism to address threats to the most important elk habitat areas in the Black Hills.

Strategy D: Annually work with public land management agencies, conservation organizations, and private landowners to consider elk habitat needs in their land management planning objectives, including the use of livestock as a management tool to enhance important elk habitat areas.

Strategy E: Work with public land management agencies, conservation organizations, and private landowners to establish and conduct a long-term monitoring strategy to quantify and evaluate elk and other wildlife habitat on the most important elk habitat areas in the Black Hills.

1. Develop a cooperative strategy with USFS to monitor forest and rangeland conditions in areas critical to elk management in the Black Hills by June of 2016.

Strategy F: Annually work with public land management agencies, conservation organizations, and private landowners to identify and secure funding opportunities for elk habitat improvement projects on both public and private lands in the Black Hills.

Strategy G: Utilize land acquisition, both in fee-title and by conservation easement, to protect the most important elk habitat areas in the Black Hills.

Objective 2: Manage for biologically and socially acceptable elk populations in each elk management unit within the Black Hills, CSP, and Prairie units of South Dakota.

Strategy A. Assess and monitor elk population levels and trends by completing winter aerial surveys in all Black Hills elk management units every 3-4 years.

Strategy B. Use population modeling to estimate elk population trends of Black Hills elk in years with no aerial survey data.

Strategy C. Annually conduct and assess Black Hills fall and spring herd composition surveys.

Strategy D. Annually survey hunters to estimate elk harvest levels and distribution, age of harvested animals, number of hunters, hunter success, and hunter satisfaction.

Strategy E. Annually assess the Black Hills elk management goal and elk unit management directions, and utilize necessary harvest management tools to ensure management directions are met as outlined in Figure 21.

Strategy F. Based on habitat conditions and population densities, in concert with input from the public and BHNF range conservationists, periodically evaluate if adjustments to management unit directions are warranted.

Strategy G. Biannually (when developing season recommendations in February and again in mid to late summer) evaluate environmental and range conditions for impacts from drought, wild fires, etc. to determine if harvest management strategies are appropriate for the range conditions. Evaluations will include USFS precipitation regressions and annual reports, personal communication with USFS staff, United States Drought Monitor (www.droughtmonitor.unl.edu), precipitation and forage production models and other monitoring information.

1. Allocate sufficient "antlerless elk" licenses when the elk hunting season is proposed by the GFP Commission in March to achieve adjustments in population levels that are consistent with elk population goals and current range conditions.
2. Promulgate Administrative Rule (http://legis.sd.gov/Rules/DisplayRule.aspx?Rule=41:06:26) to allow for the allocation of a pool of "antlerless elk" contingency licenses (based on a percentage of the antlerless licenses available in the Black Hills firearm season) that would be issued by GFP Commission resolution in August if summer range conditions dictate an adjustment in the harvest management strategy adopted by the GFP Commission earlier in that year.

3. During periods of drought that last more than one year, set harvest management strategies that move the elk population towards the lower end of the population objective range.

Objective 3: Manage elk populations in the Black Hills and CSP for quantity and quality recreational hunting opportunities, with an emphasis in CSP on view ability for visitors to the park.

Strategy A. Set population goals at appropriate levels that can be sustained by available habitat on public lands, without affecting long term range conditions and causing substantial damages to private property.

Strategy B. Manage for a minimum of 60% hunter success for hunters with "any elk" Black Hills and CSP firearm license types.

Strategy C. Manage combined Black Hills elk management units for an average minimum bull harvest age structure of 30% bulls 4+ years or older, and manage CSP for a minimum of 60% bulls 4+ years or older.

Strategy D. Maintain maximum elk hunting opportunities in the Black Hills by allocating 25% of total "any elk" licenses and 10% of total "antlerless elk" licenses available in the Black Hills as archery licenses, with the remainder (75% any-elk and 90% antlerless elk) issued as firearm licenses.

Strategy E Maintain maximum elk hunting opportunities in CSP by allocating 25% of "any elk" licenses available in CSP as archery licenses, with the remainder (75%) issued as firearm licenses. Antlerless management will be conducted using firearm hunters.

Strategy F. Further evaluate license application and lottery system to increase success of applicants with multiple years of preference points by December of 2016.

Strategy G. Further evaluate the current landowner preference system and determine if any changes are necessary by December of 2016.

Strategy H. Continue with the allocation of 1 resident elk raffle license to a non-profit organization, with funds used to benefit elk conservation in South Dakota.

Strategy I. Further evaluate resident and nonresident raffle and auction licenses as a means to enhance elk management in the Black Hills by December of 2017.

Strategy J. Elk management in Custer State Park will continually strive to produce high quality wildlife viewing opportunities in conjunction with compatible recreational hunting opportunities.

Objective 4. Engage and collaborate with the public to manage elk populations and maintain acceptable "elk unit management directions" as described and used in Objective 2, Strategy E.

Strategy A. Annually meet with concerned and interested individuals, NGOs, WYGF, NGPC, Tribal agencies, local sportsman's groups, USFS, livestock organizations, private landowners and lessees to facilitate discussions about elk populations and management.

Strategy B. When appropriate, involve SDGFP Regional Advisory Panels with further development of this plan and with future issues related to elk management.

Strategy C. Annually gather public input on elk management unit directions through Regional Public Open-houses, local press releases, and field staff contacts.

Objective 5: Cooperatively work with private landowners to resolve elk depredation to growing crops, stored-feed supplies, and private property.

Strategy A. Respond to all elk depredation concerns on private land in a timely manner.

Strategy B. Annually evaluate effectiveness of SDGFP depredation abatement management techniques and programs.

Strategy C. Develop and evaluate new management techniques that can minimize damage to private property caused by elk.

Strategy D. Continue to utilize elk depredation pool hunts (ARSD § 41:06:52) when warranted, to address elk depredation concerns.

Strategy E. Evaluate funding levels to ensure sufficient funds are available to address elk depredation requests for assistance from private landowners.

Strategy F. Expand hunting opportunities where/when possible to address elk depredation on private lands.

Objective 6: Monitor and evaluate risk and impact of disease in wild elk herds in South Dakota.

Strategy A. Investigate and collect biological samples from all reported or observed sick and/or dead elk demonstrating symptoms of concern.

Strategy B. Cooperate with WICA to monitor and address current disease issues in the southern Black Hills of South Dakota.

Strategy C. Work with the South Dakota Animal Industry Board on CWD, Brucellosis, and other potential disease risks to wild elk from captive cervids in the Black Hills and other areas within South Dakota.

Strategy D. Work with Tribal entities within South Dakota and surrounding State agencies of Nebraska, Wyoming, and North Dakota on disease concerns of elk.

Strategy E. Minimize the potential spread of any known disease beyond currently infected areas of the state. This includes restricting the unnatural movement of elk, except where extraordinary management activities are necessary and approved by the Department Secretary, that are known to carry disease within the State of South Dakota to locations with or without known disease presence.

Strategy F. Monitor elk disease by collecting and sampling all voluntary hunter submissions; adjust monitoring efforts when deemed necessary.

Objective 7: Provide the public with access to private and public land for quality hunting opportunities.

Strategy A. Promote the Wildlife Division's Walk-In Area and Controlled Hunting Access Programs with private landowners, with special emphasis on well managed forest and range habitats within the Black Hills where high densities of elk exist.

Strategy B. Promote the Elk Hunter Access program to facilitate hunter harvest on private lands experiencing depredation, and evaluate methods to fairly distribute these opportunities among volunteer hunters.

Strategy C. Provide up-to-date public land layers available for free download to be used in conjunction with compatible GPS units.

Strategy D. Annually explore methods to increase the quality of elk hunting opportunities on public land and private land.

Strategy E. Coordinate and assist other public land managers with posting property boundaries.

Strategy F. Promote and encourage hunters to respect private property boundaries and seek hunting permission well in advance of season opening dates.

Strategy G. Work cooperatively with BHNF to address road closure and recreational access issues during hunting seasons and on critical elk wintering habitats.

Objective 8: Evaluate research and management needs and prioritize frequently.

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

Strategy B. Periodically review elk survey protocol and discuss changes that could improve data collection efficiency and accuracy.

Strategy C. Formally evaluate Elk Management Plan at least every 5 years. Plan updates and changes, however, may occur more frequently as needed.

Strategy D. The SDGFP will send at least one staff member to the biennial Western States Deer and Elk Workshop. This meeting facilitates the exchange of information between states on survey techniques, harvest regulations, research and habitat management.

Strategy E. The SDGFP will consider sending a representative to scientific meetings that will exchange information related to elk management.

Strategy F. The SDGFP will work with BHNF on site-specific projects and changes to forest-wide planning to exchange information and ensure elk and other big game habitat needs are considered.

Objective 9: Promote public, landowner, and conservation agency awareness of elk and habitat management issues of highest conservation concern.

Strategy A. By April of 2015, make available paper and electronic copies of "Elk Management Plan for South Dakota 2015" to all interested conservation partners, the public, and private landowners.

Strategy B. Periodically include articles about elk and elk habitat in the South Dakota Conservation Digest and other popular magazines, journals, and media outlets.

Strategy C. By December of 2015, add a web page about elk under the outdoor learning section of the department website which includes descriptions and pictures of elk in South Dakota.

Objective 10: Provide opportunities for public involvement in elk management.

Strategy A. By July of 2016, explore the use of online platforms for facilitating public involvement which removes both temporal and geographic barriers to participation.

Strategy B. Engage affected stakeholders and interested citizens in the elk management decision-making process through 2020.

Strategy C. Use a variety of formal and informal public involvement strategies to encourage all citizens to participate in the process.

Strategy D. By 2020, evaluate trends in hunter and landowner perceptions and public opinion regarding elk management in South Dakota.

Strategy E. Conduct a public opinion survey of elk license applicants, landowners and lessees every 5 years.

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APPENDIX

Appendix 1. Transplant history of elk in South Dakota, 1911-2014.

Date	Source Location	Receiving Agency/State	Total	Sex	Age	Data Source
1911	-	N. Black Hills, SD	100	-	-	Rice 1988
1912	-	CSP[1]	65	-	-	Hipschman 1959
1912	Idaho	N. Black Hills, WY	21	-	-	Rice 1988
1912	YNP[2]	Aberdeen, SD	3	-	-	Robbins et al. 1982
1913	Idaho	N. Black Hills, WY	21	-	-	Rice 1988
1914	YNP[2]	Hot Springs, SD	2	-	-	Robbins et al. 1982
1914	Jackson Hole, WY	WICA[3]	14	9F, 5M	-	Lovaas 1973, Rice 1988
1914	Gardiner, MT	CSP[1]	25	-	-	Hedrick 1914
1915	Gardiner, MT	CSP[1]	50	-	-	Hedrick 1915
1916	YNP[2]	WICA[3]	25	-	-	Lovaas 1973
1916	Gardiner, MT	CSP[1]	50	-	-	Hedrick 1917, Millspaugh and Brundige 1996a
1924	WICA[3]	Pennsylvania Game Commission	6	-	-	Pennsylvania Game Commission 2013
1926	WICA[3]	Pennsylvania Game Commission	4	-	-	Pennsylvania Game Commission 2013
1929	WICA[3]	Texas via Carlsbad, NM	47	-	-	NPS 1978

Date	Source Location	Receiving Agency/State	Total	Sex	Age	Data Source
08/27/1963	WICA[3]	CSP[1]	153	-	-	Lovaas 1973, NPS 1963
03/21/1968	WICA[3]	CSP[1]	94	-	-	Lovaas 1973, NPS 1968
10/27/1971	WICA[3]	Oglala Sioux Tribe, SD	2	2M	2Ad	NPS 1971
1970-1972	WICA[3]	Jicarilla Apache Tribe, NM	350	-	-	Lovaas 1973
1970-1972	WICA[3]	Oglala Sioux Tribe, SD	153	-	-	Lovaas 1973
1970-1972	WICA[3]	CSP[1]	126	-	-	Lovaas 1973
03/09/1973	WICA[3]	Oglala Sioux Tribe, SD	9	9M	9Ad	NPS 1973
01/05/1976	WICA[3]	Round Valley Indian Tribes, CA	10	7F, 3M	5Calf, 5Ad/Yr	NPS 1976a
01/06/1976	WICA[3]	Chippewa-Cree Tribe, MT	26	17F, 9M	5Calf, 21Ad/Yr	NPS 1976b
01/07/1976	WICA[3]	Lower Brule Sioux Tribe, SD	50	-	-	NPS 1976c
01/07/1976	WICA[3]	Cheyenne River Sioux Tribe, SD	42	-	-	NPS 1976c
01/10/1977	WICA[3]	Oglala Sioux Tribe, SD	50	38F, 12M	22Calf, 28Ad/Yr	NPS 1977
01/11/1977	WICA[3]	Colville Tribe, WA	50	38F, 12M	23Calf, 27Ad/Yr	NPS 1977
01/11/1977	WICA[3]	Three Affiliated Tribe, ND	52	31F, 21M	26Calf, 26Ad/Yr	NPS 1977
01/12/1977	WICA[3]	Tonkana Tribe and Kaw Tribe, OK	24	17F, 7M	11Calf, 13Ad/Yr	NPS 1977
01/13/1977	WICA[3]	Oglala Sioux Tribe, SD	9	8F, 1M	2Calf, 7Ad/Yr	NPS 1977
12/15/1980	WICA[3]	CSP[1]	20	18F, 2M	6Calf, 14Ad/Yr	Rice 1988
12/15/1980	WICA[3]	Castle Creek, Black Hills, SD	11	9F, 2M	3Calf, 8Ad/Yr	Rice 1988

Date	Source Location	Receiving Agency/State	Total	Sex	Age	Data Source
12/15/1980	WICA[3]	Medicine Mountain, Black Hills, SD	10	9F, 1M	4 calves, 6 Ad/Yrlng	Rice 1988
12/19/1980	WICA[3]	Mud Springs, Black Hills, SD	10	8F, 2M	2 calves, 8 Ad/Yrlng	Rice 1988
12/19/1980	WICA[3]	Northern Cheyenne Tribe, MT	36	23F, 13M	8 calves, 28 Ad/Yrlng	NPS 1980
01/09/1985	WICA[3]	Mud Springs, Black Hills, SD	17	11F, 6M	7 calves, 10 Ad/Yrlng	Rice 1988
01/09/1985	WICA[3]	Pass Creek, Black Hills, SD	17	10F, 7M	10 calves, 7 Ad/Yrlng	Rice 1988
03/20/1985	WICA[3]	Theodore Roosevelt NP, ND	47	38F, 9M	3 calves, 44 Ad/Yrlng	NPS 1985a
01/28/1986	WICA[3]	Deerfield, Black Hills, SD	4	3F, 1M	4 Ad/Yrlng	Rice 1988
01/28/1986	WICA[3]	Lower Brule Sioux Tribe, SD	24	16F, 8M	9 calves, 15 Ad/Yrlng	NPS 1986a
01/28/1986	WICA[3]	Rosebud Sioux Tribe, SD	29	21F, 8M	10 calves, 19 Ad/Yrlng	NPS 1986a
01/28/1986	WICA[3]	Yankton Sioux Tribe, SD	10	7F, 3M	3 calves, 7 Ad/Yrlng	NPS 1986a
01/28/1986	WICA[3]	Sisseton-Wahpeton Oyate Tribe, SD	16	11F, 5M	5 calves, 11 Ad/Yrlng	NPS 1986a
01/28/1986	WICA[3]	Oglala Sioux Tribe, SD	42	29F, 13M	14 calves, 28 Ad/Yrlng	NPS 1986a
02/05/1990	WICA[3]	Veterans Peak, Black Hills, SD	18	16F, 2M	4 calves, 14 Ad	SDGFP 1990

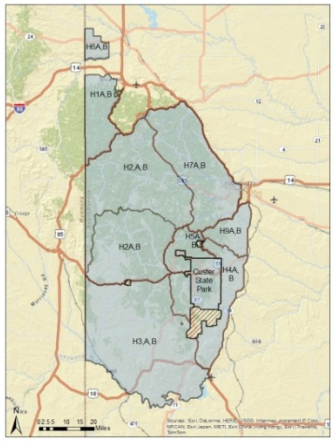
Date	Source Location	Receiving Agency/State	Total	Sex	Age	Data Source
02/05/1990	WICA[3]	Red Hill, Black Hills, SD	40	33F, 5M, 2Unk	8 calves, 32 Ad	SDGFP 1990
Feb. 1990	WICA[3]	Spokane Tribe, WA	48	41F, 7M	1 calf, 47 Ad/Yrlng	NPS 1990a
Feb. 1990	WICA[3]	Kaw Tribe, OK	48	47F, 1M	5 calves, 43 Ad/Yrlng	NPS 1990a
Feb. 1990	WICA[3]	Lower Brule Sioux Tribe, SD	103	91F, 12M	103 Ad/Yrlngs	NPS 1990a
05/03/1993	THRO[4]	Cheyenne River Sioux Tribe, SD	52	33F, 19M	21 calves, 31 Ad/Yrlng	NPS 1993
05/03/1993	THRO[4]	Oglala Sioux Tribe, SD	55	34F, 21M	18 calves, 37 Ad/Yrlng	NPS 1993
05/03/1993	THRO[4]	Standing Rock Sioux Tribe, SD	54	35F, 19M	15 calves, 39 Ad/Yrlng	NPS 1993
01/24/1994	WICA[3]	Rosebud Sioux Tribe, SD	18	16F, 2M	18 Ad/Yrlng	NPS 1994a
01/24/1994	WICA[3]	Fort Riley, KS	18	13F, 5M	2 calves, 16 Ad/Yrlng	NPS 1994a
01/24/1994	WICA[3]	Cheyenne River Sioux Tribe, SD	42	33F, 9M	1 calf, 41 Ad/Yrlng	NPS 1994a
01/24/1994	WICA[3]	Oglala Sioux Tribe, SD	71	44F, 27M	3 calves, 68 Ad/Yrlng	NPS 1994a
12/06/1994	WICA[3]	North Dakota	70	60F, 10M	70 adults	NPS 1994b
12/06/1994	WICA[3]	Oglala Sioux Tribe, SD	44	19F, 25M	-	NPS 1994b
12/06/1994	WICA[3]	Cheyenne River Sioux Tribe, SD	43	9F, 34M	-	NPS 1994b

Date	Source Location	Receiving Agency/State	Total	Sex	Age	Data Source
12/15/2012	WICA[3]	CSP[1]	14	-	-	Lehman 2014
03/01/2013	WICA[3]	CSP[1]	197	-	-	RMEF 2013
03/08/2013	WICA[3]	CSP[1]	192	-	-	RMEF 2013
03/12/2014	WICA[3]	Southern Black Hills, SD	122	-	-	RMEF 2014
03/12/2014	WICA[3]	CSP[1]	39	-	-	RMEF 2014
03/13/2014	WICA[3]	CSP[1]	17	-	-	RMEF 2014

[1] Custer State Park
[2] Yellowstone National Park
[3] Wind Cave National Park
[4] Theodore Roosevelt National Park

Appendix 2. Firearm elk season hunting boundary changes in the Black Hills, South Dakota, 1976-2014.

2002



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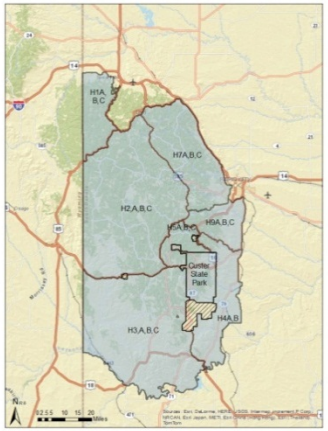

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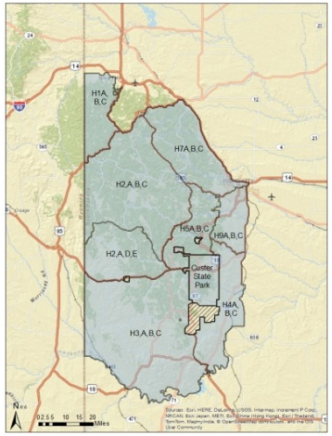

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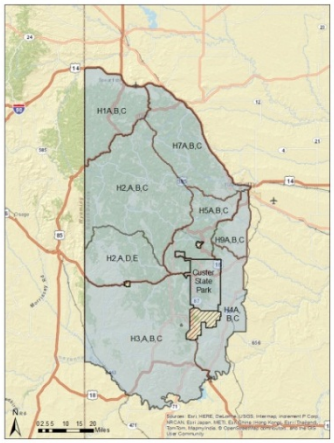


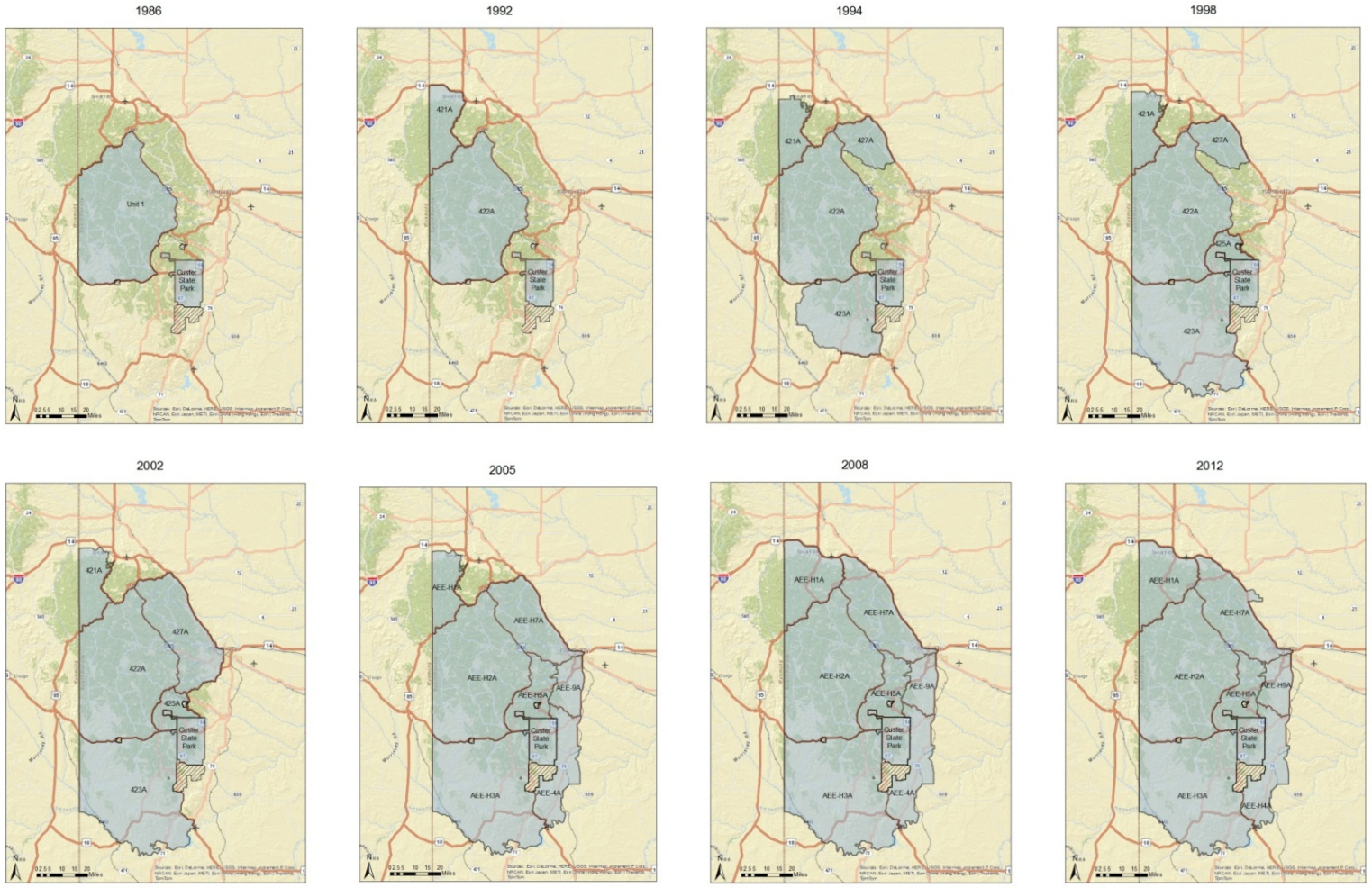
2009

2011

2012

2014

Appendix 3. Archery elk season hunting unit boundary changes in the Black Hills, South Dakota, 1986-2014.

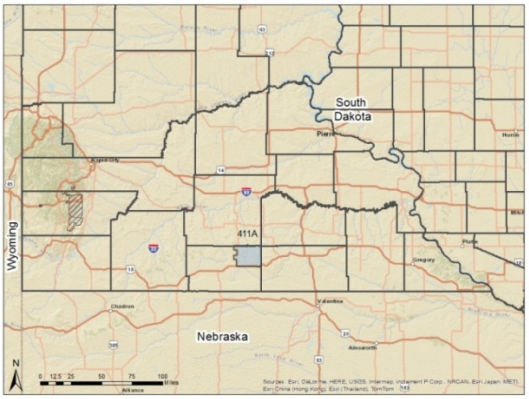


2014

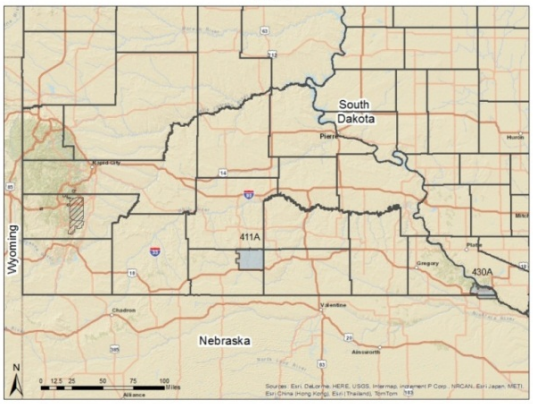

AEE-H1A
AEE-H7A
AEE-H2A
AEE-9A
AEE-H5A
Custer State Park
AEE-H3A
AEE-4A
N
0 2.5 5 10 15 20
Miles

Appendix 4. Prairie elk season hunting unit boundary changes in South Dakota, 1995-2014.

1995



1996



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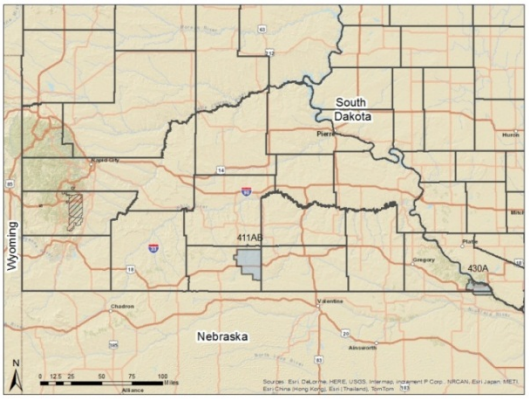

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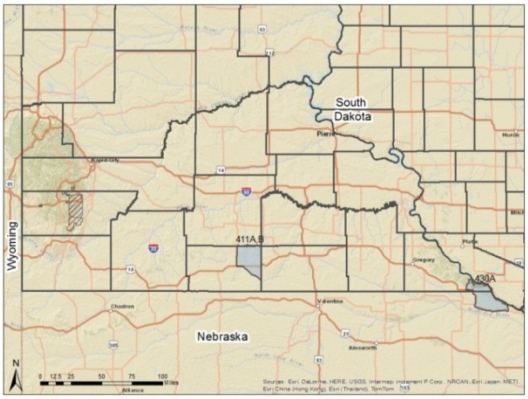
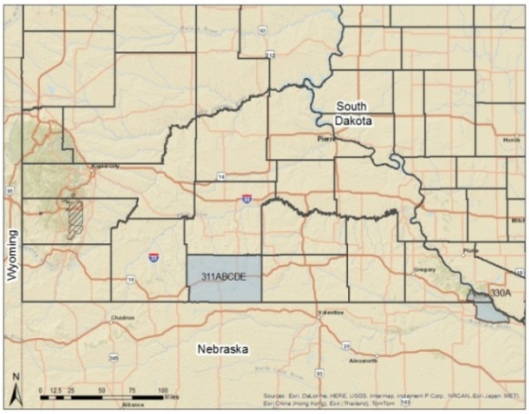
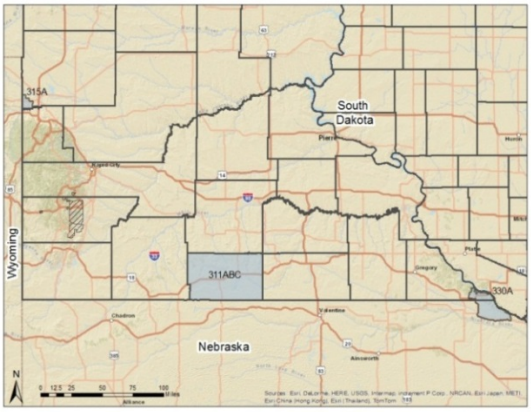


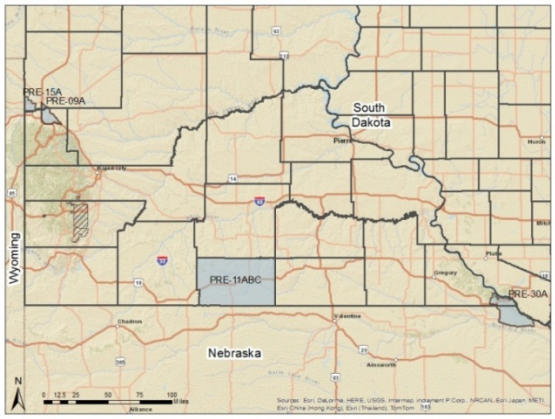
2001



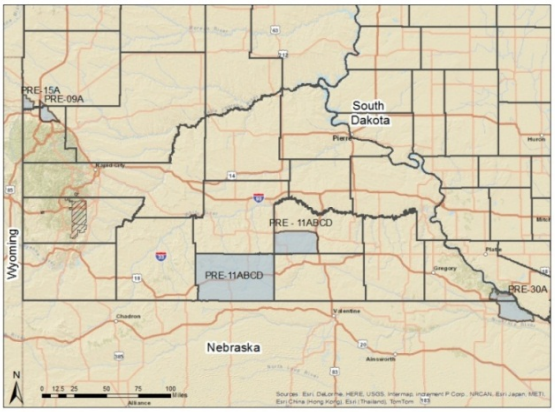
2004



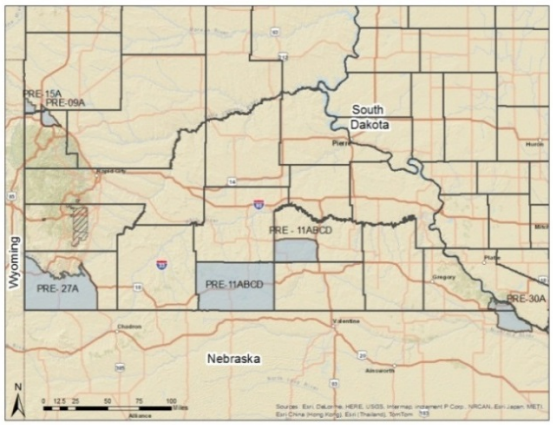
2009



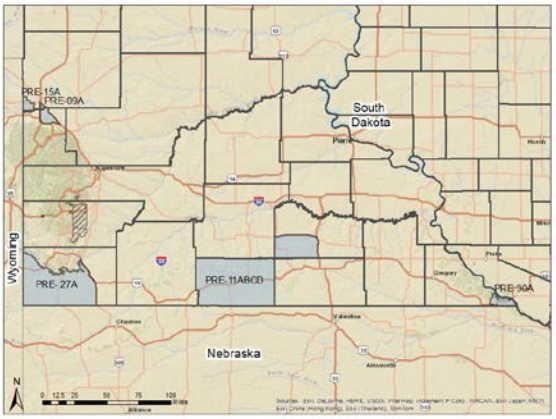
2011



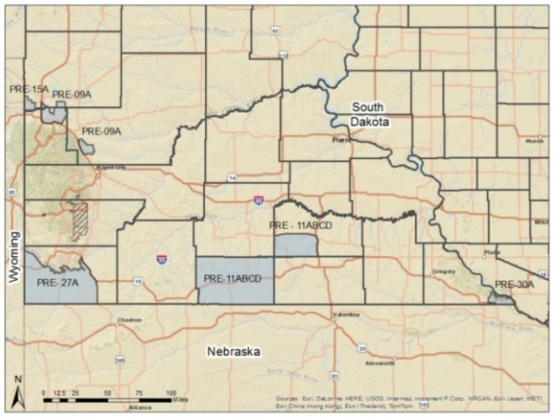
2012



2013



2014



Appendix 5. Custer State Park early archery elk season harvest statistics, 1966-2014.

Year	Applications	Licenses	Total Harvest	Success (%)
1966	NA	20	10	50
1967	NA	21	5	24
1968	NA	10	10	100
1969	NA	23	3	13
1970	NA	20	11	55
1971	NA	20	17	85
1972	NA	30	11	37
1973	NA	20	5	25
1974	NA	20	1	5
1975	NA	20	NA	NA
1976	NA	40	NA	NA
1977	NA	30	7	23
1978	NA	40	9	23
1979	NA	50	2	4
1980	NA	50	9	18
1981	NA	NA	NA	NA
1982	NA	60	11	18
1983	NA	60	NA	NA
1984	NA	60	NA	NA
1985	87	60	9	15
1986	NA	60	11	18
1987	NA	60	7	12
1988	74	60	4	7
1989	NA	5	1	20
1990	NA	5	2	40
1991	107	5	1	20
1992	NA	5	3	60
1993	249	5	0	0
1994	249	5	2	40
1995	441	5	1	20
1996	503	5	4	80
1997	687	5	1	20
1998	775	5	3	60
1999	850	8	4	50
2000	1,067	8	4	50
2001	1,309	8	3	38
2002	1,575	8	3	38
2003	1,642	8	4	50

2004	2,196	8	3	38
2005	2,385	8	3	38
2006	2,700	8	3	38
2007	2,956	8	2	25
2008	3,084	8	2	25
2009	3,134	8	2	25
2010	3,031	5	0	0
2011	2,000	3	1	33
2012	2,078	3	0	0
2013	2,740	3	3	100
2014	3,029	4	4	100

Appendix 6. Custer State Park late archery elk season harvest statistics, 1989-2014.

Year	Applications	Licenses	Total Harvest	Harvest Success (%)
1989	NA	40	3	8
1990	NA	40	6	15
1991	NA	40	12	30
1992	138	40	5	13
1993	129	40	14	35
1994	213	40	11	28
1995	387	50	9	18
1996	443	50	13	31
1997	555	50	6	13
1998	597	50	13	26
1999	667	50	10	20
2000	792	50	13	26
2001	980	50	11	22
2002	1,170	50	5	10
2003	1,136	50	13	26
2004	1,526	46	7	15
2005	1,579	49	6	12
2006	1,823	48	10	21
2007	1,913	50	2	5
2008	2,007	50	6	14
2009	2,012	49	6	13
2010	1,872	30	0	0
2011	1,473	15	0	0
2012	NA	0	NA	NA
2013	NA	0	NA	NA
2014	NA	0	NA	NA

Appendix 7. Custer State Park firearm bull elk season harvest statistics, 1962-2014.

Year	Applications	Licenses	Total Harvest	Harvest Success (%)
1962	NA	60	60	100
1963	NA	60	NA	NA
1964	NA	80	79	99
1965	NA	80	80	100
1966	NA	80	80	100
1967	NA	120	117	98
1968	NA	192	183	95
1969	NA	120	119	99
1970	NA	96	95	99
1971	NA	96	95	99
1972	NA	150	144	96
1973	NA	192	184	96
1974	NA	144	124	86
1975	NA	96	NA	NA
1976	NA	150	125	83
1977	NA	80	66	83
1978	NA	120	89	74
1979	NA	120	82	68
1980	NA	120	96	80
1981	NA	120	103	86
1982	NA	150	99	66
1983	NA	180	141	78
1984	NA	165	116	70
1985	742	135	89	66
1986	909	80	55	69
1987	2,226	75	63	84
1988	1,432	40	34	85
1989	1,739	35	30	86
1990	NA	35	35	100
1991	NA	35	33	94
1992	2,932	36	31	86
1993	3,406	36	36	100
1994	4,094	36	34	94
1995	4,696	36	36	100
1996	5,221	36	36	100
1997	5,679	36	35	97
1998	6,377	41	40	98
1999	6,934	40	40	100
2000	7,704	39	39	100
2001	8,150	41	39	95

2002	8,575	41	38	93
2003	9,165	41	39	95
2004	9,682	40	40	100
2005	11,138	41	39	95
2006	10,672	41	39	95
2007	11,374	41	37	93
2008	10,998	36	35	97
2009	10,823	36	31	86
2010	10,823	21	16	76
2011	8,022	11	10	91
2012	6,582	4	4	100
2013	7,860	4	4	100
2014	8,092	5	5	100

Appendix 8. Custer State Park firearm antlerless elk season harvest statistics, 1979-2014.

Year	Applications	Licenses	Total Harvest	Harvest Success (%)
1979	NA	50	43	86
1980	NA	NA	NA	NA
1981	NA	120	39	33
1982	NA	45	20	44
1983	NA	105	100	95
1984	NA	90	55	61
1985	NA	90	59	65
1986	NA	45	27	60
1987	NA	40	34	85
1988	NA	NA	NA	NA
1989	NA	NA	NA	NA
1990	NA	NA	NA	NA
1991	NA	NA	NA	NA
1992	NA	NA	NA	NA
1993	NA	NA	NA	NA
1994	903	29	28	97
1995	1,392	40	39	98
1996	1,661	70	63	93
1997	1,928	80	73	91
1998	2,189	85	81	95
1999	2,401	90	74	82
2000	2,740	100	81	81
2001	2,931	100	76	76
2002	3,104	121	82	68
2003	3,266	129	95	74
2004	3,514	148	127	86
2005	4,313	126	89	71
2006	3,651	126	92	73
2007	3,774	60	32	53
2008	3,655	40	23	58
2009	3,550	20	19	95
2010	3,197	5	4	80
2011	NA	0	NA	NA
2012	NA	0	NA	NA
2013	NA	0	NA	NA
2014	NA	0	NA	NA

Appendix 9. Aerial surveys completed in the Black Hills of South Dakota, 1955-2013.

Year	Area Surveyed	Time of Year	Survey methods	Model Used	Estimate within management unit	Upper	Lower	Area Surveyed (SqMi) or units size if area not provided	Density Estimate for survey area (elk/SqMi)	Extrapolated elk population estimate for Black Hills
2013-2014	Entire Black Hills	February	Complete coverage of Black Hills, 300 AGL and transects 650-1000 feet apart	Black Hills Sightability Model	Unit 1 = 277, Unit 2 = 3819, Unit 3 = 698, Unit 4 = 65, Unit 5 = 13, Unit 7 = 205, Unit 9 = 0, CSP = 506, WCNP = 484			3045	1.99	6067 (95% CI: 5794 to 7115) (includes parks)
2012-2013	Unit 1 and 2	February	Complete coverage of Unit 1 and partial coverage of Unit 2 (17 of 55 subunits) 300 AGL and transects 650-1000 feet apart	Black Hills Sightability Model	Unit 1 estimate of 169 (+/- 13) (159 observed), Unit 2 estimate of 3135 (+/- 1816) (969 observed)			Unit 1 was 266 SqMi (entire unit) and Unit 2 was 300 of 883 SqMi covered	Unit 1 = 0.64 & Unit 2 = 3.55	
1999-2000	7A	Winter	Fly subunits predicted to have elk present (23 flown of 27 total) (10 of these subunits had elk)	Idaho Elk Sightability Model	244 (221 observed)	271	217	361	0.68	
1998-1999	1A	January	Fly subunits predicted to have elk present (12 flown of 42 total) (9 of these subunits had elk)	Idaho Elk Sightability Model	401 (+/-26) (377 observed)	427	375	266	1.05	

Year	Area Surveyed	Time of Year	Survey methods	Model Used	Estimate within management unit	Upper	Lower	Area Surveyed (SqMi) or units size if area not provided	Density Estimate for survey area (elk/SqMi)	Extrapolated elk population estimate for Black Hills
1997-1998	2A	January	Fly subunits predicted to have elk present (64 flown of 128 total) (18 of these subunits had elk)	Idaho Elk Sightability Model	251 (+/- 27) (215 observed)	278	224	883	0.28	
1996-1997	2A	Winter	Fly subunits predicted to have elk present (40 flown of 128 total) (21 of these subunits had elk)	Idaho Elk Sightability Model	585 (529 observed)	618	552	883	0.66	
1995-1996	3A	Winter	Fly subunits predicted to have elk present (30 classified as high (2) and low density (28) and all high density were flown and 17 of low density were flown of 42 total) (6 out of the 19 subunits flown had elk present)	Idaho Elk Sightability Model	378 (258 observed)	500	256	838	0.45	
1994-1995	3A	Winter	Fly subunits predicted to have elk present (35 were flown of 42 total) (10 out of the 35 subunits flown had elk present)	Idaho Elk Sightability Model	432 (386 observed)	473	391	838	0.52	
1993-1994	1A	January	Fly subunits predicted to have elk present (9 were flown of 42 total) (5 out of the 9 subunits flown had elk present)	Idaho Elk Sightability Model	208 (+/- 58) (139 observed)	266	150	266	0.78	

Year	Area Surveyed	Time of Year	Survey methods	Model Used	Estimate within management unit	Upper	Lower	Area Surveyed (SqMi) or units size if area not provided	Density Estimate for survey area (elk/SqMi)	Extrapolated elk population estimate for Black Hills
1992-1993	1A	February	Fly subunits predicted to have elk present (23 were flown of 42 total) (5 out of the 23 subunits flown had elk present)	Idaho Elk Sightability Model	131 (+/- 24) (106 observed)	155	107	266	0.49	
1992-1993	2/3 of Wind Cave (Block 1 and 3)	September	September sightability flights with drive counts to determine existing population	Idaho Elk Sightability Model	241(+/-55) in Block 1&3 on first model run and 302(+/-57) in Bloc 1&3 on second model run					
1985-1986	Butte Co., Northeast hills, Unit 1, Unit 2, Unit 3, and Unit 4	Winter	Survey with National Guard helicopter, on the ground observations, track counts, and additional fall harvest data.	Winter census using track counts and both aircraft and on-the-ground observations. No methodology of flights presented.	940					890

Year	Area Surveyed	Time of Year	Survey methods	Model Used	Estimate within management unit	Upper	Lower	Area Surveyed (SqMi) or units size if area not provided	Density Estimate for survey area (elk/SqMi)	Extrapolated elk population estimate for Black Hills
1956-1957	CSP and surrounding area	January	Fly 1/4 mile belt transects 300 feet AGL. Determine detection by using ground located elk groups and determine if they were missed by the census party. 3 groups ground located, 1 missed by aerial group for a -60% error.	30% detection	300 total (0 outside the park)					
1955-1956	CSP and surrounding area	January	Fly 1/4 mile belt transects 300 feet AGL. Determine detection by using ground located elk groups and determine if they were missed by the census party. 6 groups ground located, 3 missed by aerial group for a -50% error.	50% detection	500 total (21 outside park)					

Appendix 10. Aerial surveys completed in Custer State Park , 1979-2013.

Year	Area	Time of Year	Survey Methods	Model Used	Estimate	Upper	Lower	Area (SqMi)	Density (elk/SqMi)	Estimate
2013	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	Poisson Mark-Resight Model	396	512	324	111	3.6	396 (95% C.I. 324-512)
2012-13	CSP	March	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	Poisson Mark-Resight Model	508	718	501	111	4.6	508 (95% C.I. 501-718)
2012	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	Poisson Mark-Resight Model	139	195	99	111	1.3	139 (95% C.I. 99-111)
2011-12	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	Poisson Mark-Resight Model	125	154	124	111	1.1	125 (95% C.I. 124-154)
2011	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	Poisson Mark-Resight Model	128	192	107	111	1.2	128 (95% C.I. 107-192)
2010-11	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	228			111	2.1	228 (no 95% C.I.)
2010	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	83			111	0.75	83 (no 95% C.I.)

Year	Area	Time of Year	Survey Methods	Model Used	Estimate	Upper	Lower	Area (SqMi)	Density (elk/SqMi)	Estimate
2009-10	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	222			111	2	222 (no 95% C.I.)
2009	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	167			111	1.5	167 (no 95% C.I.)
2008-09	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	408			111	3.7	408 (no 95% C.I.)
2008	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	165			111	1.5	165 (no 95% C.I.)
2007-08	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	527			111	4.7	527 (no 95% C.I.)
2007	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	244			111	2.2	528 (no 95% C.I.)
2006-07	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	560			111	5	560 (no 95% C.I.)
2006	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	113			111	1	113 (no 95% C.I.)

Year	Area	Time of Year	Survey Methods	Model Used	Estimate	Upper	Lower	Area (SqMi)	Density (elk/SqMi)	Estimate
2005-06	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	718			111	6.5	718 (no 95% C.I.)
2005	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	199			111	1.8	199 (no 95% C.I.)
2004-05	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	950			111	8.6	950 (no 95% C.I.)
2004	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	313			111	2.8	313 (no 95% C.I.)
2003-04	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	985			111	8.9	985 (no 95% C.I.)
2003	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	426			111	3.8	426 (no 95% C.I.)
2002-03	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	1,030			111	9.3	1,030 (no 95% C.I.)
2002	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	472			111	4.3	472 (no 95% C.I.)

Year	Area	Time of Year	Survey Methods	Model Used	Estimate	Upper	Lower	Area (SqMi)	Density (elk/SqMi)	Estimate
2001-02	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	1,088			111	9.8	1,088 (no 95% C.I.)
2001	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	236			111	2.1	236 (no 95% C.I.)
2000-01	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	1,030			111	9.3	1,030 (no 95% C.I.)
2000	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	312			111	2.8	312 (no 95% C.I.)
1999-2000	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	1,068			111	9.6	1,068 (no 95% C.I.)
1999	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	458			111	4.1	458 (no 95% C.I.)
1998-99	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	1,106			111	10	1,106 (no 95% C.I.)
1998	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	413			111	3.7	413 (no 95% C.I.)

Year	Area	Time of Year	Survey Methods	Model Used	Estimate	Upper	Lower	Area (SqMi)	Density (elk/SqMi)	Estimate
1997-98	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	856			111	7.7	856 (no 95% C.I.)
1997	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	427			111	3.9	427 (no 95% C.I.)
1996-97	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	897			111	8.1	897 (no 95% C.I.)
1996	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	397			111	3.6	397 (no 95% C.I.)
1995-96	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	1,126			111	10.1	1,126 (no 95% C.I.)
1995	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	297			111	2.7	297 (no 95% C.I.)
1994-95	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	796			111	7.2	796 (no 95% C.I.)
1994	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	316			111	2.9	316 (no 95% C.I.)

Year	Area	Time of Year	Survey Methods	Model Used	Estimate	Upper	Lower	Area (SqMi)	Density (elk/SqMi)	Estimate
1993-94	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	879			111	7.9	879 (no 95% C.I.)
1993	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	477			111	4.3	477 (no 95% C.I.)
1992-93	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	829			111	7.5	829 (no 95% C.I.)
1992	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	263			111	2.4	263 (no 95% C.I.)
1991-92	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	581			111	5.2	581 (no 95% C.I.)
1991	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	166			111	1.5	166 (no 95% C.I.)
1990-91	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	341			111	3.1	341 (no 95% C.I.)
1990	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	56			111	0.5	56 (no 95% C.I.)

Year	Area	Time of Year	Survey Methods	Model Used	Estimate	Upper	Lower	Area (SqMi)	Density (elk/SqMi)	Estimate
1989-90	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	446			111	4	446 (no 95% C.I.)
1989	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	187			111	1.7	187 (no 95% C.I.)
1988-89	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	259			111	2.3	259 (no 95% C.I.)
1988	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	237			111	2.1	237 (no 95% C.I.)
1987-88	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	299			111	2.7	299 (no 95% C.I.)
1987	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	199			111	1.8	199 (no 95% C.I.)
1986-87	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	166			111	1.5	166 (no 95% C.I.)
1986	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	118			111	1.1	264 (no 95% C.I.)

Year	Area	Time of Year	Survey Methods	Model Used	Estimate	Upper	Lower	Area (SqMi)	Density (elk/SqMi)	Estimate
1985-86	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	240			111	2.2	265 (no 95% C.I.)
1985	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	279			111	2.5	279 (no 95% C.I.)
1984-85	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	347			111	3.1	347 (no 95% C.I.)
1984	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	171			111	1.5	171 (no 95% C.I.)
1983-84	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	537			111	4.8	537 (no 95% C.I.)
1983	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	202			111	1.8	202 (no 95% C.I.)
1982-83	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	571			111	5.1	571 (no 95% C.I.)
1982	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	216			111	2	216 (no 95% C.I.)

Year	Area	Time of Year	Survey Methods	Model Used	Estimate	Upper	Lower	Area (SqMi)	Density (elk/SqMi)	Estimate
1981-82	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	521			111	4.7	521 (no 95% C.I.)
1981	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	190			111	1.7	190 (no 95% C.I.)
1980-81	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	317			111	2.9	317 (no 95% C.I.)
1980	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	173			111	1.6	173 (no 95% C.I.)
1979-80	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	399			111	3.6	399 (no 95% C.I.)
1979	CSP	September	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	114			111	1	114 (no 95% C.I.)
1978-79	CSP	February	Complete coverage of CSP, 300 AGL, transects 500-800 m apart	90% detection	393			111	3.5	393 (no 95% C.I.)
1947-48	CSP	January	Complete coverage of CSP with airplane, 200 AGL, transects 800 m apart	90% detection	603			111	5.4	603 (no 95% C.I.)

Appendix 11. Age and gender ratio data completed in Custer State Park, 1979-2014.

Year	Area Surveyed	Time of Year	Survey Methods	calf:cow ratio	bull:cow ratio	calves:100 cows	bulls:100 cows
2014	CSP	September	Ground Survey	0.30	0.21	30	21
2013	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.26	0.21	26	21
2012	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.29	0.33	29	33
2011	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.13	0.43	13	43
2010	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.15	0.96	15	96
2009	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.19	0.29	19	29
2008	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.17	0.59	17	59

Year	Area Surveyed	Time of Year	Survey Methods	calf:cow ratio	bull:cow ratio	calves:100 cows	bulls:100 cows
2007	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.21	0.64	21	64
2006	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.42	0.5	42	50
2005	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.33	0.34	33	34
2004	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.35	0.3	35	30
2003	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.37	0.32	37	32
2002	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.33	0.23	33	23
2001	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.38	0.35	38	35
2000	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.39	0.34	39	34

Year	Area Surveyed	Time of Year	Survey Methods	calf:cow ratio	bull:cow ratio	calves:100 cows	bulls:100 cows
1999	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.28	0.24	28	24
1998	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.37	0.15	37	15
1997	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	-	-	-	-
1996	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.37	0.19	37	19
1995	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.47	0.16	47	16
1994	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.51	0.26	51	26
1993	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.60	0.4	60	40
1992	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.55	0.34	55	34

Year	Area Surveyed	Time of Year	Survey Methods	calf:cow ratio	bull:cow ratio	calves:100 cows	bulls:100 cows
1991	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.53	0.26	53	26
1990	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.46	0.3	46	30
1989	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.27	0.21	27	21
1988	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.29	0.07	29	7
1987	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.32	0.23	32	23
1986	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	-	-	-	-
1985	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.35	0.17	35	17
1984	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.46	0.22	46	22

Year	Area Surveyed	Time of Year	Survey Methods	calf:cow ratio	bull:cow ratio	calves:100 cows	bulls:100 cows
1983	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.33	0.17	33	17
1982	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.35	0.17	35	17
1981	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.36	0.32	36	32
1980	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.32	0.11	32	11
1979	CSP	September	Helicopter Survey, Complete coverage of CSP, 300 AGL, transects 500-800 m apart	0.37	-	37	-

Appendix 12. Memorandum of understanding between Wind Cave National Park and South Dakota Department of Game, Fish & Parks.

MEMORANDUM OF UNDERSTANDING
BETWEEN
THE UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
AND THE
STATE OF SOUTH DAKOTA,
DEPARTMENT OF GAME, FISH AND PARKS

This Agreement is entered into by and between the National Park Service, United States Department of the Interior, acting through the Superintendent of Wind Cave National Park (hereinafter "WICA"), and the State of South Dakota, acting through the Secretary of Game, Fish and Parks (hereinafter "GFP").

ARTICLE I – BACKGROUND AND OBJECTIVES

The objective of this Agreement is to establish standard operating procedures for handling accidental bison exchanges and elk management between Wind Cave National Park and Custer State Park.

This Agreement also reaffirms the commitment to maintain the fence that serves as the common boundary between the two parks.

ARTICLE II – AUTHORITY

A. Federal:

16 U.S.C. §§1-3 A memorandum of understanding is used to document mutually agreed upon policies, procedures, objectives, and/or assistance relationships that do not involve funding. The enabling park legislation or the general management authorities under **16 U.S.C. §§1-3** are the legal authorities for this type of agreement.

B. State:

South Dakota Codified Law (SDCL) 41.17.1.1 State Parks
Rules for administration, management, and development of state park system--Violation as misdemeanor. The Game, Fish and Parks Commission may adopt such rules as may be necessary to establish uniform procedures for the administration, management, and development of the state park system. The state park system includes all lands and waters owned, leased, or controlled by the Department of Game, Fish and Parks and designated as a state park, a state recreation area, a state nature area, a state lakeside use area, or a state recreational trail. Such rules may be adopted in the following areas:

(1) Management and control of public use of all lands, structures, and waters in the state park system;
(2) Issuance, display, inspection, and expiration of park entrance licenses;
(3) Management, control, and protection of the natural, historical, archaeological, and geological resources in the state park system, if the rules do not conflict with chapters 1-19A and 1-20;
(4) Management, control, and protection of wild and domestic animals in the state

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park system;
(5) Regulate the operation of all vehicles, on and off roads, in the state park system;
(6) Granting, termination, management, and development of easements, leases, or permits authorizing the commercial or noncommercial use of land, buildings, cabins, mobile homes, and docks or dock systems in the state park system;
(7) Issuance and administration of camping permits and the establishment and collection of fees for camping permits and for other park services in the state park system, if the fees and procedures are not set by statute;
(8) Control and prohibit the type, location and use of uncased firearms and bows in the state park system;
(9) Fees for licenses to permit the harvest within Custer State Park of surplus animals including but not limited to mountain goat, bighorn sheep, elk, bison, and coyote;
(10) Fees for special events held within a unit of the state park system.

The rules shall be adopted pursuant to chapter 1-26 and shall be in accordance with the provisions of this chapter. A violation of the substantive provision of any rule authorized by this chapter relating to prohibited use of lands, structures, buildings, cabins, mobile homes, docks, waters, and resources in the state park system, park entrance license and camping permit requirements, regulation of wild and domestic animals in the state park system, prohibited operation of vehicles within the state park system, and prohibitions of the use of firearms and bows in the state park system is a Class 2 misdemeanor. If the same incident is a violation of statute and of the rules authorized by this chapter, only the penalty authorized for the violation of the statute may be imposed.

To satisfy the mutual responsibilities and interests and to derive mutual benefits, WICA and GFP agree to engage in the activities as detailed below:

ARTICLE III – STATEMENT OF WORK

Bison Management

A. The NPS agrees to:

1. General Rut Season (July 1- Sept 1).
    a. Contact the CSP Resource Program Manager or Bison Herd Manager and notify of the intent to dispatch branded bison and associated calves at the time they are located within WICA in case CSP has manpower and the time to salvage the meat, hide, head, etc.
    b. Dispatch CSP branded bison that appear within WICA if immediate capture is not possible. If the NPS finds a way to confine the CSP bison long enough for CSP to retrieve them, then the NPS will do so i.e. CSP bison located within the NPS corral system fences.
    c. See "NPS and CSP" section for actions on groups exceeding 5 animals.
2. Outside General Rut Season (Sept 2- June 30)

a. Notify the CSP Resource Program Manager or Bison Herd Manager of any CSP bison located in WICA at the earliest convenience. Accommodate CSP, to the extent possible, in allowing for retrieval of any CSP bison found during this period, but activity and breeding behavior (i.e., "tending", sniffing, licking, lip curling, fighting, proximity to other animals, etc.) taking place at the time must be considered. WICA has bison that participate in breeding at nearly all times of the year and reserves the right to dispatch a CSP animal exhibiting breeding behavior immediately without consultation. CSP may use horses and noisemakers (i.e., whips, whistles, etc.) for safety while attempting to retrieve branded animals back to CSP.

b. In the event of a failed retrieval, WICA may dispatch the animal(s). A failed retrieval will be determined on a case by case basis and take into account the time of day, activity of the animals, and probability of successfully retrieving the animals on a second attempt.

3. Collect and relay to CSP within 2 days the following data from animals dispatched: sex, brand numbers, PIT tag if available, ear tag number, and condition description. CSP will be responsible for collection of additional data or materials of interest, such as heads and hide on bison dispatched within WICA.

4. Assume responsibility for genetic testing of accidental animals and share test results with CSP.

5. Maintain, repair, and upgrade the entire joint boundary fence at NPS cost.

6. Inspect and repair the boundary fence between the two parks within one to two days notification of a breach or fence damage.

B. CSP agrees to:

1. Note all PIT tags or ear tags discovered during CSP handling events that are not registered on CSP data bases and forward tag numbers, age, sex, and animal condition comments to WICA as soon as possible following the handling event. CSP also agrees to continue to steel ear tag their bison and brand calves as conditions permit.

2. Retain and manage as their own any accidental WICA bison of 1 to 5 animals found within CSP after notifying WICA. Retention of larger numbers of WICA bison will be determined on a case-by-case basis taking into account the time of year, possibility of their having been bred, estimated length of time they have been in CSP, and the probability of success of returning them to WICA.

3. Continue to move the CSP bison herds out of the pastures immediately adjacent to the CSP and WICA boundary fence during the primary rut period.

4. Immediately notify WICA of fence damage or breaks in the boundary fence during the course of their daily activities. If movement of bison between the two parks is possible, they also agree to make immediate temporary repairs to the fence at no cost to WICA.

C. Both WICA and CSP agree to:

1. Fund their individual participation in this process regardless of which lands have the accidental bison as budgets allow. This includes monitoring and assisting the partnering organization. Due to the fact that WICA does not have access to horses

and riders trained in moving bison, they may request assistance in rounding up WICA bison in CSP if the decision is made to return the WICA animals to NPS lands.

2. Meet regularly to inform and coordinate, to the best of their ability, bison management efforts.

3. Should an exchange occur that involves a significant number of bison (>5 animals), consultation shall occur between both parks regarding options for retrieval. Alternatives such as a helicopter roundup with DNA testing of all animals, replacement of animals that must be dispatched by WICA, and whether the small herd of exchanged bison can be kept separated from the main herds of either WICA or CSP while they are being returned will all be considered. Agreement on how the selected alternative will be funded will then be made prior to taking action.

Elk Management

A. The NPS agrees to:

1. Install elk jump gates along the boundary fence with CSP. Utilize the elk jump gates to achieve population objectives through free or facilitated movement of elk through gates installed on the boundary between WICA and CSP.

B. GFP agrees to:

1. Allow WICA to install elk jump gates on the CSP/WICA boundary fence.
2. Allow elk to enter CSP directly from WICA in 2012 and future years.

C. Both WICA and GFP agree to:

1. Work cooperatively to meet shared elk population and elk herd health objectives for WICA, CSP and the rest of the Black Hills.
2. Meet annually in mid to late winter to discuss elk management and set elk movement objectives for the upcoming year.

ARTICLE IV – TERM OF AGREEMENT

This Agreement will be effective for a period of five years from the date of final signature, unless it is terminated earlier by one of the parties pursuant to Article VII that follows.

ARTICLE V – KEY OFFICIALS

A. Key officials are essential to ensure maximum coordination and communications between the parties and the work being performed.

1. **For WICA:**

2. **For CSP:**

Greg M. Schroeder, Chief – Res. Mgt.
Wind Cave National Park
26611 U.S. Hwy 385
Hot Springs, South Dakota 57747
e-mail: greg_schroeder@nps.gov
Telephone: (605) 745-1190
Facsimile: (605) 745-4207

Matt Snyder, Superintendent.
Custer State Park
13329 U.S. Hwy 16A
Custer, South Dakota 57730
e-mail: matt.snyder@state.sd.us
Telephone: (605) 255-4515
Facsimile: (605) 255-4460

3. For Division of Wildlife:

Mike Kintigh, Regional Supervisor
Region 1
Rapid City, SD
Mike.kintigh@state.sd.us

ARTICLE VI – PROPERTY UTILIZATION

OMB Circulars and 43 CFR 12, Subpart F, 12.930 - 12.948 Establishes property management standards for this Agreement.

ARTICLE VII – MODIFICATION AND TERMINATION

A. This Agreement may be modified only by a written instrument executed by the parties.

B. Either party may terminate this Agreement by providing the other party with thirty (30) days advance written notice. In the event that one party provides the other party with notice of its intention to terminate, the parties will meet promptly to discuss the reasons for the notice and to try to resolve their differences.

ARTICLE VIII – STANDARD CLAUSES

A. Special Provisions

Publications of Results of Studies

No party will unilaterally publish a joint publication regarding trespass bison activities without consulting the other party. This restriction does not apply to popular publication of previously published technical matter. Publications pursuant to this Agreement may be produced independently or in collaboration with others; however, in all cases proper credit will be given to the efforts of those parties contributing to the publication. In the event no agreement is reached concerning the manner of publication or interpretation of results, either party may publish data after due notice and submission of the proposed manuscripts to the other. In such instances, the party publishing the data will give due credit to the cooperation but assume full responsibility for any statements on which there is a difference of opinion.

Public Information Release

No party will unilaterally publish a public information release regarding trespass bison activities without consulting the other party. The specific text, layout, photographs, etc. of the proposed release must be submitted with the request for approval.

ARTICLE IX – SIGNATURES

IN WITNESS HEREOF, the parties hereto have executed this Agreement on the date(s) set forth below.

FOR THE NATIONAL PARK SERVICE, WIND CAVE NATIONAL PARK:

Signature: Vidal Davila

Name: Vidal Davila

Title: Superintendent

Date: 5/4/12

FOR THE STATE OF SOUTH DAKOTA, CUSTER STATE PARK:

Signature:

Name: Jeffrey R. Vonk

Title: Department Secretary, South Dakota Game, Fish and Parks

Date: 5/4/12

Appendix 13. South Dakota Elk Stakeholders Group Chapter.

Elk Management Stakeholder Group

Purpose – The SDGFP 'Elk Management Stakeholder Group' is a diverse group of citizen stakeholders who have been asked to assist SDGFP Staff and the SDGFP Commission in conducting a review of the broad range of issues affecting elk management in South Dakota. The Elk Management Stakeholder Group will assist SFGFP Staff and the SDGFP Commission by offering insight, ideas, and alternatives that could be considered in regard to the Department and Commission positions on various elk management goals, strategies, challenges and related recreational opportunities.

Objectives – The basic objectives of the Elk Management Stakeholder Group are to:

- Provide an additional link between the SDGFP Staff and the SDGFP Commission and the citizens we serve;
- Identify challenges and opportunities and develop ideas and suggestions regarding the range of issues affecting the management of elk and associated recreation in South Dakota; and
- Promote communication, increased awareness and mutual understanding between and among the Stakeholder Group members regarding the diversity of elk management challenges.

Scope of Authority – The Stakeholder Group will function in an advisory capacity only and will provide a discussion forum for members to share their personal perspective and the perspective of the group or organization they may represent on a diversity of issues related to elk management. Members who serve on the Stakeholder Group do so solely in a volunteer capacity. The Stakeholder Group is granted no authority over rule-making or rule enforcement on public or private land, has no budgetary authority or authority over personnel management, nor is it granted any authority over any state or federal agency or non-governmental organization. The Stakeholder Group was assembled as an additional citizen participation opportunity but is not designed to supplant or curtail any other type of citizen participation or public involvement opportunities that may be further utilized by SDGFP.

Organizational Structure and Stakeholder Group Membership – The Stakeholder Group is comprised of a diverse group of citizen stakeholders who may represent a broad range of public interests in the management of elk in South Dakota. Participants will attend 2 to 4 structured meetings to hear SDGFP Staff presentations and offer their ideas and perspectives on elk

management. The Stakeholder Group meetings will be facilitated by SDGFP staff or a third party facilitator hired by SDGFP.

Stakeholder Group Member Roles and Responsibilities – Working Group members will:

- Make a commitment to attend the scheduled Stakeholder Group meetings;
- Offer their thoughts and ideas and communicate with others in a respectful manner while maintaining an open mind with regard to the views and perspectives of other Working Group members, and;
- Serve as a sounding board and provide feedback and ideas to SDGFP Staff and the SDGFP Commission.

SDGFP Staff Roles and Responsibilities – SDGFP Staff will:

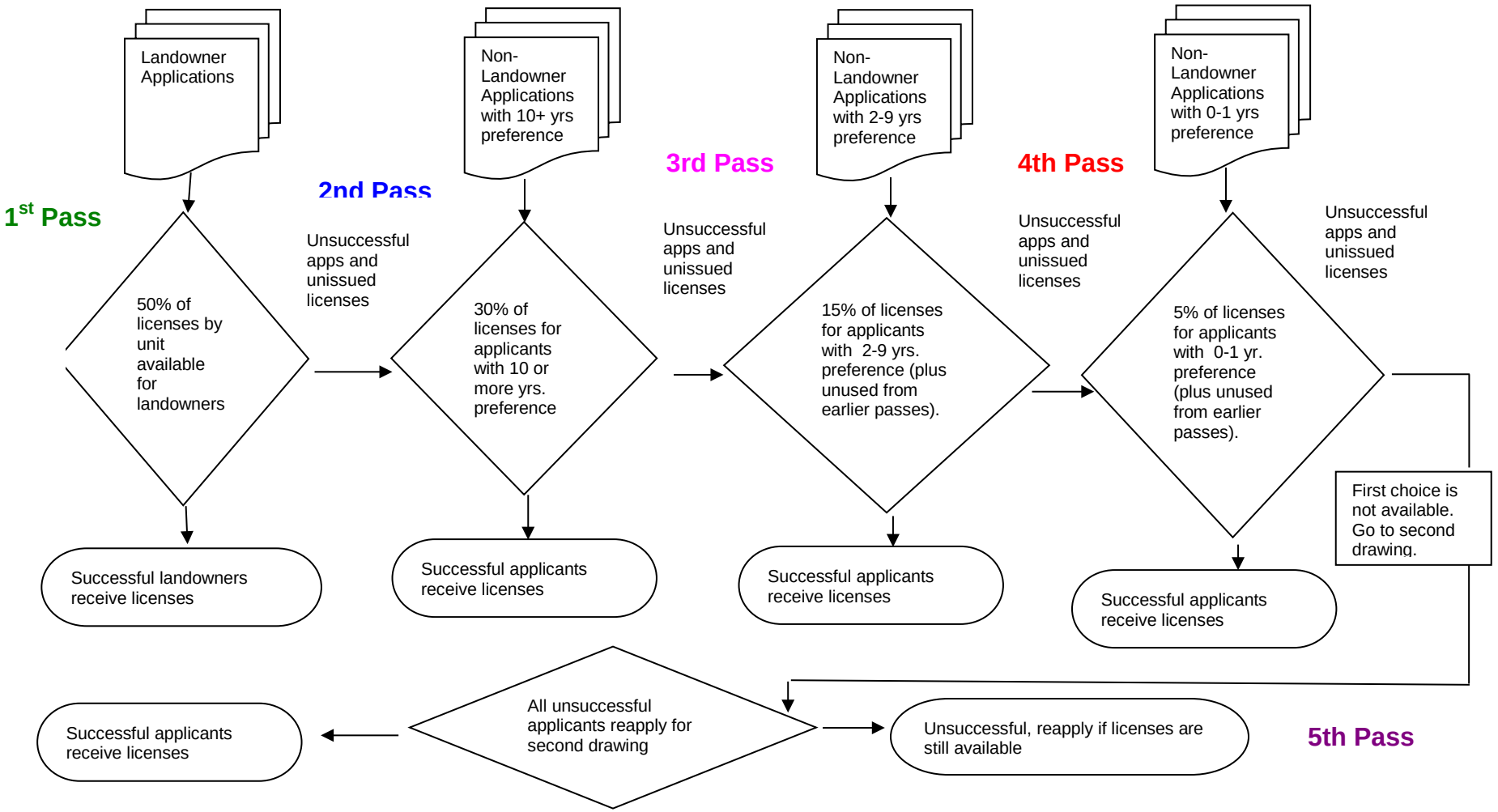
- Provide a diversity of information regarding elk management to the Stakeholder Group;
- Serve the role of facilitator for the meetings, including keeping order, achieving the meeting agenda and providing a comfortable working atmosphere for Working Group members to share ideas and opinions;
- Schedule and arrange meeting room facilities, including providing all necessary communication related to the meetings;
- Listen attentively and respectfully to all viewpoints; and
- Gather meeting notes and make them available to the public via the SDGFP website.

Meeting Guidelines and Communication – The purpose of the Elk Management Stakeholder Group is to provide a forum to promote understanding of elk management issues and challenges from diverse perspectives, therefore voting or other similar methods will not be used to formulate final group consensus on issues discussed.

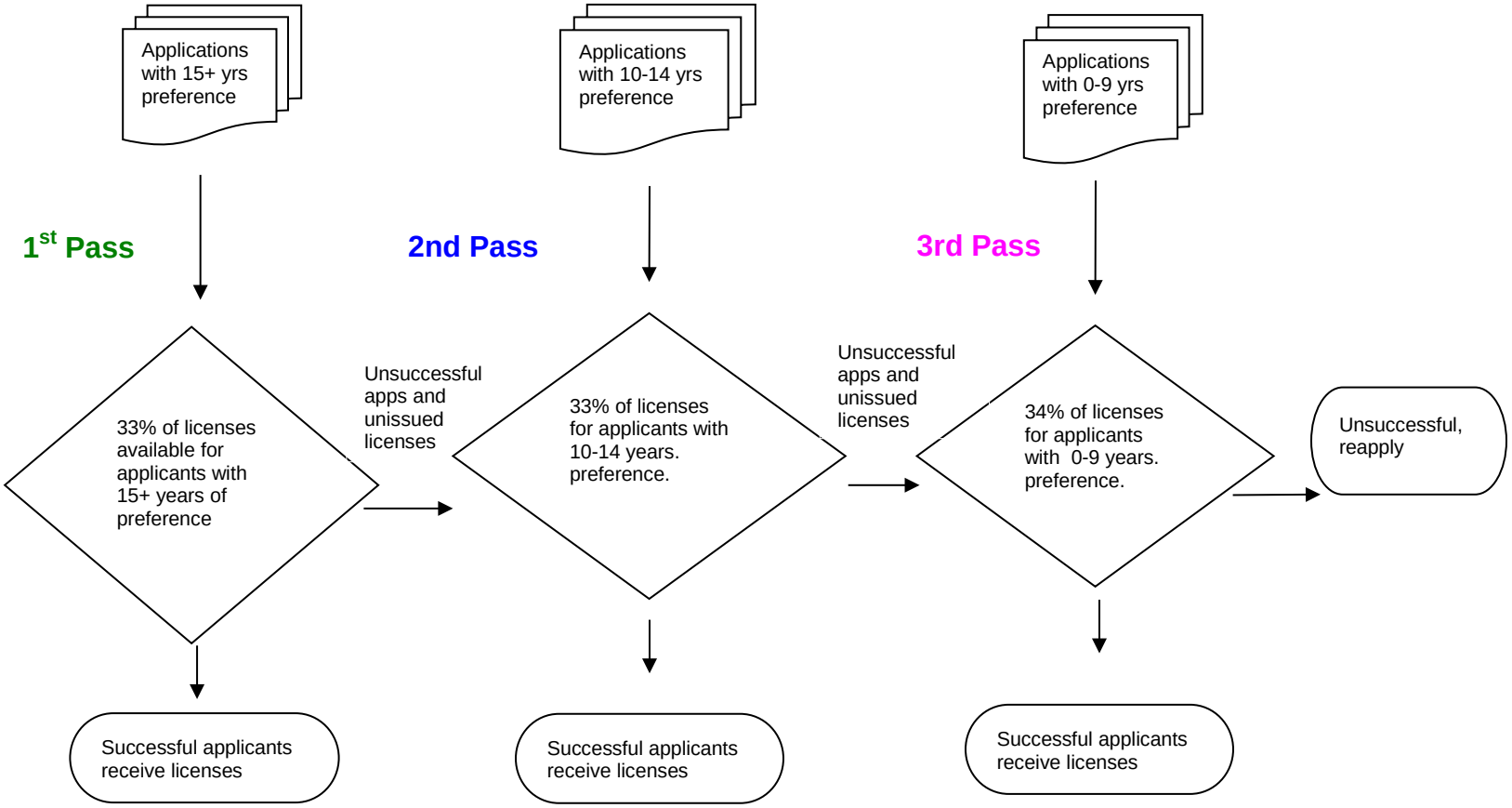
- Additional Open House meetings, citizen surveys or other public involvement techniques may be used as a means to share information and gather additional public input on any proposed changes in elk management.
- Stakeholder Group members are encouraged to discuss and communicate with others about specific elk management issues discussed at the Stakeholder Group meetings.

Travel Expenditures – Travel expenses (lodging, per diem and vehicle mileage) for Stakeholder Group members will be reimbursed in accordance with State Reimbursement Rules for those members who are not reimbursed by another organization or agency.

Appendix 14. Elk license drawing process for Black Hills and Prairie seasons.



Appendix 15. Elk license drawing process for Custer State Park.




SouthDakota
Wildlife Division
Department of Game, Fish and Parks